PROJECT MANUAL

INGLEWOOD LIBRARY AND INNOVATION CENTER RENOVATION PROJECT

101 West Manchester Blvd, Inglewood, CA 90301

2nd Agency Submittal / Bid Set

04/28/2025

LPA Project No.: 31312

IRVINE • SAN DIEGO • SAN JOSE
SACRAMENTO DALLAS • SAN ANTONIO

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SECTION 00 0105
CERTIFICATIONS PAGE

OWNER:

City of Inglewood
1 W Manchester Blvd., Inglewood, CA 90301.
(310) 412-5324

Contact:
Harjinder Singh
Deputy City Manager

OWNER'S REPRESENTATIVE:

Griffin Structures, Inc.
1 Technology Drive, Building I, Suite 890, Irvine, CA 92618
(949) 497-9000

Contact:
Leonard Marshall
Project Executive

ARCHITECT:

LPA, INC.
5301 California Avenue, Suite 100, Irvine, CA 92617
(949) 261-1001

Contact:
Jeremy Hart
Architect of Record

CIVIL ENGINEER:

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Contact:
Kathereen Shinkai
Civil Engineer of Record

ELECTRICAL ENGINEER:

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Contact:
Aldo Bacuzzi
Electrical Engineer of Record:

FIRE PROTECTION ENGINEER:

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(949) 261-1001

Contact:
Erik Ring
Fire Protection Engineer of Record

LANDSCAPE ARCHITECT:

LPA, INC.
5301 California Avenue, Suite 100, Irvine, CA 92617
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Contact:
Jeff Yamamoto
Landscape Architect of Record

MECHANICAL ENGINEER:

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Contact:
Erik Ring
Mechanical Engineer of Record

PLUMBING ENGINEER:

LPA, INC.
5301 California Avenue, Suite 100, Irvine, CA 92617
(949) 261-1001

Contact:
Erik Ring
Plumbing Engineer of Record

STRUCTURAL ENGINEER:

KPFF
700 S Flower St., Suite 200, Los Angeles, CA 90017
(213) 418-0201

Contact:
Maikol Del Carpio
Structural Engineer of Record

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SECTION 00 0110
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SECTION 01 1000
SUMMARY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project information.
B. Contract description.
C. Sustainability.
D. Corrosive environment.
E. Deferred approvals.
F. Owner occupancy.
G. Contractor use of site and premises.

1.02 PROJECT INFORMATION

A. Project Name: Inglewood Library and Innovation Center Renovation Project
B. Owner's Name: City of Inglewood.
C. Architect's Name: LPA.
D. The Project will consist of the scope of work as generally described below:
    1. The City of Inglewood seeks to develop a renovation of the Inglewood Main Library to improve the condition & overall experience of the library. The 70,000 sq ft Library was constructed in 1973 and is four stories in height.
    2. This renovation scope shall comprise upgrades to:
        a. The building's structure.
        b. Mechanical, electrical, plumbing and other systems.
        c. Interior partitions.
        d. Ceilings.
        e. Millwork and finishes.
    3. Additionally, the scope shall include improvements to:
        a. The surrounding site.
        b. Second level Exterior Plaza.
        c. Vertical circulation.
        d. Accessibility.
        e. Selected areas of the building envelope.
    4. For the specific scope of work for this Project, refer to the contract plans.

1.03 SUSTAINABILITY

A. This Project is designed to be sustainable, with the intent of incorporating the following qualities:
    1. The project will minimize its effect on the environment by selecting environmentally friendly, non-toxic, and low-emitting building materials, and utilizing sustainable construction practices.
        a. See Section 01 6000 - Product Requirements, for additional information.

2. The project will provide a healthy and comfortable space for its occupants by developing and following an Indoor Air Quality Management Plan during construction, and by designing the building's systems to provide tenants with exceptional indoor air quality.
    a. See Section 01 5719 - Temporary Environmental Controls, for additional information.
3. The finished project will consume significantly less energy and water than a typical code-compliant building through the use of premium efficiency equipment and designing efficient building systems.
    a. Refer to Divisions 22 through 26 for additional information.

1.04 CORROSIVE ENVIRONMENT

A. Corrosive Environments: Areas within approximately 10 miles of salt water or brackish water shorelines. These environments contain salts, including chloride, calcium chloride, and magnesium chloride; which are carried by sea spray, rain, fog, and dry salt particles in wind.
    1. Marine / Coastal Corrosive Environments: Areas immediately adjacent to salt or brackish water are the most damaging corrosive environment and require the highest level of protection.

B. This Project is:
    1. Not located within a corrosive environment. No special treatment of exterior metal is required.
    2. Located within a corrosive environment. Special treatment of exterior metal is required.
    3. Located within a marine / coastal corrosive environment. Special treatment of exterior metal is required.

C. Metals within corrosive environments require special protection. Refer to the following for additional information:
    1. Section 05 0513 - Shop-Applied Coatings for Metal.
    2. Section 07 6200 - Sheet Metal Flashing and Trim.
    3. Section 09 9113 - Exterior Painting.
    4. Section 09 9600 - High-Performance Coatings.

1.05 DEFERRED APPROVALS

A. Deferred Approvals, General: Responsibility of design and submittal to the City's building official has been deferred to the Contractor for portions of the Work.
    1. Refer to the Architectural drawings for a list of deferred approvals for this Project.
    2. Submittal format and number of copies to be submitted to be coordinated by the Contractor with the building official.

B. Deferred approval documents are to be prepared by a qualified professional engineer.
    1. See Section 01 4000 - Quality Requirements, for additional information.

C. Deferred approval documents are to be reviewed and approved by the Architect and associated engineers of record in responsible charge, as applies, prior to submittal to the building official.
    1. See Section 01 3000 - Administrative Requirements, for additional information.

D. Construction of deferred approval items will not begin until documents have been approved by the building official and paid for by the Contractor.

1.06 OWNER OCCUPANCY

A. Owner intends to occupy the Project upon Substantial Completion.

B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

C. Schedule the Work to accommodate Owner occupancy.

1.07 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on Drawings.
   1. Locate and conduct construction activities in ways that will limit disturbance to site.

B. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

C. Nonsmoking Building: Smoking is not permitted within the building or 25 feet of entrances, operable windows, outdoor-air intakes.

D. Controlled Substances: Use of tobacco products and other controlled substances within the exisitng building is not permitted.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 2000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Price and Contract Time.

C. Change procedures.

D. Correlation of Contractor submittals based on changes.

E. Procedures for preparation and submittal of application for final payment.

1.02 DEFINITIONS

A. Minor Change in the Work: A change which does not affect the Contract Sum or Contract Time.

1.03 RELATED REQUIREMENTS

A. Section 01 7800 - Closeout Submittals: Project record documents.

1.04 SCHEDULE OF VALUES

A. Use Schedule of Values Form: As stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.

E. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.

F. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

G. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization and bonds and insurance.

H. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.

I. Revise schedule to list approved Change Orders, with each Application For Payment.

1.05 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   3. Scheduled Values.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Authorized Change Orders.
   7. Total Completed and Stored to Date of Application.
   8. Percentage of Completion.
   9. Balance to Finish.
   10. Retainage.

E. Execute certification by signature of authorized officer.

F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.

H. Submit three notarized copies of each Application for Payment.

I. Include the following with the application:
   1. Transmittal letter as specified for submittals in Section 01 3000.
   2. Construction progress schedule, revised and current as specified in Section 01 3000.
   3. Partial release of liens from major subcontractors and vendors.

J. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.06 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Price or Contract Time, Architect will issue instructions directly to Contractor.

B. For other required changes, Owner's Representative will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
   1. The document will describe the required changes and will designate method of determining any change in Contract Price or Contract Time.
   2. Promptly execute the change.

C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change . Contractor shall prepare and submit a fixed price quotation within 15 working days.

D. Contractor may propose a change by submitting a request for change to Owner's Representative, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation.

E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.

1. For change requested by Owner's Representative for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Owner's Representative.
3. For pre-determined unit prices and quantities, the amount will based on the fixed unit prices.
4. For change ordered by Owner's Representative without a quotation from Contractor, the amount will be determined by Owner's Representative based on the Contractor's substantiation of costs as specified for Time and Material work.

F. Substantiation of Costs: Provide full information required for evaluation.
1. Provide the following data:
a. Quantities of products, labor, and equipment.
b. Taxes, insurance, and bonds.
c. Overhead and profit.
d. Justification for any change in Contract Time.
e. Credit for deletions from Contract, similarly documented.
2. Support each claim for additional costs with additional information:
a. Origin and date of claim.
b. Dates and times work was performed, and by whom.
c. Time records and wage rates paid.
d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

G. Execution of Change Orders: Owner's Representative will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

H. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Price.

I. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

J. Promptly enter changes in Project Record Documents.

1.07 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Price, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:
1. All closeout procedures specified in Section 01 7000.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. Waivers.
5. Consent of Surety to final payment.
6. Evidence that claims have been settled.
7. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

8. Final liquidated damages settlement statement.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Section 012500.01 - Substitution Form: Required form for substitution requests.

B. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.

C. Section 01 6000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

D. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Restrictions on emissions of indoor substitute products.

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   4. Waives claims for additional costs or time extension that may subsequently become apparent.

5. Agrees to reimburse Owner and Owner's Representative for review or redesign services associated with re-approval by authorities.
6. Will obtain necessary approval of agencies having jurisdiction.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
1. Note explicitly any non-compliant characteristics.

C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
1. Forms included in the Project Manual are adequate for this purpose, and must be used.

D. Limit each request to a single proposed substitution item.
1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Submittal Time Restrictions:
1. Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.

B. Submittal Form (before award of contract):
1. Submit substitution requests by completing the form attached to this section. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Should a Contractor-proposed substitution or alternative sequence or method of construction require revision of the Contract Drawings or Specifications, including revisions for the purposes of determining feasibility, scope or cost, or revisions for the purpose of obtaining review and approval by authorities having jurisdiction, revisions will be made by Architect or other who is the responsible design professional.

B. Services of Architect, other responsible design professionals, Owner, and Owner's Representative for researching and reporting on proposed substitutions or alternative sequence and method of construction shall be paid by Contractor when such activities are considered additional services to the design services contracts of Architect or other responsible design professional with Owner.

C. Costs of services by Architect, other responsible design professionals and Owner's Representative shall be paid, including travel, reproduction, long distance telephone and shipping costs reimbursable at cost plus usual and customary mark-up for handling and billing. Such fees shall be paid whether or not the proposed substitution or alternative sequence or method of construction is ultimately accepted by Owner and a Change Order is executed.

D. Such fees shall be paid from Contractor's portion of savings, if a net reduction in Contract Sum results. If fees exceed Contractor's portion of net reduction, Contractor shall pay all remaining fees unless otherwise agreed in advance by District's Representative.

E. Submittal Form (after award of contract):
1. Submit substitution requests by completing the form attached to this section. See this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.

F. Architect and Owner will consider requests for substitutions only within 15 days after date of Agreement.

G. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect and Owner, in order to stay on approved project schedule.

H. Submit request for Substitution for Convenience within 14 days of discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect and Owner, in order to stay on approved project schedule.
   1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
   2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
   3. Bear the costs engendered by proposed substitution of:
      a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.

I. Substitutions will not be considered under one or more of the following circumstances:
   1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
   2. Without a separate written request.
   3. When acceptance will require revisions to Contract Documents.

3.04 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data within 2 business days.

B. Architect and Owner's Representative will notify Contractor in writing of decision to accept or reject request.
   1. Architect and Owner's Representative's decision following review of proposed substitution will be noted on the submitted form.

3.05 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

END OF SECTION

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SECTION 012500.01

SUBSTITUTION REQUEST FORM

Project Name:	Job No.:
	Date:
To: Architect: LPA, Inc.	Contractor:
Specified Item:	

Specification Section	Paragraph No.	Drawing No.	Detail No.

Contractors Proposed Substitution:

Reason for Request: _____

_____

Manufacturer: _____

Manufacturer Contract: _____

Trade Name and Model: _____

History: ☐ New Product ☐ 1-4 Years in market ☐ 5-10 years in Market ☐ Over 11 years in market

Mandatory for Consideration: Specification Section 012500 – Substitution Procedures

☐ Drawings ☐ Product Data ☐ Samples ☐ Test Data ☐ Reports ☐Other _____

Attach a **Point by Point Comparison** between proposed product and product indicated. Provide complete data for proposed product, including product/material descriptions, specifications, drawings, photographs, performance, MSDS data sheet and test data adequate for evaluation of the request. Clearly annotate applicable portions of the data. Include ICC Evaluation Service (ICC ES) Evaluation Report, if applicable.

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The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equivalent or superior in all respects to specified product.
- Proposed substitution complies with applicable Codes, ordinances and standards.
- Proposed substitution complies with Contract requirements.
- Same warranty will be furnished for proposed substitution as specified products.
- Same maintenance service and source of replacement parts, as applicable, are available.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs cause by the substitution.

Submitted by: (name) _____ Title: _____

Signed: _____ Date: _____

SUBSTITUTION REQUEST

LPA

Architect's Recommended Action:

☐ **Approved.** Refer to the change document noted under Remarks below.

☐ **Rejected – Use specified product/material.**

Name: _____ Date: _____

Remarks: _____

_____

_____

_____

_____

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SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.
B. Web-based project software service.
C. Electronic document submittal service.
D. Preconstruction meeting.
E. Site mobilization meeting.
F. Construction progress (OAC) meetings.
G. Project closeout conference.
H. Construction progress schedule.
I. Contractor's daily reports.
J. Progress photographs.
K. Coordination drawings.
L. Requests for Interpretation (RFI).
M. Submittal procedures.
N. Delegated design.

1.02 RELATED REQUIREMENTS

A. Section 01 6000 - Product Requirements: General product requirements.
B. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements and preinstallation meetings.
C. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 01 7000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
B. Make the following types of submittals to Architect:
    1. Requests for Interpretation (RFI).
    2. Requests for substitution.
    3. Shop drawings, product data, and samples.
    4. Test and inspection reports.
    5. Manufacturer's instructions and field reports.
    6. Applications for payment and change order requests.
    7. Progress schedules.
    8. Coordination drawings.
    9. Correction Punch List and Final Correction Punch List for Substantial Completion.

10. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 WEB-BASED PROJECT SOFTWARE SERVICE

A. The Owner will provide Construction Management (CM) web-based software Submittal Exchange for implementation as the Project Controls platform method for the Project.

B. The Contractor shall be required to interface with the CM software for all aspects of construction.

C. The Software's use shall include at a minimum, but limited to the following:
   1. Project directory, including names and contacts for Owner, Contractor, subcontractors, Architect, consultants, and other entities involved in the project.
   2. Submittals.
   3. RFI's.
   4. Substitution Requests.
   5. Daily reports.
   6. Daily progress photos.
   7. SWPPPs log documents (All QSP reports).
   8. Change Order Requests.
   9. Permits.
   10. Pay Application submissions, processing, and tracking.
   11. Contract modifications processing and tracking.
   12. Creation and distribution of meeting agendas and minutes.
   13. Construction Procurement and Progress schedules.
   14. Document management for drawings, specifications, coordination & revisions.
   15. Any type of official correspondence.
   16. As-Built drawings.
   17. Materials, equipment and building systems test reports.

D. Costs & Training:
   1. Submittal Exchange set up and operational costs during the construction period is the responsibility of the Owner.
   2. The Contractor has the option for software training regarding use of the website and PDF uploading. Reference website: www.submittalexchange.com. Contact:1-800-714-0024.

E. Internet Service and Equipment Requirements:
   1. Email address and internet access at Contractor's main office and on site construction office
   2. Adobe Acrobat (www.adobe.com), Bluebeam PDF Revu (www.bluebeam.com), or similar PDF review software for applying electronic stamps and comments.

F. Project Closeout:
   1. Owner's Representative determines when to terminate the software service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
   1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
   2. Contractor, Architect, and Owner's Representative are required to use this service.
   3. It is Contractor's responsibility to submit documents in allowable format.
   4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service.
   5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
   6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
   7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

3.03 PRECONSTRUCTION MEETING

A. Schedule meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Owner's Representative.
   3. Architect.
   4. Contractor.
   5. Project Inspector of Record.

C. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.
   3. Distribution of Contract Documents.
   4. Submission of list of subcontractors, schedule of values, and progress schedule.
   5. Submission of initial Submittal schedule.
   6. Designation of personnel representing the parties to Contract and Architect.
   7. Procedures and processing of field decisions, RFIs, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   8. Scheduling.
   9. Critical work sequencing and long-lead items.
   10. Sustainable design requirements.
   11. Labor law requirements, including payment and reporting requirements.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 SITE MOBILIZATION MEETING

A. Schedule meeting at the Project site prior to Contractor occupancy.

B. Attendance Required:
   1. Contractor.
   2. Owner.
   3. Owner's Representative.

C. Agenda:
   1. Use of premises by Owner and Contractor.
   2. Owner's requirements.
   3. Work restrictions.
   4. Work hours.
   5. Construction facilities and controls provided by Owner.
   6. Temporary utilities provided by Owner.
   7. Survey and building layout.
   8. Procedures for moisture and mold control.
   9. Procedures for disruptions and shutdowns.
   10. Construction waste management and recycling.
   11. Parking availability.
   12. Office, work, and storage areas.
   13. Equipment deliveries and priorities.
   14. First aid.
   15. Security and housekeeping procedures.
   16. Schedules.
   17. Application for payment procedures.
   18. Procedures for testing.
   19. Procedures for maintaining record documents.
   20. Requirements for start-up of equipment.
   21. Inspection and acceptance of equipment put into service during construction period.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, Owner's Representative, participants, and those affected by decisions made.

3.05 CONSTRUCTION PROGRESS (OAC) MEETINGS

A. Schedule and administer meetings throughout progress of the work at maximum weekly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required:
   1. Contractor.
   2. Owner.
   3. Owner's Representative.
   4. Architect.

D. Agenda:
   1. Review minutes of previous meetings.
   2. Review of work progress.
   3. Field observations, problems, and decisions.

4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of RFIs log and status of responses.
7. Review of off-site fabrication and delivery schedules.
8. Maintenance of progress schedule.
9. Corrective measures to regain projected schedules.
10. Planned progress during succeeding work period.
11. Coordination of projected progress.
12. Maintenance of quality and work standards.
13. Effect of proposed changes on progress schedule and coordination.
14. Other business relating to work.

E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, Owner's Representative, participants, and those affected by decisions made.

3.06 **PROJECT CLOSEOUT CONFERENCE**

A. Schedule and conduct a project closeout conference, at a time convenient to Owner, Owner's Representative, and Architect, but no later than 30 days prior to the scheduled date of Substantial Completion.
   1. Conduct the conference to review requirements and responsibilities related to Project closeout.
   2. Attendees: Authorized representatives of Owner, Owner's Commissioing Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
   3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
      a. Preparation of record documents.
      b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
      c. Submittal of written warranties.
      d. Coordination of separate contracts.
      e. Owner's partial occupancy requirements.
      f. Installation of Owner's furniture, fixtures, and equipment.
      g. Responsibility for removing temporary facilities and controls.
   4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

3.07 CONSTRUCTION PROGRESS SCHEDULE - SEE SECTION 01 3216

A. Within 10 days after date of the Agreement, submit preliminary baseline schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.

B. If preliminary baseline schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary baseline schedule, submit draft of proposed complete schedule for review.
   1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

3.08 DAILY CONSTRUCTION REPORTS

A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.

B. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
   1. Date.
   2. High and low temperatures, and general weather conditions.
   3. List of subcontractors at Project site.
   4. Major equipment at Project site.
   5. Material deliveries.
   6. Safety, environmental, or industrial relations incidents.
   7. Meetings and significant decisions.
   8. Unusual events (submit a separate special report).
   9. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
   10. Directives and requests of Authority(s) Having Jurisdiction (AHJ).
   11. Change Orders received and implemented.
   12. Testing and/or inspections performed.
   13. List of verbal instruction given by Owner and/or Architect.
   14. Signature of Contractor's authorized representative.

3.09 PROGRESS PHOTOGRAPHS

A. Submit through Submittal Exchange new photographs at least once a month, within 3 days after being taken.

B. Photography Type: Digital; electronic files.

C. Provide high-resolution photographic images of site and construction throughout progress of work.

D. In addition to periodic, recurring views, take photographs of each of the following events:
   1. Completion of site clearing.
   2. Excavations in progress.
   3. Foundations in progress and upon completion.
   4. Structural framing in progress and upon completion.
   5. Mock-ups.
      a. Take photographs of all mock-ups required for Project scope.
      b. Take photographs of materials and assemblies that are both accepted and rejected by Owner, Owner's Representative, and Architect.
   6. Testing and inspections.
      a. Take photographs of materials and assemblies which require testing and inspections.
      b. Pay special attention to items that will be concealed during further construction operations.
   7. Concealed Work.

a. Before proceeding with installing Work that will conceal other Work, take photographs in sufficient number, with annotated descriptions, to record the nature and location of concealed Work. Including, but not limited to:
   1) Underslab utilities.
   2) Underslab services.
   3) Piping.
   4) Electrical conduit.
   5) Below-grade waterproofing.
   6) Weather barrier membranes.
   7) Roofing components.

8. Fabrication, at locations away from Project site.

E. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
   1. Delivery Medium: Uploaded to Project web site..
   2. File Naming: Include project identification, date and time of view, and view identification.

3.10 COORDINATION DRAWINGS

A. Provide information required by Project Coordinator for preparation of coordination drawings.

B. Review drawings prior to submission to Architect.

3.11 REQUESTS FOR INTERPRETATION (RFI)

A. Definition: A request seeking one of the following:
   1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
   2. A resolution to an issue which has arisen due to field conditions and affects design intent.

B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.

C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
   1. Prepare a separate RFI for each specific item.
      a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
      b. Do not forward requests which solely require internal coordination between subcontractors.
   2. Prepare using an electronic version of the form appended to this section.
   3. Prepare using software provided by the Electronic Document Submittal Exchange.
   4. Combine RFI and its attachments into a single electronic file. PDF format is preferred.

D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
   1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
   2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
      a. Approval of submittals (use procedures specified elsewhere in this section).
      b. Approval of substitutions (see Section - 01 6000 - Product Requirements)

c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).

3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
   a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.

E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
1. Official Project name and number, and any additional required identifiers established in Contract Documents.
2. Owner's, Owner's Representative, Architect's, and Contractor's names.
3. Discrete and consecutive RFI number, and descriptive subject/title.
4. Issue date, and requested reply date.
5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
1. Indicate current status of every RFI. Update log promptly and on a regular basis.
2. Note dates of when each request is made, and when a response is received.
3. Highlight items requiring priority or expedited response.
4. Highlight items for which a timely response has not been received to date.
5. Identify and include improper or frivolous RFIs.

H. Review Time: Architect will respond and return RFIs to Contractor within 10 business days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular business day.
1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.

I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.

2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.

1.02 SUBMITTAL SCHEDULE

A. Submit to Architect and Owner's Representative for review a schedule for submittals in tabular format.
   1. Submit at the same time as the preliminary schedule specified in Section - 01 3216 - Construction Progress Schedule.
   2. Coordinate with Contractor's construction schedule and schedule of values.
   3. Format schedule to allow tracking of status of submittals throughout duration of construction.
   4. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
   5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
      a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

1.03 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data. Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
   2. Shop drawings. Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
   3. Samples: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
      a. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.
         1) Samples for selection.
         2) Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

1.04 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Sustainability design submittals and reports.
   3. Certificates.

4. Test reports.
5. Inspection reports.
6. Manufacturer's instructions.
7. Manufacturer's field reports.
8. Other types indicated.

B. Submit for Architect and Owner's Representative's knowledge as contract administrator or for Owner.

1.05 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
4. Bonds.
5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

1.06 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Extra Copies at Project Closeout: See Section 01 7800.

C. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
1. After review, produce duplicates.
2. Retained samples will not be returned to Contractor unless specifically so stated.

1.07 SUBMITTAL PROCEDURES

A. General Requirements:
1. Use a single transmittal for related items.
2. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
3. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
4. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
   a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
5. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
   a. Send submittals in electronic format via email to Architect.
6. Schedule submittals to expedite the Project, and coordinate submission of related items.

a. For each submittal for review, allow 15 business days excluding delivery time to and from the Contractor.
b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.

7. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
8. Provide space for Contractor and Architect review stamps.
9. When revised for resubmission, identify all changes made since previous submission.
10. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
11. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.

B. Product Data Procedures:
1. Submit only information required by individual specification sections.
2. Collect required information into a single submittal.
3. Submit concurrently with related shop drawing submittal.
4. Do not submit (Material) Safety Data Sheets for materials or products.
5. Submit sustainable design reporting submittals under separate cover.

C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
2. Do not reproduce Contract Documents to create shop drawings.
3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
1. Transmit related items together as single package.
2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.

E. Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

F. Submittal number or other unique identifier, including revision identifier.
1. Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

G. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

H. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

1.08 SUBMITTAL REVIEW

A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.

C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
   1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.

D. Architect's and consultants' actions on items submitted for review:
   1. Authorizing purchasing, fabrication, delivery, and installation:
      a. "Reviewed", or language with same legal meaning.
         1) No corrections noted.
      b. "Make Corrections Noted", or language with same legal meaning.
         1) Incorporate review notations, resubmission not required.
   2. Not Authorizing purchasing, fabrication, delivery, and installation:
      a. "Revise and Resubmit", or language with same legal meaning.
         1) Submittal is incomplete and / or needs corrections.
         2) Resubmit, with all required components and with review notations acknowledged and incorporated.
         3) Non-responsive resubmittals may be rejected.
      b. "Submit Specified Item", or language with same legal meaning.
         1) Provide new submittal with item specified in Project Manual or drawings.
         2) Substitutions not permitted.
      c. "Rejected", or language with same legal meaning.
         1) Submit item complying with requirements of Contract Documents.

E. Architect's and consultants' actions on items submitted for information:
   1. Items for which no action was taken:
      a. "Received" - to notify the Contractor that the submittal has been received for record only.
   2. Items for which action was taken:
      a. "Reviewed" - no further action is required from Contractor.

1.09 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. BIM Incorporation: Incorporate delegated design drawings and data files into BIM establlished for Project.

END OF SECTION

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SECTION 013000.01

REQUEST FOR INTERPRETATION

Project Name:		Job No.:	
		RFI No:	
To: Architect: LPA, Inc.		Contractor:	
Subject:			
Specification Section	**Paragraph No.**	**Drawing No.**	**Detail No.**
Category: ☐ Need for Clarification. ☐ Unforeseen Condition. ☐ Conflict Within Documents.		☐ Coordination Problem. ☐ Other.	
Description:			
Contractor's Proposed Resolution:			
☐ Attachments: ☐ Estimated Cost Impact" $		☐ Estimated Time Impact:	
Contactor Signature:		Date:	
Architect's Response:			

Refer to RFI procedures specified in Section 013100 – Project Management and Coordination. This RFI, when completed is not authorization for change to the Contract Documents. Changes to the Contract Documents are authorized only by properly executed Construction Change Directives or Change Order.
☐ Attachments:
Architect's Signature: Date:

SECTION 013000.02 – DIGITAL DATA REQUEST FORM

From (Requestor): _____ DRC NO.: _____ Date: _____

Project: _____

Project No: _____

Location: _____

Attn: _____ Description: _____

Phone: _____

Fax: _____

Execution of this document will confirm your request for copies of digital files related to the above referenced project. Please complete the following section and return a signed copy of this form via fax or mail with payment to LPA.

DESCRIPTION OF DOCUMENTATION REQUESTED:

Type of Files Needed:

_____ DWG (AutoCAD Native)

_____ DWF (AutoCAD Design Web)

_____ DXF (AutoCAD Drawing Exchange)

Purpose of Request: _____

If Requestor is a subcontractor to the Project's General Contractor, please indicate the name and phone number of contact at General Contractor's office:

Name: _____ Number: _____

If Requestor is a consultant to the project's owner, please indicate the name and phone number of contact at owner's office:

Name: _____ Number: _____

LPA can only release electronic files to the Project's Owner, consultants to the Project's Owner and/or the Project's General Contractor. A written statement by the Project's General Contractor authorizing LPA to release documentation to a subcontractor of the General Contractor must accompany this request. Please be advised that, in case of existing construction, the documents requested are reproductions of documentation on file and do not necessarily represent as-built or existing conditions. LPA does not warrant in any way the accuracy of this information and shall not be responsible for any discrepancy between this documentation and the existing conditions. In the case of projects which are currently being designed and/or under construction, the electronic documentation are reproductions of the documentation on file and may be subject to change due to owner, field and/or coordination revisions. LPA shall not be responsible for reissuing files which may me revised after issuance of these requested files and shall not be responsible for advising other parties as to the status of document revisions. Also, please be advised that the requested documents are instruments of service and, as such, remain the property of LPA and/or the respective consultant. Any unauthorized re-use of these documents without the written authorization of LPA and/or consultant is strictly prohibited. Please note all disclaimers and warnings printed on electronic media labels. Electronic media may contain undetected viruses. It is always recommended that disks be checked prior to use. LPA assumes no liability or responsibility for damage to user's property as a result of using this request may include archive storage and retrieval, charges, reproduction and handling expenses, etc., which are estimated to be, but may exceed $0.00. The exact cost will be determined by LPA upon execution of this request confirmation

The basic charge for copying/translating DWG (AUTOCAD), DWF or DXF files is $100 per drawing.

_____ Payment of these costs must be made by the requestor to LPA, Inc. prior to release of the documents.

_____ The requested files shall be provided at the direction of the Owner. No charge to Requestor.

By signing this Request, the Requestor agrees to the conditions for reimbursement to LPA, Inc. as stated above.

Authorized Signature: _____ Date:_____

Please return one fully executed copy of this form to: LPA, Inc.
(Offices in Irvine, San Diego, San Jose, & Sacramento, CA and San Antonio, TX)

SECTION 013000.03

SUBMITTAL COVER SHEET

Project Name: **LPA, Inc. Project No.:**	**Resubmittal** ☐ **Yes** **Add "letter" to original number**	**Submittal No:**
SUBCONTRACTOR: **Name:** **Address:** **Phone:** **Contact:**	**CONTRACTOR:** **Name:** **Signed:** **Dates:** **I hereby certify that I have reviewed the attached, have verified requirements and compliance with the Contract Documents.**	
Submittal Description:	**Specification Section:**	
Date Received From Contractor:	**Specification Section:**	
Consultant Review: ☐ **Civil** ☐ **Electrical** ☐ **Mechanical** ☐ **Structural** ☐ **Other:** _____ **Date sent to consultant:** _____ **Date received from consultant:** _____	**Copies:** ☐ **Contractor** ☐ **Inspector** ☐ **LPA File** ☐ **Owner** ☐ **Other:** _____	

Review and commentary noted below are only for general conformance with (1) The design concept of the project and (2) The information given in the contract documents and for no other purpose. Commentary below is subject to the requirements of the contract documents. The contractor is not relieved from responsibility for any deviation from the requirements of the contract documents, errors or omissions in drawings, calculations or samples, confirmation and correlation of dimensions at the job site, fabrication process and techniques of construction, coordination of his work with that of all other trades and satisfactory performance of his work.

☐ **Reviewed** ☐ **Furnish as corrected** ☐ **Revise and Resubmit**	☐ **Contractor** ☐ **Inspector**
Reviewed by:	**Date:**

Remarks:	

SECTION 01 3216
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preliminary baseline schedule.

B. Construction progress schedule, with network analysis diagrams and reports.

1.02 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
   1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
   2. Predecessor Activity: An activity that precedes another activity in the network.
   3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Owner and Owner's Representative.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.03 REFERENCE STANDARDS

A. AGC (CPSM) - Construction Planning and Scheduling Manual; 2004.

B. M-H (CPM) - CPM in Construction Management - Project Management with CPM; 2016.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements.

B. Within 10 days after date of Agreement, submit preliminary schedule.

C. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

D. Within 20 days after review of preliminary schedule, submit draft of proposed complete Critical Path Method schedule for review.

E. Within 10 days after joint review, submit complete Critical Path Method schedule.

F. Submit updated schedule with each Application for Payment.

G. Submit in PDF format.

1.05 QUALITY ASSURANCE

A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with one years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

1.06 SCHEDULE FORMAT

A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.

B. Scale and Spacing: To allow for notations and revisions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY BASELINE SCHEDULE

A. Prepare preliminary baseline schedule in the form of a horizontal bar chart.

3.02 CONTENT

A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

B. Identify each item by specification section number.

C. Identify work of separate stages and other logically grouped activities.

D. Include conferences and meetings in schedule.

E. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

F. Indicate delivery dates for owner-furnished products.

G. Coordinate content with schedule of values specified in Section 01 2000 - Price and Payment Procedures.

H. Provide legend for symbols and abbreviations used.

3.03 PRELIMINARY BASELINE SCHEDULE BAR CHARTS

A. Include a separate bar for each major portion of Work or operation.

B. Identify the first work day of each week.

3.04 CONTRACTOR'S CRITICAL PATH METHOD (CPM) CONSTRUCTION SCHEDULE

A. Prepare network analysis diagrams and supporting mathematical analyses using the Critical Path Method (CPM).

B. Illustrate order and interdependence of activities and sequence of work; how start of a given activity depends on completion of preceding activities, and how completion of the activity may restrain start of subsequent activities.

C. Mathematical Analysis: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:
   1. Preceding and following event numbers.
   2. Activity description.
   3. Estimated duration of activity, in maximum 15 day intervals.
   4. Earliest start date.
   5. Earliest finish date.
   6. Actual start date.
   7. Actual finish date.
   8. Latest start date.
   9. Latest finish date.
   10. Total and free float; float time shall accrue to Owner and to Owner's benefit.
   11. Monetary value of activity, keyed to Schedule of Values.
   12. Percentage of activity completed.
   13. Responsibility.

D. Analysis Program: Capable of compiling monetary value of completed and partially completed activities, accepting revised completion dates, and recomputation of all dates and float.

E. Required Reports: List activities in sorts or groups:
   1. By preceding work item or event number from lowest to highest.
   2. By amount of float, then in order of early start.
   3. Listing of activities on the critical path.

3.05 REVIEW AND EVALUATION OF SCHEDULE

A. Participate in joint review and evaluation of schedule with Architect at each submittal.

B. Evaluate project status to determine work behind schedule and work ahead of schedule.

C. After review, revise as necessary as result of review, and resubmit within 10 days.

3.06 UPDATING SCHEDULE

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity.

C. Annotate diagrams to graphically depict current status of Work.

D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

E. Indicate changes required to maintain Date of Substantial Completion.

F. Submit reports required to support recommended changes.

3.07 DISTRIBUTION OF SCHEDULE

A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner's Representative, Owner, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION

SECTION 01 4000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.
B. Quality assurance.
C. References and standards.
D. Testing and inspection agencies and services.
E. Contractor's construction-related professional design services.
F. Contractor's design-related professional design services.
G. Control of installation.
H. Mock-ups.
I. Preconstruction testing.
J. Tolerances.
K. Manufacturers' field services.
L. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittal procedures.
B. Section 01 4216 - Definitions.

1.03 REFERENCE STANDARDS

A. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.

1.04 DEFINITIONS

A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.
B. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
    1. Design Services Types Required:
        a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor’s sole responsibilities for construction means, methods, techniques, sequences, and procedures.
        b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.

C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

D. Experienced: When used with an entity or individual, "experienced", unless otherwise further described, means:
   1. Having successfully completed a minimum of five previous projects similar in nature, size, and extent of this Project.
   2. Bring familiar with special requirements indicated.
   3. Having complied with requirements of authorities having jurisdiction.

E. Mock-ups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.
   1. Mockups are used for one or more of the following:
      a. Verify selections made under Sample submittals.
      b. Demonstrate aesthetic effects.
      c. Demonstrate the qualities of products and workmanship.
      d. Demonstrate successful installation of interfaces between components and systems.
      e. Perform preconstruction testing to determine system performance.

F. Quality Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

G. Quality Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.05 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
   1. Temporary sheeting, shoring, or supports.
   2. Temporary scaffolding.
   3. Temporary bracing.
   4. Temporary falsework for support of spanning or arched structures.
   5. Temporary foundation underpinning.
   6. Temporary stairs or steps required for construction access only.
   7. Temporary hoist(s) and rigging.
   8. Investigation of soil conditions to support construction equipment.

1.06 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Base design on performance and/or design criteria indicated in individual specification sections.
   1. Submit a Request for Interpretation to Architect if the criteria indicated are not sufficient to perform required design services.

1.07 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements.

B. Designer's Qualification Statement: Submit for Architect and Owner's Representative's knowledge as contract administrator, or for Owner's information.
   1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
      a. Full name.
      b. Professional licensure information.
      c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.

C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
   1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
   2. Include required product data and shop drawings.
   3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
   4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.

D. Mock-up Shop Drawings:
   1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
   2. Indicate manufacturer and model number of individual components.
   3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

E. Contractor's Quality Control (CQC) Plan.

F. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test/inspection.
      h. Date of test/inspection.
      i. Results of test/inspection.
      j. Compliance with Contract Documents.
      k. When requested by Architect, provide interpretation of results.
   2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

G. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.

1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

H. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

I. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
1. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

C. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
1. Requirements of Authorities Having Jurisdiction supersede requirements for specialists.

D. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

E. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.09 CONTRACTOR'S QUALITY CONTROL (CQC) PLAN

A. Contractor's Quality Control (CQC) Plan:
1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
1) Include qualifications (in resume form), duties, responsibilities of each person assigned to CQC function.
b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
1) Management and control of documents and records relating to quality.
2) Communications.

3) Coordination procedures.
4) Resource management.
5) Process control.
6) Inspection and testing procedures and scheduling.
7) Control of noncomplying work.
8) Tracking deficiencies from identification, through acceptable corrective action, and verification.
9) Control of testing and measuring equipment.
10) Project materials certification.
11) Managerial continuity and flexibility.

c. Owner will not make a separate payment for providing and maintaining a Quality Control Plan. Include associated costs in Bid price.

d. Acceptance of the plan is required prior to start of construction activities not including mobilization work. Owner's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. Owner reserves the right to require Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.

B. Quality-Control Personnel Qualifications. Engage a person with requisite training and experience to implement and manage quality assurance (QA) and quality control (QC) for the project.

1.10 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.11 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ and pay for services of an independent testing agency to perform specified testing and inspection.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

1.12 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to assess the Work.

C. Notify Architect fifteen (15) working days in advance of dates and times when mock-ups will be constructed.

D. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.

E. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

F. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

G. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
   1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
   2. Make corrections as necessary until Architect's approval is issued.

H. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

I. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

J. Where possible salvage and recycle the demolished mock-up materials.

3.03 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
   1. Contractor's Responsibilities:
      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
      c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
      d. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
      e. When testing is complete, remove test specimens. Do not reuse on Project.
   2. Testing Agency's Responsibilities:
      a. Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor.
      b. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

3.04 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.05 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.

B. Testing Agency Duties:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.

5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
6. Perform additional tests and inspections required by Architect.
7. Submit reports of all tests/inspections specified.

C. Limits on Testing/Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency may not approve or accept any portion of the Work.
3. Agency may not assume any duties of Contractor.
4. Agency has no authority to stop the Work.

D. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
3. Provide incidental labor and facilities:
a. To provide access to Work to be tested/inspected.
b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
c. To facilitate tests/inspections.
d. To provide storage and curing of test samples.
4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.06 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.07 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect and Owner's Representative will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 4113.11
REGULATORY REQUIREMENTS - GLOBAL WARMING POTENTIAL (GWP)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mandatory requirements for maximum allowable global warming potential (GWP) value of products.

1.02 RELATED REQUIREMENTS

A. Section 01 6000 - Product Requirements: Additional sustainable product requirements.

1.03 DEFINITIONS

A. Embodied Carbon: The sum of greenhouse gas (GHG) emissions arising from the manufacturing, transportation, installation, maintenance, and disposal of building materials. Embodied carbon is expressed as Global Warming Potential (GWP).

B. Environmental Product Declaration (EPD): A document which quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function. EPDs are conducted in accordance with a Product Category Rule (PCR) for the specific product being evaluated. EPDs are available as Industry-Wide EPDs (IW-EPD) or Factory / Product Specific EPDs.
   1. Type III EPDs are third-party verified and compliant with the ISO 14025 standard.

C. Global Warming Potential (GWP): The heat absorbed by any greenhouse gas in the atmosphere as a multiple of the heat that would be absorbed by the same mass of carbon dioxide, usually over a 100-year period. GWP is reported as carbon dioxide equivalent (CO2e).

D. Life Cycle Assessment (LCA): A methodology for assessing environmental impacts associated with all the stages of the life cycle of a commercial product, process, or service.

E. Product Category Rules (PCR): A set of rules, requirements, and guidelines for developing Environmental Product Declarations (EPD) for one or more categories.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal requirements.

B. Sustainable Product Data: See Section 01 6000 - Product Requirements.
   1. Life Cycle Data: Provide Type III environmental product declarations (EPD) for products listed in Part 2 of this Section but specified in other Sections.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS - GLOBAL WARMING POTENTIAL (GWP)

A. CBC 5.409.3 Product GWP Compliance: Permanently installed products listed in this Section must have a Type III environmental product declaration (EPD), either product-specific or factory-specific, showing compliance with the maximum allowable GWP value specified.

B. Concrete Reinforcement: See Structural drawings and Section 03 2000 - Concrete Reinforcing for maximum allowable GWP values for the following:
   1. Deformed bar reinforcing steel.

C. Concrete: See Structural drawings and Section 03 3000 - Cast-in-Place Concrete for maximum allowable GWP values for the following:
   1. Ready-mixed concrete.
   2. Lightweight ready-mixed concrete.

D. Steel: See Structural drawings and Section 05 1200 - Structural Steel Framing for maximum allowable GWP values for the following:
   1. Hot-rolled structural steel.
   2. Hollow structural sections.
   3. Steel plate.

E. Flat Glass:
   1. Maximum Allowable GWP Value: 2.50 kg CO_2e/MT.

F. Light-Density Mineral Wool Board Insulation:
   1. Maximum Allowable GWP Value: 5.83 kg CO_2e/l m^2.

G. Heavy-Density Mineral Wool Board Insulation:
   1. Maximum Allowable GWP Value: 14.28 kg CO2e/l m^2.

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 4216
DEFINITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Definitions.
   1. Other definitions are included in individual specification sections.
B. Industry standards.
C. Abbreviations and acronyms.

1.02 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.
B. Approved: When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
C. Directed: A command or instruction by Architect. Other terms, including "requested," "authorized," "selected," "required," and "permitted," have the same meaning as "directed".
D. Indicated: Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms, including "shown," "noted," "scheduled," and "specified," have the same meaning as "indicated".
E. Furnish: To supply, deliver, unload, and inspect for damage.
F. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
G. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
H. Project Site: Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
I. Provide: To furnish and install, complete and ready for the intended use.
J. Regulations: Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
K. Reviewed: When used to convey Architect's action on Contractor's submittals, applications, and requests, "reviewed" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
L. Supply: Same as Furnish.

1.03 TECHNICAL DEFINITIONS

A. Hydrostatic Pressure: Force exerted by water. Below-grade hydrostatic pressure can be caused by the presence of rainwater, irrigation water, high water table, rising water vapor, or a combination of these sources. The ability of the soil to drain water will impact the amount of hydrostatic pressure.

B. Vapor Retarder: A material or system of materials which prevent the transmission of water vapor, between 1.0 and 0.1 perm, without hydrostatic pressure.

C. Vapor Barrier: A material or system of materials which prevent the transmission of water vapor, less than 0.1 perm, without hydrostatic pressure.

D. Waterproofing: A material or system of materials which prevent the transmission of liquid water under hydrostatic pressure.

1.04 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
   1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
   1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.05 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States".

B. Industry Organizations, List: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.
   1. AABC - Associated Air Balance Council; www.aabc.com.
   2. AAMA - American Architectural Manufacturers Association; (see FGIA).
   3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
   4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
   5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
   6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
   7. ABMA - American Boiler Manufacturers Association; www.abma.com.
   8. ACI - American Concrete Institute; www.concrete.org.
   9. ACP - American Clean Power; (Formerly: American Wind Energy Association); www.cleanpower.org.

10. ACPA - American Concrete Pipe Association; www.concretepipe.org.
11. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
12. AF&PA - American Forest & Paper Association; www.afandpa.org.
13. AGA - American Gas Association; www.aga.org.
14. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
16. AI - Asphalt Institute; www.asphaltinstitute.org.
17. AIA - American Institute of Architects (The); www.aia.org.
18. AISC - American Institute of Steel Construction; www.aisc.org.
19. AISI - American Iron and Steel Institute; www.steel.org.
20. AITC - American Institute of Timber Construction; (see PLIB).
21. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
22. AMPP - Association for Materials Protection and Performance; www.ampp.org.
23. ANSI - American National Standards Institute; www.ansi.org.
24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); www.analyzeseeds.com.
25. APA - The Engineered Wood Association; www.apawood.org.
26. APA - Architectural Precast Association; www.archprecast.org.
27. API - American Petroleum Institute; www.api.org.
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASA - Acoustical Society of America; www.acousticalsociety.org.
30. ASCE - American Society of Civil Engineers; www.asce.org.
31. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (see ASCE).
32. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
33. ASME - ASME International; American Society of Mechanical Engineers (The); www.asme.org.
34. ASSE - ASSE International; (American Society of Sanitary Engineering); www.asse-plumbing.org.
35. ASSP - American Society of Safety Professionals; www.assp.org.
36. ASTM - ASTM International; www.astm.org.
37. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
38. AVIXA - Audiovisual and Integrated Experience Association; www.avixa.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; www.bwfbadminton.com.
50. CARB - California Air Resources Board; www.arb.ca.gov.
51. CDA - Copper Development Association Inc.; www.copper.org.

52. CE - Conformite Europeenne (European Commission); www.ec.europa.eu/growth/single-market/ce-marking.
53. CEA - Canadian Electricity Association; www.electricity.ca.
54. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
55. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
56. CGA - Compressed Gas Association; www.cganet.com.
57. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
58. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
59. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
60. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
61. CPA - Composite Panel Association; www.compositepanel.org.
62. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
63. CRRC - Cool Roof Rating Council; www.coolroofs.org.
64. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
65. CSA - CSA Group; www.csagroup.org.
66. CSI - Cast Stone Institute; www.caststone.org.
67. CSI - Construction Specifications Institute (The); www.csiresources.org.
68. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
69. CTA - Consumer Technology Association; www.cta.tech.
70. CTI - Cooling Technology Institute; www.coolingtechnology.org.
71. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
72. DHA - Decorative Hardwoods Association; www.decorativehardwoods.org.
73. DHI - Door and Hardware Institute; www.dhi.org.
74. ECIA - Electronic Components Industry Association; www.ecianow.org.
75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; www.esda.org.
78. ESTA - Entertainment Services and Technology Association; www.esta.org.
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
81. FGIA - Fenestration and Glazing Industry Alliance; https://fgiaonline.org.
82. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
83. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
84. FM Approvals - FM Approvals LLC; www.fmapprovals.com.
85. FM Global - FM Global; www.fmglobal.com.
86. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.; www.floridaroof.com.
87. FSA - Fluid Sealing Association; www.fluidsealing.com.
88. FSC - Forest Stewardship Council U.S.; www.fscus.org.
89. GA - Gypsum Association; www.gypsum.org.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
93. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
94. IAS - International Accreditation Service; www.iasonline.org.
95. ICC - International Code Council; www.iccsafe.org.

96. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
97. ICPA - International Cast Polymer Association (The); www.theicpa.com.
98. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
99. IEC - International Electrotechnical Commission; www.iec.ch.
100. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
101. IES - Illuminating Engineering Society; www.ies.org.
102. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
103. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
104. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
105. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
106. Intertek - Intertek Group; www.intertek.com.
107. ISA - International Society of Automation (The); www.isa.org.
108. ISFA - International Surface Fabricators Association; www.isfanow.org.
109. ISO - International Organization for Standardization; www.iso.org.
110. ITU - International Telecommunication Union; www.itu.int.
111. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
112. LPI - Lightning Protection Institute; www.lightning.org.
113. MBMA - Metal Building Manufacturers Association; www.mbma.com.
114. MCA - Metal Construction Association; www.metalconstruction.org.
115. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
116. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
117. MHI - Material Handling Industry; www.mhi.org.
118. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
119. MPI - Master Painters Institute; www.paintinfo.com.
120. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.; www.msshq.org.
121. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
122. NACE - NACE International; (National Association of Corrosion Engineers International); (see AMPP).
123. NADCA - National Air Duct Cleaners Association; www.nadca.com.
124. NAIMA - North American Insulation Manufacturers Association; www.insulationinstitute.org.
125. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
126. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
127. NBI - New Buildings Institute; www.newbuildings.org.
128. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
129. NCMA - National Concrete Masonry Association; www.ncma.org.
130. NEBB - National Environmental Balancing Bureau; www.nebb.org.
131. NECA - National Electrical Contractors Association; www.necanet.org.
132. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
133. NEMA - National Electrical Manufacturers Association; www.nema.org.
134. NETA - InterNational Electrical Testing Association; www.netaworld.org.
135. NFHS - National Federation of State High School Associations; www.nfhs.org.
136. NFPA - National Fire Protection Association; www.nfpa.org.
137. NFPA - NFPA International; (see NFPA).
138. NFRC - National Fenestration Rating Council; www.nfrc.org.
139. NGA - National Glass Association; www.glass.org.
140. NHLA - National Hardwood Lumber Association; www.nhla.com.

141. NLGA - National Lumber Grades Authority; www.nlga.org.
142. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).
143. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
144. NRCA - National Roofing Contractors Association; www.nrca.net.
145. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
146. NSF - NSF International; www.nsf.org.
147. NSI - Natural Stone Institute; www.naturalstoneinstitute.org.
148. NSPE - National Society of Professional Engineers; www.nspe.org.
149. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
150. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
151. NWFA - National Wood Flooring Association; www.nwfa.org.
152. NWRA - National Waste & Recycling Association; www.wasterecycling.org.
153. PCI - Precast / Prestressed Concrete Institute; www.pci.org.
154. PDI - Plumbing & Drainage Institute; www.pdionline.org.
155. PLASA - PLASA; www.plasa.org.
156. PLIB - Pacific Lumber Inspection Bureau; www.plib.org.
157. PVCPA - Uni-Bell PVC Pipe Association; www.uni-bell.org.
158. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
159. RFCI - Resilient Floor Covering Institute; www.rfci.com.
160. RIS - Redwood Inspection Service; (see WWPA).
161. SAE - SAE International; www.sae.org.
162. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
163. SDI - Steel Deck Institute; www.sdi.org.
164. SDI - Steel Door Institute; www.steeldoor.org.
165. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
167. SIA - Security Industry Association; www.securityindustry.org.
168. SJI - Steel Joist Institute; www.steeljoist.org.
169. SMA - Screen Manufacturers Association; www.smainfo.org.
170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
171. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
172. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
173. SPIB - Southern Pine Inspection Bureau; www.spib.org.
174. SPRI - Single Ply Roofing Industry; www.spri.org.
175. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
176. SSINA - Specialty Steel Industry of North America; www.ssina.com.
177. SSPC - SSPC: The Society for Protective Coatings; (see AMPP).
178. STI/SPFA - Steel Tank Institute/Steel Plate Fabricators Association; www.steeltank.com.
179. SWI - Steel Window Institute; www.steelwindows.com.
180. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
181. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
182. TCNA - Tile Council of North America, Inc.; www.tcnatile.com.
183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.kbcdco.tema.org.
184. TIA - Telecommunications Industry Association (The); www.tiaonline.org.
185. TMS - The Masonry Society; www.masonrysociety.org.
186. TPI - Truss Plate Institute; www.tpinst.org.
187. TPI - Turfgrass Producers International; www.turfgrasssod.org.

188. TRI - Tile Roofing Industry Alliance; www.tileroofing.org.
189. UL - Underwriters Laboratories Inc.; www.ul.org.
190. UL LLC - UL LLC; www.ul.com.
191. USAV - USA Volleyball; www.usavolleyball.org.
192. USGBC - U.S. Green Building Council; www.usgbc.org.
193. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
194. WA - Wallcoverings Association; www.wallcoverings.org.
195. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
196. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
197. WDMA - Window & Door Manufacturers Association; www.wdma.com.
198. WI - Woodwork Institute; www.woodworkinstitute.com.
199. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
200. WWPA - Western Wood Products Association; www.wwpa.org.

C. Abbreviations and acronyms not included in this list are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States".

D. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
   1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
   2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
   3. ICC - International Code Council; www.iccsafe.org.
   4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

E. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
   1. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.
   2. DOC - U.S. Department of Commerce; www.commerce.gov.
   3. DOD - U.S. Department of Defense; www.defense.gov.
   4. DOE - U.S. Department of Energy; www.energy.gov.
   5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov
   6. DOS - U.S. Department of State; www.state.gov.
   7. EPA - United States Environmental Protection Agency; www.epa.gov.
   8. FAA - Federal Aviation Administration; www.faa.gov.
   9. GPO - U.S. Government Publishing Office; www.gpo.gov.
   10. GSA - U.S. General Services Administration; www.gsa.gov.
   11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
   12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
   13. NIST - National Institute of Standards and Technology; www.nist.gov.
   14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
   15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
   16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
   17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
   18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
   19. USP - U.S. Pharmacopeial Convention; www.usp.org.
   20. USPS - United States Postal Service; www.usps.com.

F. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
   1. CFR - Code of Federal Regulations; Available from U.S. Government Publishing Office; www.govinfo.gov.
   2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
   3. DSCC - Defense Supply Center Columbus; (see FS).
   4. FED-STD - Federal Standard; (see FS).
   5. FS - Federal Specification; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
      a. Available from Defense Standardization Program; www.dsp.dla.mil.
      b. Available from U.S. General Services Administration; www.gsa.gov.
      c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
   6. MILSPEC - Military Specification and Standards; (see DOD).
   7. USAB - United States Access Board; www.access-board.gov.
   8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).

G. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
   1. BEARHFTI; California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; (see BHGS).
   2. BHGS; State of California Bureau of Household Goods and Services; (Formerly: California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation); www.bhgs.dca.ca.gov.
   3. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.oal.ca.gov/publications/ccr/.
   4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx.
   5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
   6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
   7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; https://tfsweb.tamu.edu/.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dewatering
B. Temporary Controls: Barriers, enclosures, and fencing.
C. Temporary facility use.

1.02 RELATED REQUIREMENTS

A. Section 01 5100 - Temporary Utilities.
B. Section 01 5213 - Field Offices and Sheds.
C. Section 01 5500 - Vehicular Access and Parking.
D. Section 01 5813 - Temporary Project Signage.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
D. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.04 DEWATERING

A. Provide temporary means and methods for dewatering all temporary facilities and controls.
B. Maintain temporary facilities in operable condition.
C. Maintain temporary facilities as directed by Architect.

1.05 TEMPORARY BARRIERS AND ENCLOSURES, GENERAL

A. Accessible Temporary Egress: Comply with applicable provisions in ADA Standards and ICC A117.1.
B. Materials: Refer to Part 2 of this Section.

1.06 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.07 FENCING

A. Provide 6 foot high fence around construction site; equip with vehicular gates with locks.

1.08 TEMPORARY EXTERIOR ENCLOSURES

A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.09 TEMPORARY INTERIOR ENCLOSURES

A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.

B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.10 TEMPORARY FACILITY USE

A. Temporary Use of New Elevators:

B. Temporary Use of Existing Elevators: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner.
   1. Do not load elevators beyond their rated weight capacity.
   2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
   3. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.

C. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

D. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
   1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

E. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

1.11 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; with galvanized-steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts, and with 1-5/8-inch OD top rails.

B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; with galvanized-steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts, with 1-5/8-inch OD top and bottom rails. Provide concrete bases for supporting posts.

C. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.

D. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

E. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches.

F. Temporary Enclosure Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 5100
TEMPORARY UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary utilities.
B. Temporary sanitary facilities.
C. Removal of temporary utilities.

1.02 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.03 TEMPORARY UTILITIES, GENERAL

A. Owner will provide the following:
   1. Electrical power and metering, consisting of connection to existing facilities.
   2. Water supply, consisting of connection to existing facilities.
B. Existing facilities may be used.
C. Use trigger-operated nozzles for water hoses, to avoid waste of water.

1.04 TEMPORARY ELECTRICITY

A. Connect to Owner's existing power service.
   1. Exercise measures to conserve energy.
B. Provide temporary electric feeder from existing building electrical service at location as directed.
C. Complement existing power service capacity and characteristics as required.
D. Provide power outlets for construction operations, with branch wiring and distribution boxes located at each floor. Provide flexible power cords as required.
E. Provide main service disconnect and over-current protection at convenient location and meter.
F. Permanent convenience receptacles may be utilized during construction.
G. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.

1.05 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain LED, compact fluorescent, or high-intensity discharge lighting as suitable for the application for construction operations in accordance with requirements of 29 CFR 1926 and authorities having jurisdiction.
B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
C. Maintain lighting and provide routine repairs.
D. Permanent building lighting may be utilized during construction.

1.06 TEMPORARY HEATING

A. Provide heating devices and heat as needed to maintain specified conditions for construction operations.

B. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

1.07 TEMPORARY COOLING

A. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.

B. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

1.08 TEMPORARY VENTILATION

A. Provide air handling and filtration units capable of providing negative air pressure in all work areas to maintain dust control. Provide HEPA primary and secondary filter-equiped portable units with four-stage filtration. Provide single switch emergency shut-off. Configure to run continuously.

1.09 TEMPORARY WATER SERVICE

A. Connect to existing water source.
   1. Exercise measures to conserve water.

1.10 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

1.11 REMOVAL OF TEMPORARY UTILITIES

A. Remove temporary utilities prior to Date of Substantial Completion inspection.

B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 5213
FIELD OFFICES AND SHEDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary field offices and sheds.

1.02 RELATED REQUIREMENTS

A. Section 01 5000 - Temporary Facilities and Controls:
B. Section 01 5000: Parking and access to field offices.

PART 2 PRODUCTS

2.01 FIELD OFFICES

A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.

2.02 MATERIALS, EQUIPMENT, FURNISHINGS

A. Materials, Equipment, Furnishings: Serviceable, new or used, adequate for required purpose.

2.03 CONSTRUCTION

A. Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
B. Construction: Structurally sound, secure, weather tight enclosures for office. Maintain during progress of Work; remove when no longer needed.
C. Temperature Transmission Resistance of Floors, Walls, and Ceilings: Compatible with occupancy requirements.
D. Exterior Materials: Weather resistant, finished .
E. Fire Extinguishers: Appropriate type fire extinguisher at each office.

2.04 ENVIRONMENTAL CONTROL

A. Heating, Cooling, and Ventilating: Automatic equipment to maintain comfort conditions.

PART 3 EXECUTION

3.01 PREPARATION

A. Fill and grade sites for temporary structures to provide drainage away from buildings.

3.02 INSTALLATION

A. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.

3.03 MAINTENANCE AND CLEANING

A. Weekly janitorial services for offices; periodic cleaning and maintenance for offices.

B. Maintain approach walks free of mud and water.

3.04 REMOVAL

A. At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

END OF SECTION

SECTION 01 5500
VEHICULAR ACCESS AND PARKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Access roads.
B. Parking.
C. Existing pavements and parking areas.
D. Permanent pavements and parking facilities.
E. Construction parking controls.
F. Flag persons.
G. Haul routes.
H. Maintenance.
I. Removal, repair.
J. Dust control.

PART 2 PRODUCTS

2.01 MATERIALS

A. Temporary Construction: Contractor's option.
B. Materials for Permanent Construction: As specified in product specification sections, including earthwork, paving base, and topping.

PART 3 EXECUTION

3.01 VEHICULAR ACCESS AND PARKING, GENERAL

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
B. Coordinate access and haul routes with governing authorities and Owner.
C. Provide and maintain access to fire hydrants, free of obstructions.
D. Existing parking areas may be used for construction parking.

3.02 PREPARATION

A. Clear areas, provide surface and storm drainage of road, parking, area premises, and adjacent areas.

3.03 PARKING

A. Use of existing parking facilities by construction personnel is permitted.

3.04 PERMANENT PAVEMENTS AND PARKING FACILITIES

A. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.

3.05 CONSTRUCTION PARKING CONTROL

A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and Owner's operations.

B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.

C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.06 FLAG PERSONS

A. Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

3.07 HAUL ROUTES

A. Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

3.08 MAINTENANCE

A. Maintain traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow, and ice.

B. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

3.09 REMOVAL, REPAIR

A. Remove equipment and devices when no longer required.

B. Repair damage caused by installation.

3.10 **DUST CONTROL**

A. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

END OF SECTION

SECTION 01 5639
TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Tree protection of existing trees and plants
B. Tree pruning of existing trees

1.02 RELATED REQUIREMENTS

A. Division 01 Section - Temporary Facilities and Controls
B. Division 31 Section - Site Clearing
C. Division 32 Section - Landscape Work

1.03 DEFINITIONS

A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at 6 inches (150 mm) above the ground for trees up to, and including, 4-inch (100-mm) size; and 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.
B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.
D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Samples for Verification: For each type of the following:
    1. Organic Mulch: 1-pint (0.5-L) 1-quart (1-L) volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
    2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
    3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.
C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
    1. Species and size of tree.
    2. Location on site plan. Include unique identifier for each.
    3. Reason for pruning.
    4. Description of pruning to be performed.
    5. Description of maintenance following pruning.
D. Qualification Data: For qualified arborist and tree service firm.

E. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

F. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

G. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
   1. Use sufficiently detailed photographs or videotape.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.05 QUALITY ASSURANCE

A. Arborist Qualifications:
   1. Certified Arborist as certified by ISA.
   2. Licensed Arborist in jurisdiction where Project is located.

B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
      a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
      b. Enforcing requirements for protection zones.
      c. Arborist's responsibilities.
      d. Contractor responsibilities
      e. Field quality control.

1.06 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or trenching or digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
   8. Do not direct vehicle or equipment exhaust toward protection zones.
   9. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch (25 mm) Insert dimension in diameter; and free of weeds, roots, and toxic and other nonsoil materials.
   1. Obtain topsoil only from well-drained sites where topsoil is 4 inches (100 mm) deep or more; do not obtain from bogs or marshes.
   2. Refer to Section 32 Landscape Work for material requirements.

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
   1. Type: Wood and bark chips.
   2. Size Range: 1-1/2" inch minimum, 3" maximum.
   3. Color: Natural.

C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements. Previously used materials may be used when approved by Architect.
   1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch (50-mm) opening, 0.148-inch- (3.76-mm-) diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- (60-mm-) OD line posts, and 2-7/8-inch- (73-mm-) OD corner and pull posts; with 1-5/8-inch- (42-mm-) OD top rails and 0.177-inch- (4.5-mm-) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
      a. Height: 6 feet (1.8 m).
      b. Galvanized
      c. Polymer-Coating Color: Black.
   2. Gates: Single swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches (914 mm) .

D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering and as follows:
   1. Size: as required
   2. Text: "TREE PROTECTION ZONE - KEEP OUT. No unauthorized entry. No storage of vehicles, materials, or debris. No dumping of chemicals, slurry, paint, oil, etc. "
   3. Lettering: 3-inch (75-mm-)high minimum, black characters on white background.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.02 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag - Tie a 1-inch (25-mm) blue-vinyl tape around each tree trunk at 54 inches (1372 mm) above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.
   1. Apply 3-inch (76-mm) average thickness of organic mulch. Do not place mulch within 6 inches (152 mm) of tree trunks.

3.03 TREE- AND PLANT-PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
   1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
   2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
   3. Access Gates: Install as required; adjust to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 35 feet (10.5 m) on protection-zone fencing, but no fewer than four signs with each facing a different direction.

C. Maintain protection zones free of weeds and trash.

D. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

E. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
   1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
   2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.04 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Division 31 Section "Earth Moving."

B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only roots smaller than 2” in diameter that interfere with installation of utilities. Cut roots as required for root pruning.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches (75 mm) back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.05 ROOT PRUNING

A. Do Not prune any roots without written authorization from Arborist or Client.

B. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:
   1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
   2. Cut Ends: Do not paint cut root ends. Coat cut ends of roots more than 1-1/2 inches (38 mm) in diameter with emulsified asphalt or other coating formulated for use on damaged plant tissues as approved by the arborist.
   3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
   4. Cover exposed roots with burlap and water regularly.
   5. Backfill as soon as possible according to requirements in Division 31 Section "Grading”

C. Root Pruning at Edge of Protection Zone: Prune roots 12 inches (300 mm) outside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.

D. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.06 CROWN PRUNING

A. Do not prune any branches without written authorization from Arborist or Client.

B. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:
   1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
   2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:
      a. Type of Pruning: Cleaning Thinning Raising Reduction.
   3. Cut branches with sharp pruning instruments; do not break or chop.
   4. Do not apply pruning paint to wounds.

C. Chip removed branches and dispose of off-site.

3.07 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
   1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 4 inches (50 mm) or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.08 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.09 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
   1. Submit details of proposed root cutting and tree and shrub repairs.
   2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
   3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
   4. Perform repairs within 24 hours.
   5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Trees: Remove and replace trees indicated to remain that are more than 66 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
   1. Provide new trees of same size and species as those being replaced for each tree that measures 4 inches (100 mm) or smaller in caliper size.
   2. Provide one new tree(s) of 6-inch (150-mm) caliper size for each tree being replaced that measure more than 4 inches (100 mm) in caliper size.
      a. Species: Species selected by Architect.
   3. Plant and maintain new trees as specified in Division 32 Section "Landscape Work"

C. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) O.C. Backfill holes with an equal mix of native soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION

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SECTION 01 5719
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Construction procedures to promote adequate indoor air quality after construction.

B. Building flush-out after construction and before occupancy.

C. Testing indoor air quality after completion of construction.

1.02 PROJECT GOALS

A. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
   1. Cleaning of ductwork is not contemplated under this Contract.
   2. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.

B. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
   1. Furnish products meeting the specifications.
   2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

1.03 RELATED REQUIREMENTS

A. Section 01 4000 - Quality Requirements: Testing and inspection services.

B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

1.04 REFERENCE STANDARDS

A. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Addendum (2022).

B. ASTM D5197 - Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology); 2021.

C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.

D. EPA 600/4-90/010 - Compendium of Methods for the Determination of Air Pollutants in Indoor Air; 1990.

E. EPA 625/R-96/010b - Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air; 1999, with Addendum (2000).

F. SMACNA (OCC) - IAQ Guidelines for Occupied Buildings Under Construction; 2007.

1.05 DEFINITIONS

A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.

B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.

C. Particulates: Dust, dirt, and other airborne solid matter.

D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements.

B. Indoor Air Quality Management Plan: Describe, in detail, measures to be taken to promote adequate indoor air quality upon completion; use SMACNA (OCC) as a guide.
   1. Submit not less than 60 days before enclosure of building.
   2. Identify potential sources of odor and dust.
   3. Identify construction activities likely to produce odor or dust.
   4. Identify areas of project potentially affected, especially occupied areas.
   5. Evaluate potential problems by severity and describe methods of control.
   6. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
   7. Describe cleaning and dust control procedures.

C. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.

D. Duct and Terminal Unit Inspection Report.

E. Air Contaminant Test Plan: Identify:
   1. Testing agency qualifications.
   2. Locations and scheduling of air sampling.
   3. Test procedures, in detail.
   4. Test instruments and apparatus.
   5. Sampling methods.

F. Air Contaminant Test Reports: Show:
   1. Location where each sample was taken, and time.
   2. Test values for each air sample; average the values of each set of 3.
   3. HVAC operating conditions.
   4. Certification of test equipment calibration.
   5. Other conditions or discrepancies that might have influenced results.

1.07 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: Independent testing agency having minimum of 5 years experience in performing the types of testing specified.

PART 2 PRODUCTS

2.01 MATERIALS

A. Low VOC Materials: See Sections 01 6000 and 01 6116.

B. Auxiliary Air Filters: MERV of 8, minimum, when tested in accordance with ASHRAE Std 52.2.

PART 3 EXECUTION

3.01 CONSTRUCTION PROCEDURES

A. Prevent the absorption of moisture and humidity by adsorptive materials by:
   1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
   2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
   3. Provide sufficient ventilation for drying within reasonable time frame.

B. Begin construction ventilation when building is substantially enclosed.

C. If extremely dusty or dirty work must be conducted inside the building, shut down HVAC systems for the duration; remove dust and dirt completely before restarting systems.

D. Do not store construction materials or waste in mechanical or electrical rooms.

E. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
   1. Inspect duct intakes, return air grilles, and terminal units for dust.
   2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
   3. Clean tops of doors and frames.
   4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
   5. Clean return plenums of air handling units.
   6. Remove intake filters last, after cleaning is complete.

F. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.

G. Use other relevant recommendations of SMACNA (OCC) for avoiding unnecessary contamination due to construction procedures.

3.02 AIR CONTAMINANT TESTING

A. Contractor's Option: Either full continuous flush-out, or satisfactory air contaminant testing is required, not both.

B. Perform air contaminant testing before occupancy.

C. Do not start air contaminant testing until:
   1. All construction is complete, including interior finishes.
   2. HVAC systems have been tested, adjusted, and balanced for proper operation.
   3. New HVAC filtration media have been installed.

D. Indoor Air Samples: Collect from spaces representative of occupied areas:
   1. Collect samples while operable windows and exterior doors are closed, HVAC system is running normally as if occupied, with design minimum outdoor air, but with the building unoccupied.
   2. Collect samples from spaces in each contiguous floor area in each air handler zone, but not less than one sample per 25,000 square feet; take samples from areas having the least ventilation and those having the greatest presumed source strength.
   3. Collect samples from height from 36 inches to 72 inches above floor.
   4. Collect samples from same locations on 3 consecutive days during normal business hours; average the results of each set of 3 samples.

5. Exception: Areas with normal very high outside air ventilation rates, such as laboratories, do not need to be tested.
6. When retesting the same building areas, take samples from at least the same locations as in first test.

E. Outdoor Air Samples: Collect samples at outside air intake of each air handler at the same time as indoor samples are taken.

F. Analyze air samples and submit report.

G. Volatile Organic Compounds Limits:
1. Formaldehyde: Not more than 27 parts per billion.
2. Total Volatile Organic Compounds (TVOCs): Not more than 500 micrograms per cubic meter.
3. Chemicals Listed in CAL (CDPH SM) Table 4-1, other than Formaldehyde: Not more than allowable concentrations listed in Table 4-1.

H. Air Contaminant Concentration Test Methods:
1. Formaldehyde: ASTM D5197, EPA 625/R-96/010b Method TO-11A, or EPA 600/4-90/010 Method IP-6A.
2. Particulates: EPA 600/4-90/010 Method IP-10.
3. Total Volatile Organic Compounds (TVOC): EPA 625/R-96/010b Method TO-1, TO-15, or TO-17; or EPA 600/4-90/010 Method IP-1.
4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: ASTM D5197, or EPA 625/R-96/010b Method TO-1, TO-15, or TO-17.
5. Carbon Monoxide: EPA 600/4-90/010 Method IP-3, plus measure outdoor air; measure in ppm; report both indoor and outdoor measurements.

END OF SECTION

SECTION 01 5813
TEMPORARY PROJECT SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project identification sign.

1.02 REFERENCE STANDARDS

A. FHWA (SHS) - Standard Highway Signs and Markings; 2004, with Supplement (2012).

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements.

B. Shop Drawing: Show content, layout, lettering, color, foundation, structure, sizes and grades of members.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Design sign and structure to withstand 50 miles/hr wind velocity.

B. Finishes: Adequate to withstand weathering, fading, and chipping for duration of construction.

2.02 SIGN MATERIALS

A. Structure and Framing: New, wood, structurally adequate.

B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch thick, standard large sizes to minimize joints.

C. Rough Hardware: Galvanized.

2.03 PROJECT IDENTIFICATION SIGN

A. One sign, 48 sq ft area, bottom 6 feet above ground.

B. Content:
   1. Names and titles of authorities.
   2. Names and titles of Architect and Consultants.
   3. Name of Prime Contractor.

C. Graphic Design, Colors, Style of Lettering: Designated by Architect.

D. Lettering: Standard Alphabet Series C, as specified in FHWA (SHS).

PART 3 EXECUTION

3.01 INSTALLATION

A. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.

B. Install sign surface plumb and level, with butt joints. Anchor securely.

3.02 MAINTENANCE

A. Maintain signs and supports clean, repair deterioration and damage.

3.03 REMOVAL

A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

END OF SECTION

SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.
B. Sustainable design-related product requirements, including:
   1. Low-emitting products.
C. Re-use of existing products.
D. Transportation, handling, storage, and protection requirements.
E. Product option requirements.
F. Procedures for Owner-supplied products.
G. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 01 2500 - Substitution Procedures: Substitutions made during procurement and/or construction phases, and substitution limitations.
B. Section 01 4000 - Quality Requirements: Product quality monitoring.
C. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
D. Section 01 7419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 DEFINITIONS

A. Basis of Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "Basis of Design Product" including make or model number or other designation. Published attributes and characteristics of basis of design product establish salient characteristics of products.
   1. Evaluation of Comparable Products: In addition to the basis of design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis of design product also establish salient characteristics of products for purposes of evaluating comparable products.
B. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
   1. Identification of basis of design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.

2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

C. Material Transparency: The practice by manufacturers of disclosing the environmental and health impacts of products.

D. Passive (As Related to MEP): Not part of the active portions of the Mechanical, Electrical, and Plumbing systems, for example piping, pipe insulation, ducts, duct insulation, conduit, plumbing fixtures, faucets, showerheads, and lamp housings.Product Category Rules: A set of rules, requirements, and guidelines for developing Environmental Product Declarations.

E. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.04 REFERENCE STANDARDS

A. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements.

B. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

C. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

D. Sustainable Product Data: Provide sustainable product documentation specified in this Section when required in other Sections, to validate sustainable properties of products.
   1. Documentation must be specific to products actually installed in the Project.
   2. Confirm that documentation contains certification labels for the companies and agencies providing certification.

E. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

F. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

1.06 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.07 PRODUCT WARRANTY REQUIREMENTS

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
   1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
   2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
   1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
   3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 3000 - Administrative Requirements.

PART 2 PRODUCTS

2.01 PRODUCTS, GENERAL

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged, and, unless otherwise indicated, are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected", Architect will make selection.
   5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. See Section 01 4000 - Quality Requirements, for additional source quality control requirements.

C. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
   1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.

2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
   a. Name of product and manufacturer.
   b. Model and serial number.
   c. Capacity.
   d. Speed.
   e. Ratings.
3. See individual identification sections in Divisions 21, 22, 23, and 26 for additional identification requirements.

D. Foreign Product Limitations: Except under one or more of the following conditions, provide domestic products, not foreign products, for inclusion in the Work:
1. No available domestic product complies with the Contract Documents.
2. Domestic products that comply with the Contract Documents are available only at prices or terms substantially higher than foreign products that comply with the Contract Documents.

2.02 EXISTING PRODUCTS

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.

B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.

C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.03 NEW PRODUCTS, GENERAL

A. Provide new products unless specifically required or permitted by Contract Documents.

B. See Section 01 4000 - Quality Requirements, for additional source quality control requirements.

2.04 LOW-EMITTING PRODUCTS

A. Low-Emitting Products: Provide low-VOC-emitting products to meet Owner's sustainability goals for Project and as otherwise required by code.
1. See Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions, for additional information.

B. VOC Restrictions Data: Provide manufacturer's data that verifies products are at or below acceptable thresholds of volatile content specified in Section 016116.
1. Items in list below with (CDPH) indicate compliance with California Department of Public Health "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers" CAL (CDPH SM). See Section 016116 for additional information.
   a. Other 3rd party document specifically indicating compliance with standard is acceptable.
2. Examples include, but are not limited to:
   a. Collaborative for High Performance Schools.
      1) Web: https://chps.net/ .
   b. Carpet and Rug Institute (CRI) Green Label Plus (CDPH).

1) Web: https://carpet-rug.org/testing/green-label-plus/ .

c. Cradle to Cradle Material Health Certificate.
1) Web: https://c2ccertified.org/material-health-certificate .

d. Declare.
1) Web: https://living-future.org/declare/ .

e. Emicode (flooring):
1) Web: https://www.emicode.com/en/home/ .

f. GreenScreen.
1) Web: https://www.greenscreenchemicals.org/certified .

g. Green Squared (tile products).
1) Web: https://greensquaredcertified.ecomedes.com/ .

h. Health Product Declaration (HPD).
1) Web: https://www.hpd-collaborative.org/ .

i. Intertek, Clean Air Gold certification (CDPH).
1) Web: https://www.intertek.com/certification/indoor-air-quality/ .

j. MAS, Certified Green certification (CDPH).
1) Web: https://mascertifiedgreen.com/ .

k. SCS Global Services / Resilient Floor Coverings Institute (RFCI), FloorScore (CDPH).
1) Web: https://www.scsglobalservices.com/services/floorscore .

l. SCS Global Services, Indoor Advantage.
1) Web: https://www.scsglobalservices.com/services/indoor-air-quality-certification.

m. UL Ecologo.
1) Web: https://www.ul.com/resources/ecologo-certification-program .

n. UL Greenguard (CDPH - Gold certification required).
1) Web: https://www.ul.com/services/ul-greenguard-certification .

2.05 PRODUCT OPTIONS

A. Product selection shall be done in accordance with the following requirements:
1. Standards, Codes and Regulations: Select from among products that are in compliance with the project requirements, as well as with construction standards, all applicable codes and regulations and sustainable design requirements.
2. Performance Requirements: Provide products that comply with specific performances indicated and are recommended by the manufacturer, in published product literature or by individual certification, for the application indicated.
3. Prescriptive Requirements: Provide products that have been produced in accordance with prescriptive requirements, using specified ingredients and components and complying with specified requirements for mixing, fabricating, curing, finishing, testing and other operations in the manufacturing process.

B. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

C. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

D. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

E. Basis of Design Products: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers.

1. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named.

F. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

G. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 2500 - Substitution Procedures for proposal of product.

H. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

I. Products, which, by nature of their application, are likely to be needed at a later date for maintenance and repair or replacement work, shall be current models for which replacement parts are available.

2.06 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 01 3000 - Administrative Requirements, for submittal procedures.
1. Form of Approval of Submittal: As specified in Section 01 3000 - Administrative Requirements.
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

2.07 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 01 2500 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS

A. Owner's Responsibilities:
   1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
   2. Arrange and pay for product delivery to site.
   3. On delivery, inspect products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:
   1. Review Owner reviewed shop drawings, product data, and samples.
   2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
   3. Handle, store, install and finish products.
   4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION, DELIVERY, AND HANDLING REQUIREMENTS

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

E. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

F. Deliver products in manufacturer's original sealed containers or other packaging system, complete with labels and instructions for handling, storage, unpacking, protection, and installing.
   1. Comply with manufacturer's warranty conditions, if any.

G. Transport and handle products in accordance with manufacturer's instructions.

H. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

I. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

J. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

K. Packaging Waste Management: See Section 01 7419 - Construction Waste Management and Disposal.
   1. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION REQUIREMENTS

A. Provide protection of stored materials and products against theft, casualty, or deterioration.

B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 7419.
   1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.

C. Store and protect products in accordance with manufacturers' instructions.
   1. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

D. Store with seals and labels intact and legible.

E. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.

F. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

G. For exterior storage of fabricated products, place on sloped supports above ground.

H. Provide off-site storage and protection when site does not permit on-site storage or protection.
   1. Execute a formal supplemental agreement between Owner and Contractor allowing off-site storage, for each occurrence.

I. Protect products in accordance with manufacturers' written instructions.

J. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

K. Comply with manufacturer's warranty conditions, if any.

L. Do not store products directly on the ground.

M. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

N. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

O. Protect liquids from freezing.

P. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

Q. Prevent contact with material that may cause corrosion, discoloration, or staining.

R. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

S. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 6116
VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements for Indoor-Emissions-Restricted products.

B. Requirements for VOC-Content-Restricted products, including:
   1. Adhesives.
   2. Sealants.
   3. Paints and coatings.
   4. Wood.

C. Toxic and hazardous materials to avoid.

D. Toxic and hazardous materials to limit.

E. Requirement for installer certification that they did not use any non-compliant products.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittal procedures.

1.03 DEFINITIONS

A. Volatile: The tendency of a substance to transition from a solid or liquid state to vapor (evaporate).

B. Volatile Organic Compounds (VOC): Organic compounds that evaporate under normal atmospheric conditions. Some VOCs impact human health and comfort as odor, irritation, chronic toxicity, or carcinogenicity. Materials which produce significantly harmful VOCs are regulated by local, state, and national laws.

C. Ground Level Ozone: A "secondary" pollutant that is produced when nitrogen oxides and VOCs (primary pollutants) react with sunlight and stagnant air. Ozone in the lower atmosphere (ground level to approximately 30,000 feet) is known as ground level ozone. Aerosol sprays contribute to the production of this pollutant.

D. Global Warming Potential: Global warming potential is a measure of how much heat a greenhouse gas traps in the atmosphere up to a specific time horizon, relative to carbon dioxide.

E. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
   1. Interior paints and coatings applied on site.
   2. Interior adhesives and sealants applied on site, including flooring adhesives.
   3. Flooring.
   4. Composite wood.
   5. Products making up wall and ceiling assemblies.
   6. Thermal and acoustical insulation.
   7. Free-standing furniture.

8. Other products when specifically stated in the specifications.

F. Interior of Building: Anywhere inside the exterior weather barrier.

G. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.

H. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

I. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
   1. Stone.
   2. Concrete.
   3. Clay brick.
   4. Metals that are plated, anodized, or powder-coated.
   5. Glass.
   6. Ceramics.
   7. Solid wood flooring that is unfinished and untreated.

J. Hazardous Materials: Pesticides, biocides, and carcinogens as listed by recognized authorities, such as the Environmental Protection Agency (EPA), the International Agency for Research on Cancer (IARC) or regulated under OSHA Hazard Communication Standard, 29 CFR 1910.1200.

K. Harmful Materials: Materials which contain the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances; or degrade the utility of the environment for aesthetic, cultural, or historical purposes.

L. Composite Wood and Agrifiber: Products such as particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates, and door cores that are a composite of wood and / or plant material pressed and adhered together.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2018).

C. BIFMA e3 - Furniture Sustainability Standard; Business and Institutional Furniture Manufacturers Association; 2019.

D. BIFMA M7.1 - Standard Test Method for Determining VOC Emissions from Office Furniture Systems, Components, and Seating; 2011 (Reaffirmed 2021).

E. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.

F. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; Current Edition.

G. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.

H. CHPS (HPPD) - High Performance Products Database; Current Edition.

I. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.

J. GreenSeal GS-36 - Standard for Adhesives for Commercial Use; 2013.

K. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

L. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).
M. SCS (CPD) - SCS Certified Products; Current Edition.
N. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements.
B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.
   1. See Section 01 6000 - Product Requirements, for acceptable documentation.
C. Installer Certifications Regarding Prohibited Content: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of installer's products, or 2) that such products used comply with these requirements.

PART 2 PRODUCTS

2.01 PRODUCT EMISSIONS TESTING AND STANDARDS REQUIREMENTS, GENERAL

A. Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
   1. Wet-Applied Products: State amount applied in mass per surface area.
   2. Paints and Coatings: Test tinted products, not just tinting bases.
   3. Evidence of Compliance: Acceptable types of evidence are the following;
      a. Current UL (GGG) Greenguard Gold certification.
      b. Current SCS (CPD) Floorscore certification.
      c. Current SCS (CPD) Indoor Advantage Gold certification.
      d. Current listing in CHPS (HPPD) as a low-emitting product.
      e. Current CRI (GLP) certification.
      f. Test report showing compliance and stating exposure scenario used.
   4. Product data submittal showing VOC content is NOT acceptable evidence.
   5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
   6. If the applicable regulation requires subtraction of exempt compounds, any content of intentionally added exempt compounds larger than 1 percent weight by mass (total exempt compounds) shall be disclosed.
B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Report of laboratory testing performed in accordance with requirements.
      b. Published product data showing compliance with requirements.
      c. Certification by manufacturer that product complies with requirements.
C. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
   1. Evidence of Compliance: Acceptable types of evidence are:

a. Current SCS "No Added Formaldehyde (NAF)" certification.
1) Web: www.scscertified.com.
b. Report of laboratory testing performed in accordance with requirements.
c. Published product data showing compliance with requirements.

D. Flooring: Flooring shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Ceilings, Walls, and Insulation: Ceilings, walls, and thermal insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Furnishings Emissions Standard and Test Method: BIFMA e3 Sections 7.6.1 and 7.6.2, tested in accordance with BIFMA M7.1.
1. Evidence of Compliance:
a. Test report showing compliance and stating exposure scenario used.
2. Any furniture procured as part of this project must meet the Healthier Hospitals Initiative: Healthy Interiors (HHI-Healthy Interiors) standard for 100 percent of furniture, including being free of chemical flame retardants, unless required by code.

2.02 MATERIAL REQUIREMENTS, GENERAL

A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.

B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
1. Composite Wood, Wood Fiber, and Wood Chip Products: Comply with Composite Wood Emissions Standard or contain no added formaldehyde resins.
2. Furnishings: Comply with Furnishings Emissions Standard and Test Method.
3. Inherently Non-Emitting Materials.

C. VOC-Content-Restricted Products: VOC content not greater than required by the following:
1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
2. Aerosol Adhesives: GreenSeal GS-36.
3. Joint Sealants: SCAQMD 1168 Rule.
4. Paints and Coatings: Each color; most stringent of the following:
a. 40 CFR 59, Subpart D.
b. SCAQMD 1113 Rule.
c. CARB (SCM).
5. Wet-Applied Roofing and Waterproofing: Comply with requirements for paints and coatings.

2.03 ADHESIVES

A. The volatile organic compound (VOC) content of all field-applied adhesives, adhesive bonding primers, and adhesive primers used on the interior of this Project to not exceed the limits defined in Rule 1168 - "Adhesive and Sealant Applications" of the South Coast Air Quality Management District (SCAQMD), of the State of California, with a rule amendment date of October 6, 2017.

B. General: For specified building construction related applications, the allowable VOC content is as follows, measured in grams per liter (g/L), less water and less exempt compounds:

1. Architectural Applications:
   a. Building Envelope Membrane Adhesive: 250.
   b. Carpet pad adhesive: 50.
   c. Ceramic Tile Adhesive: 65.
   d. Cove Base Adhesive: 50.
   e. Gypsum Board and Panel Adhesive: 50.
   f. Multipurpose Construction Adhesive: 70.
   g. Roofing:
      1) Single-Ply Roof Membrane Adhesive: 250.
      2) All Other Roof Adhesive: 250.
   h. Rubber Floor Adhesive: 60.
   i. Structural Glazing Adhesive: 100.
   j. Structural Wood Member Adhesive: 140.
   k. Subfloor Adhesive: 50.
   l. VCT and Asphalt Tile Adhesive: 50.
   m. Wood Flooring Adhesive: 100.
   n. All Other Indoor Floor Covering Adhesives: 50.
   o. All Other Outdoor Floor Covering Adhesives: 50.
2. Specialty Applications:
   a. Contact Adhesive: 80.
   b. Edge Glue Adhesive: 250.
   c. All Other Plastic Cement:
      1) ABS Welding: 325.
      2) ABS to PVC Transition Cement: 510.
      3) PVC Welding: 510.
      4) CPVC Welding: 490.
      5) All Other Plastic Welding Cements: 250.
   d. Adhesive Primer for Plastic: 550.
   e. Special Purpose Contact Adhesive: 250.
   f. Adhesive Primer for Traffic Marking Tape: 150.
   g. Structural Wood Member Adhesive: 140.
   h. Plastic Foams: 50.
   i. Top and Trim Adhesive: 250.
3. Substrate and Specific Applications:
   a. Metal to Metal: 30.
   b. Plastic Foams: 50.
   c. Porous Material, Except Wood: 50.
   d. Wood: 30.
   e. Fiberglass: 80.
   f. Reinforced Plastic Composite: 250.
4. Other:
   a. Other Adhesives: 250.
   b. Adhesive Bonding Primers: 250.
   c. Adhesive Primers, or Any Other Primers: 250.
5. Adhesive Primers:
   a. Plastic: 550.
   b. Pressure-Sensitive: 785.
   c. Traffic Marking Tape: 150.

d. All Other Adhesive Primers: 250.

2.04 SEALANTS

A. The volatile organic compound (VOC) content of all field-applied adhesives, adhesive bonding primers, sealant primers and sealants used on the interior of this Project to not exceed the limits defined in Rule 1168 - "Adhesive and Sealant Applications" of the South Coast Air Quality Management District (SCAQMD), of the State of California, with a rule amendment date of October 6, 2017.

B. General: For specified building construction related applications, the allowable VOC content is as follows, measured in grams per liter, less water and less exempt compounds:
   1. Sealants:
      a. Clear, Paintable, and Immediately Water-Resistant Sealant: 280.
      b. Foam Insulation and Sealant: 250.
      c. Grout Sealant: 65.
      d. Non-Staining Plumbing Putty: 150.
      e. Potable Water Sealant: 100.
      f. Roofing:
         1) Single-Ply Roofing Membrane Sealant: 450.
         2) Other Roofing Sealant: 300.
   2. Sealant Primer:
      a. Architectural, Nonporous: 250.
      b. Architectural, Porous: 775.
      c. Modified Bituminous: 500.
      d. Other: 750.

2.05 PAINT AND COATINGS

A. VOC Content Requirements for Wet Applied Products: All paint and coatings wet-applied on site must meet the applicable VOC limits of the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective February 5, 2016.

B. Product specific requirements are as follows, measured in grams per liter, less water and less exempt compounds:
   1. Paint:
      a. Flat: 50.
      b. Non-Flat: 100.
      c. Non-Flat High-Gloss: 150.
   2. Coatings:
      a. Aluminum Roof Coatings: 400.
      b. Basement Specialty Coatings: 400.
      c. Roofing:
         1) Bituminous Roof Coatings: 50.
         2) Bituminous Roof Primers: 350.
         3) Roof Coatings: 50.
      d. Bond Breakers: 350.
      e. Building Envelope Coatings: 50.
      f. Clear Wood Finish:
         1) Varnish: 275.
         2) Sanding Sealers: 275.

3) Lacquer: 275.
g. Concrete Curing Compounds: 100.
h. Concrete / Masonry Sealers: 100.
i. Concrete Surface Retarders: 50.
j. Dry Fog Coatings: 50.
k. Faux Finishing Coatings:
1) Clear Topcoat: 100.
2) Decorative Coatings: 350.
3) Glazes: 350.
4) Japan: 50.
l. Fire-Resistive Coatings: 150.
m. Floor Coatings: 50.
n. Form-Release Compounds: 100.
o. Graphic Arts Coatings / Sign Paints: 200.
p. High-Temperature Coatings: 420.
q. Industrial Maintenance Coatings: 100.
1) Color-Indicating Safety Coatings: 480.
2) High-Temperature IM Coatings: 420.
3) Non-Sacrificial Anti-Graffiti Coatings: 100.
4) Zinc-Rich IM Primers: 100.
r. Low-Solids Coatings: 120.
s. Magnesite Cement Coatings: 450.
t. Mastic Texture Coatings: 100.
u. Metallic Pigmented Coatings: 150.
v. Multi-Color Coatings: 250.
w. Pre-Treatment Wash Primers: 420.
x. Primers, Sealers, and Undercoaters: 100.
y. Reactive Penetrating Sealers: 350.
z. Recycled Coatings: 250.
aa. Rust-Preventative Coatings: 100.
bb. Sacrificial Anti-Graffiti Coatings: 50.
cc. Shellacs:
1) Clear: 730.
2) Opaque: 550.
dd. Specialty Primers, Sealers, and Undercoaters: 50.
ee. Stains: 250.
ff. Stone Consolidants: 450.
gg. Swimming Pool Coatings: 340.
hh. Tile and Stone Sealers: 100.
ii. Traffic Marking Coatings: 100.
jj. Tub and Tile Refinish Coatings: 420.
kk. Waterproofing Membranes: 250.
ll. Waterproofing Sealers: 100.
mm. Waterproofing Concrete / Masonry Sealers: 100.
nn. Wood Coatings: 275.
oo. Wood Preservatives: 350.
pp. Zinc-Rich Primers: 340.

2.06 WOOD

A. Composite Wood: Use no-added-formaldehyde (NAF) or ultra-low-emitting formaldehyde (ULEF) resins.

2.07 TOXIC AND HAZARDOUS MATERIALS TO AVOID

A. Asbestos and Lead, General:
   1. No materials may be used in this project or in any tools, devices, clothing or equipment used to affect this construction that contain asebestos or lead-based paint. All work or materials found to contain asbestos or lead-base paint, or material installed with asbestos containing equipment or lead-base paint will be immediately rejected and this work will be removed by a certified EPA hazard material Contractor under the supervision of a certified hazard material consultant at no additional cost to Owner.
   2. Contractor and subcontractors shall certify that no asbestos containing materials and no lead-base paint were used in this project. Certification letter must be addressed to Owner, including project and Contractors' information; to be notarized.

B. Avoid the use of the following toxic and hazardous materials. Refer to Definitions article above.
   1. Asbestos: No products containing asbestos.
   2. Lead: Products containing lead content, including older or flux containing not more than 0.25 percent lead in wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures, and 0.20 percent for solder or flux used in plumbing for water intended for human consumption.
   3. Mercury:
      a. No new mercury containing thermometers, switches and electrical relays.
      b. All lamps compliant with low-mercury limits.
         1) Illuminated exit signs only use Light-Emitting Diode (LED) or Light-Emitting Capacitor (LEC) lamps.
      c. No mercury vapor or probe-start metal halide high intensity discharge lamps.
   4. Added Urea-Formaldehyde: Prefabricated wood products, composite wood, and agrifiber products to contain no added urea-formaldehyde resins.
      a. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins.
   5. Sealants: Provide products that comply with specified VOC limits. Refer to Section 07 9200 - Joint Sealants, for additional requirements.
      a. Sealants containing aromatic solvents, fibrous talc, formaldehyde, halogenated solvents, mercury, lead, cadmium, chromium and their compounds, are not permitted.
   6. Avoid the use of the following products: butyl rubber, solvent acrylic, neoprene, styrene butadiene rubber, and nitril.
   7. Avoid the use of products containing CFC's or HCFC's.

2.08 TOXIC AND HAZARDOUS MATERIALS TO LIMIT

A. Limit the use of the following toxic and hazardous materials. Refer to Definitions article above.
   1. Halogenated and Organophosphorous Flame Retardants: Limit to 100ppm in the following categories to the extent allowable by local code:
      a. Window and waterproofing membranes, door and window frames and siding.
      b. Flooring, ceiling tiles and wall coverings.
      c. Piping and electrical cables, conduits and junction boxes.

2. Phthalate (Plasticizers): DEHP, DBP, BBP, DINP, DIDP or DNOP (often found in polyvinyl chloride PVC) are limited in the following components to 0.01 percent (100 ppm):
   a. Flooring, including resilient and hard surface flooring and carpet.
   b. Wall coverings, window blinds and shades, shower curtains, furniture and upholstery.
   c. Plumbing pipes.
   d. Moisture barriers.
3. Isocyanate-Based Polyurethane: Not to be used in interior finishes.
4. Urea-Formaldehyde: Limited to 100 ppm in the following components:
   a. Furniture.
   b. Composite wood products.
   c. Laminating adhesives and resins.
   d. Thermal insulation.
5. Perfluoroalkyl and polyfluoroalkyl substances (such as stain and water repellants).
6. Antimicrobials.
7. Fly ash.
8. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements.

B. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.

C. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION

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SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.
B. Requirements for alterations work, including selective demolition.
C. Pre-installation meetings.
D. Cutting and patching.
E. Surveying for laying out the work.
F. Cleaning and protection.
G. Protection of installed work.
H. Starting of systems and equipment.
I. Final cleaning.
J. Demonstration and instruction of Owner personnel.
K. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
L. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
B. Section 01 3000 - Administrative Requirements: Submittals procedures, additional meetings not specified here.
C. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
D. Section 01 7900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections
E. Section 07 8400 - Firestopping.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
    1. On request, submit documentation verifying accuracy of survey work.
    2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
    3. Submit surveys and survey logs for the project record.
C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
    1. Structural integrity of any element of Project.

2. Integrity of weather exposed or moisture resistant element.
3. Efficiency, maintenance, or safety of any operational element.
4. Visual qualities of sight exposed elements.
5. Work of Owner or separate Contractor.

D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.04 QUALIFICATIONS

A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

1.05 PROJECT CONDITIONS

A. Perform dewatering activities, as required, for the duration of the project.
   1. See Section 01 5000 - Temporary Facilities and Controls for additional information.

B. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

C. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
   1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
      a. See Section 01 5000 - Temporary Facilities and Controls for additional information.

D. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

E. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

F. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.06 COORDINATION

A. See Section 01 1000 for occupancy-related requirements.

B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

C. Notify affected utility companies and comply with their requirements.

D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations. Furnish information to local uitlity and Owner where necessary to adjust, move, or relocate existing utilities and appertenances.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Architect four days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, Owner's Representative, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

F. Utilize recognized engineering survey practices.

G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.

H. Periodically verify layouts by same means.

I. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

A. Drawings showing existing construction and utilities are based on existing record documents and digital scan of spaces.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.

C. Remove existing work as indicated and as required to accomplish new work.
1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
2. Remove items indicated on drawings.
3. Relocate items indicated on drawings.
4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
    a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
    b. Provide temporary connections as required to maintain existing systems in service.
4. Verify that abandoned services serve only abandoned facilities.
5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

E. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.

F. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.

G. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

H. Clean existing systems and equipment.

3.07 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-complying work.

C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

D. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

F. Restore work with new products in accordance with requirements of Contract Documents.

G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.

I. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

1.02 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

1.03 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

1.04 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

D. Verify that wiring and support components for equipment are complete and tested.

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

1.05 DEMONSTRATION AND INSTRUCTION

A. See Section 01 7900 - Demonstration and Training.

1.06 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

1.07 FINAL CLEANING

A. Use cleaning materials that are nonhazardous.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

E. Clean filters of operating equipment.

F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.

G. Clean site; sweep paved areas, rake clean landscaped surfaces.

H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

1.08 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.

B. Substantial Completion
   1. Prepare and submit a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
      a. Advise Owner of pending insurance changeover requirements.
      b. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
      c. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
      d. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
      e. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
      f. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
      g. Complete startup testing of systems.
      h. Submit test/adjust/balance records.
      i. Complete commissioning requirements.
      j. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
      k. Advise Owner of changeover in heat and other utilities.
      l. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
      m. Complete final cleaning requirements, including touchup painting.
   2. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
      a. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
   3. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
   4. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

C. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect and Owner's Representative.

D. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

1.09 **FINAL COMPLETION**

A. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

B. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

C. Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment.
2. Submit copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), certified by the Contractor, stating that each item has been completed or otherwise resolved for acceptance. This inspection list will be reviewed and dated by Architect and Owner's Representative.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Coordinate and provide training to Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
    a. Submit demonstration and training video recordings.

D. Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will notify Contractor of construction that must be completed or corrected.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Following completion of all final inspection items, Contactor shall prepare and submit a final Certificate for Payment.
3. Owner may proceed with preparation of Notice of Final Completion.

1.10 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

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SECTION 01 7419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements for management and disposal of construction waste, including waste management plan.

1.02 WASTE MANAGEMENT REQUIREMENTS

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
   1. Provide containers with lids. Remove trash from site periodically.
   2. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

B. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

C. Owner requires that this project generate the least amount of trash and waste possible.
   1. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
   2. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
   1. Aluminum and plastic beverage containers.
   2. Corrugated cardboard.
   3. Wood pallets.
   4. Clean dimensional wood.
   5. Land clearing debris, including brush, branches, logs, and stumps.
   6. Concrete: May be crushed and used as riprap, aggregate, sub-base material, or fill.
   7. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
   8. Glass.
   9. Gypsum drywall and plaster.
   10. Carpet, carpet cushion, carpet tile, and carpet remnants, both new and removed: DuPont (http://flooring.dupont.com) and Interface (www.interfaceinc.com) conduct reclamation programs.
   11. Paint.
   12. Plastic sheeting.
   13. Rigid foam insulation.

E. Contractor Reporting Responsibilities: Submit periodic Waste Disposal Reports; report landfill disposal, incineration, recycling, salvage, and reuse regardless of to whom the cost or savings accrues; use the same units of measure on required reports.

F. Develop and follow a Waste Management Plan designed to implement these requirements.

G. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.
   2. Burying on the project site.
   3. Dumping or burying on other property, public or private.
   4. Other illegal dumping or burying.

H. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.03 RELATED REQUIREMENTS

A. Section 01 2500 - Substitution Procedures.

B. Section 01 7000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

1.04 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements.

B. Waste management plan.

C. Waste disposal records.

1.06 WASTE MANAGEMENT PLAN

A. Submit Waste Management Plan within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner; submit projection of all trash and waste that will require disposal and alternatives to landfilling.

B. Waste Management Plan: Include the following information:
   1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
   2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
   3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
   4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
   5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
   6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.

1.07 WASTE DISPOSAL REPORTS

A. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
   1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
   2. Submit Report on a form acceptable to Owner.
   3. Landfill Disposal: Include the following information:
      a. Identification of material.
      b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
      c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   4. Incinerator Disposal: Include the following information:
      a. Identification of material.
      b. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
      c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.

d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.

5. Recycled and Salvaged Materials: Include the following information for each:
   a. Identification of material, including those retrieved by installer for use on other projects.
   b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
   c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
   d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
6. Material Reused on Project: Include the following information for each:
   a. Identification of material and how it was used in the project.
   b. Amount, in tons or cubic yards.
   c. Include weight tickets as evidence of quantity.
7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

B. Recycling Incentive Programs:
   1. Where revenue accrues to Contractor, submit copies of documentation required to qualify for incentive.
   2. Where revenue accrues to Owner, submit any additional documentation required by Owner in addition to information provided in periodic Waste Disposal Report.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Universal Waste Disposal: Meet requirements of CA GBC 5.408.2.

B. Excavated Soil and Land Clearing Debris: Meet requirements of CA GBC 5.408.3.

2.02 PRODUCT SUBSTITUTIONS

A. See Section 01 6000 and Section 01 2500.

B. For each proposed product substitution, submit the following information in addition to requirements specified in Section 01 6000:
   1. Relative amount of waste produced, compared to specified product.
   2. Cost savings on waste disposal, compared to specified product, to be deducted from the Contract Price.
   3. Proposed disposal method for waste product.
   4. Markets for recycled waste product.

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.
   1. Prebid meeting.
   2. Preconstruction meeting.
   3. Regular job-site meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
   1. Provide containers as required.
   2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
   3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

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SECTION 01 7800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.

B. Operation and maintenance data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Specific requirements for operation and maintenance data.

D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal requirements.

B. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

C. Operation and Maintenance Data:
   1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   2. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   3. Submit two sets of revised final documents in final form within 10 days after final inspection.

D. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   3. Field changes of dimension and detail.
   4. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.

2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
1. Description of unit or system, and component parts.
2. Identify function, normal operating characteristics, and limiting conditions.
3. Include performance curves, with engineering data and tests.
4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

E. Provide servicing and lubrication schedule, and list of lubricants required.

F. Include manufacturer's printed operation and maintenance instructions.

G. Include sequence of operation by controls manufacturer.

H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

I. Provide control diagrams by controls manufacturer as installed.

J. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

K. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

L. Include test and balancing reports.

M. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

J. Arrangement of Contents: Organize each volume in parts as follows:
   1. Project Directory.
   2. Table of Contents, of all volumes, and of this volume.
   3. Operation and Maintenance Data: Arranged by system, then by product category.
      a. Source data.
      b. Product data, shop drawings, and other submittals.
      c. Operation and maintenance data.
      d. Field quality control data.
      e. Photocopies of warranties and bonds.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Include photocopies of each in operation and maintenance manuals, indexed separately on Table of Contents.

END OF SECTION

SECTION 017800.01

WARRANTY/GUARANTEE FORM – NOTICE OF COMPLETION

FOR _____ WORK

We, the undersigned, do hereby warranty and guaranty that the parts of the work described above which we have furnished or installed for:

Project Name: Inglewood Library and Innovative Center Renovation

Owner: City of Inglewood

Location: _____

are in accordance with the Contract Documents and that all said work as installed will fulfill or exceed all the Warranty and Guaranty requirements. We agree to repair or replace work installed by us, together with any other work which is displaced or damaged by so doing that proves to be defective in workmanship, material, or operation within a period of:

_____

from the date of filing of the Notice of Completion, ordinary wear and tear and unusual neglect or abuse excepted.

In the event of our failure to comply with the above-mentioned conditions within a reasonable time period determined by the Owner, after notification in writing, we, the undersigned, all collectively and separately, hereby authorize the Owner to have said defective work repaired and/or replaced and made good, and agree to pay to the Owner upon demand all monies that the owner may expend in making good said defective work, including all collection costs and reasonable attorney fees.

Date: _____

(Insert Name of Contractor)	(Insert Name of Subcontractor, Sub-Subcontractor, Manufacturer or Supplier)
Signature: _____	Signature: _____
Name: _____	Name: _____
Title: _____	Title: _____
State License No: _____	State License No: _____

Local Representative: For Maintenance, Repair, or Replacement Service, Contact:

Name: _____

Address: _____

Phone Number: _____

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SECTION 01 7900
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance is required for:
   1. All software-operated systems.
   2. HVAC systems and equipment.
   3. Plumbing equipment.
   4. Electrical systems and equipment.
   5. Conveying systems.
   6. Landscape irrigation.
   7. Items specified in individual product Sections.

C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
   1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
   2. Finishes, including flooring, wall finishes, ceiling finishes.
   3. Fixtures and fittings.
   4. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

A. Section 01 7800 - Closeout Submittals: Operation and maintenance manuals.

B. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.

B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit to Architect for transmittal to Owner.
   2. Submit not less than four weeks prior to start of training.
   3. Revise and resubmit until acceptable.
   4. Provide an overall schedule showing all training sessions.
   5. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such a slides, hand-outs, etc.

h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
1. Include applicable portion of O&M manuals.
2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
3. Provide one extra copy of each training manual to be included with operation and maintenance data.

1.04 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.

C. Demonstration may be combined with Owner personnel training if applicable.

D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
1. Perform demonstrations not less than two weeks prior to Substantial Completion.
2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.

B. Conduct training on-site unless otherwise indicated.

C. Owner will provide classroom and seating at no cost to Contractor.

D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.

E. Provide training in minimum two hour segments.

F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.

G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
   1. The location of the O&M manuals and procedures for use and preservation; backup copies.
   2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
   3. Typical uses of the O&M manuals.

I. Product- and System-Specific Training:
   1. Review the applicable O&M manuals.
   2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
   3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
   4. Provide hands-on training on all operational modes possible and preventive maintenance.
   5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
   6. Discuss common troubleshooting problems and solutions.
   7. Discuss any peculiarities of equipment installation or operation.
   8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
   9. Review recommended tools and spare parts inventory suggestions of manufacturers.
   10. Review spare parts and tools required to be furnished by Contractor.
   11. Review spare parts suppliers and sources and procurement procedures.

J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

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SECTION 01 9113
COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. This work contributes to 2019 California Green Building Standards Code (CALGreen), and T-24 part 6.

B. Commissioning is a systematic quality-controlled process to provide documented confirmation that building systems perform according to the criteria set forth in the design intent and satisfy the owner's operational needs. This is achieved in the design phase by documenting design intent and continues through construction, acceptance, and the warranty period with actual verification of performance. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training.

C. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

D. The Owner has the required level of training and documentation to operate the building efficiently. This section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.

1.02 GENERAL

A. The commissioned systems will be required to be installed and operate in accordance with:
   1. The manufacturer's recommendations.
   2. The Contract Documents.
   3. The Commissioning Authority's Pre-Functional Checklists, Functional Test forms and procedures.

B. The commissioning process will include verification of the following processes:
   1. Pre-Functional Checking.
   2. Test & Balance results.
   3. Functional Testing.
   4. Owner Training.

C. The commissioning process will include verification of the following documents:
   1. Owners Project Requirements.
   2. Basis of Design.
   3. Contract Documents.
   4. Submittals.
   5. Pre-Functional Checklists.
   6. Test & Balance report.
   7. Training plan.

1.03 SCOPE OF WORK

A. The commissioning process will include, but is not limited to, the following systems:
   1. Mechanical Systems

a. Air Handling Unit
b. Boiler
c. Building Automation System
d. Fan (Exhaust)
e. Pumps
f. Split System
g. Terminal Unit – VAV (Cooling + Heating + DCV)

2. Electrical Systems
   a. Lighting (Exterior)
   b. Lighting (Interior)
3. Plumbing Systems
   a. Water Heater (Gas Storage + Pump)
   b. Water Heater (Tankless Electric)
4. Landscape Irrigation Systems
   a. Landscape Irrigation

1.04 RELATED SECTIONS

A. Division 01 Specification Sections.

B. Division 22 Specification Sections.

C. Division 23 Specification Sections.

D. Division 26 Specification Sections.

E. Related Documents:
   1. OPR, BOD, Cx Plan (for reference only).

1.05 RESPONSIBILITIES

A. The Commissioning Team includes the following members:
   1. Owner (or Owner Representative).
   2. Construction Manager.
   3. Project Manager.
   4. Commissioning Authority.
   5. Design Team.
   6. Contractor.
   7. Sheet Metal Subcontractor.
   8. Test & Balance Subcontractor.
   9. DDC Systems Programmer.
   10. Boiler Suppler Star-Up Technician.
   11. BAS/Controls Subcontractor.
   12. Manufacturer Representative for specialized equipment or systems.
   13. Electrical Subcontractor Representative: (the following are a listing of major suppliers & their personnel to the Electrical Subcontractor who must play a significant part in the Cx Process).
      a. Lighting Control System Integrator Technician and/or Manufacturer Technician.
   14. Others who might be deemed essential by the Commissioning Authority.

B. Owner will:
   1. Assist with the preparation of the Owners Project Requirements.
   2. Make timely decisions where required.

3. Be available for and participate in commissioning meetings as needed.
4. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
5. Complete CALGreen closeout documentation as required.

C. Owner's Project/Construction Manager will:
1. Assist the Owner.
2. Make timely decisions where required.
3. Be available for commissioning meetings as needed.
4. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
5. CompleteCALGreen closeout documentation as required.

D. Commissioning Authority will:
1. Not be responsible for the design concept, design criteria, design intent, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The
2. Observe and document performance, that systems are functioning in accordance with the documented design intent and in accordance with the contract documents.
3. Coordinates and directs the commissioning activities.
4. Coordinate the commissioning work and, with the GC and PM, ensure that commissioning activities are being scheduled in the master schedule.
5. Review the Contract Documents.
6. Conduct 1 review of contractor submittals.
7. Create, edit, distribute, and manage portions of the commissioning process within Cx Alloy.
8. Submit commissioning status reports to the Owner.
9. Attend site meetings, as necessary, to obtain information on construction progress.
10. Conduct commissioning meetings.
11. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
12. Perform site visits to observe component and system installations.
13. Attend site to verify completed Pre-Functional Checklists.
14. Coordinate the resolution of non-compliance and deficiencies.
15. Attend site to witness Functional Testing.
16. Verify outcomes of commissioning tests and approve tests when completed.
17. Compile and maintain a commissioning record and building systems book(s).
18. Review, approve and provide comments to the training plan.
19. Analyze functional performance logs and monitoring data.
20. Provide a final commissioning report to the Owner.
21. Produce Current Facility Requirements for inclusion in Systems Manual.
22. Provide Systems Manual for commissioned systems.

E. Design Team will:
1. Design and document the building and services in response to the Owner Project Requirements.
2. Prepare, issue, and update the Basis of Design throughout the project as needed.
3. Accept invite, log-in, review and respond to items within Cx Alloy as required by the Commissioning Authority.
4. Attend and participate in commissioning meetings.
5. Include specific commissioning requirements in the contract documents.

6. Provide any design narrative and sequence documentation requested by the Commissioning Authority. The designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
7. Work with the Commissioning Authority to resolve design, documentation, and operational issues.
8. Review construction and issue punch lists when required.
9. Issue all document revisions and construction bulletins to the Commissioning Authority.
10. Approve equipment submittals prior to distribution to the Commissioning Authority.
11. Approve Testing and Balancing reports prior to distribution to the Commissioning Authority.
12. Participate in Functional Testing when required.
13. Provide assistance and documentation as required for the systems manual.
14. Complete CALGreen compliance forms.

F. Contractor will:
1. Provide all labor, instrumentation, tools, or the use of tools to start-up, check out and functionally test equipment and systems.
2. Follow the commissioning plan.
3. Attend commissioning meetings.
4. Accept invite, log-in, review and respond to issues, complete checklists and tests within Cx Alloy as required by the Commissioning Authority.
5. Upload O&Ms, startup reports, TAB reports and any other necessary documents to Cx Alloy.
6. Attend testing, adjusting, and balancing review and coordination meetings.
7. Analyze specified products and verify that the designer has specified the newest most updated equipment reasonable for this project's scope and budget.
8. Provide submittals for systems to be commissioned to the Engineer of Record for approval. The approved submittals will then be issued to the CxA for development of PFC and FT forms.
9. Provide Commissioning Authority with equipment manufacturer start-up reports and upload to Cx Alloy.
10. Included detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
11. Provide measuring instruments and logging devices to record test data and provide data acquisition equipment to record data for the complete range of testing for the required test period.
12. Provide information requested by Commissioning Authority regarding equipment sequence of operation and testing procedures including final calibration point to point reports.
13. Coordinate all commissioning activities with the Building Owner with special attention to those tasks that will impede building access for other building occupants, create fumes, noise etc. that may be objectionable the Owner or other building occupants.
14. Coordinate all commissioning activities with any Utility Company whose systems may see significant or abnormal changes in load or usage prior to proceeding with such testing.
15. Coordinate with the Commissioning Authority to provide ten (10) day advance notice so that the witnessing of equipment and system start-up and testing can begin.
16. Notify the Commissioning Authority a minimum of ten (10) days in advance of the time for start of the testing and balancing work. Attend the initial testing and balancing meeting for review of the official testing and balancing procedures.

17. Execute, document, and submit Pre-Functional Checklists for all systems to be commissioned for approval. Complete paper or electronic checklists as work is completed and provide to the Commissioning Authority on a weekly basis in Cx Alloy.
18. Review test procedures for equipment installed by factory representatives.
19. Provide input on Functional Test scripts.
20. Contractors shall pre-test all systems and equipment using functional test scripts prior to formal testing in presence of Commissioning Authority. Contractors shall provide filled in functional test forms to Commissioning Authority.
21. The Contractor will advise the Commissioning Authority of TAB Work that is incomplete or of obligations that have not been fulfilled but are required for Acceptance in accordance with the Contract Documents.
22. If engineer of record has approved certified TAB report with no comments, submit certified TAB report to the Commissioning Authority minimum of (5) days prior to the start date of TAB verification.
23. If engineer of record has not approved certified TAB report because of comments (issues i.e. air shortage, missing reads, equipment excluded) complete corrections and resubmit certified TAB report to the Commissioning Authority (3) days prior to the start date TAB verification. Handwritten copy is acceptable provided all issues have been resolved.
24. TAB verification and mechanical functional testing cannot be started in the event the TAB report has not been received / reviewed by the Engineer of Record or Commissioning Authority.
25. Participate in verification of the final test and balance report, which will consist of repeating measurements contained in the testing and balancing reports.
26. Assist in diagnostic purposes when directed.
27. Provide written notification to the CM/PM/GC and Commissioning Authority that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.
28. Provide desk space in close proximity to utility, data and specialized software services that will record, trend, and Provide utility services required for the commissioning process.
29. Analyze components and systems that are identified as required for the commissioning process. A computer station to use during commissioning shall be set up on site to access building automation system and any individual sub-system servers to allow viewing of trending, alarms etc. during the commissioning process.
30. Assist in and execute Functional Tests for verification by the Commissioning Authority.
31. Include all special tools and instruments (only available from Vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price, except for stand-alone data logging equipment that may be used by the Commissioning Authority.
32. Cooperate with the Commissioning Authority for resolution of issues recorded in the issues log.
33. Review and accept pre-functional checklists provided by the Commissioning Authority.
34. Issue deficiency reports for any systems or equipment that is not in compliance with Contract Documents.
35. Resolve system deficiencies identified during the commissioning process.
36. Execute all re-testing of deficient equipment and systems.
37. Provide trend logs in graphical format from the building automation system to the Commissioning Authority for review and approval. This includes prior to, during, and after functional testing.
38. Submit an Owner training plan to the Commissioning Authority for review and approval.
39. Participate in, and schedule vendors and contractors to participate in Owner Operation & Maintenance training for the Owner’s operating personnel.

40. Provide Operation & Maintenance manuals to the Commissioning Authority for review and provide approved manuals to the Owner.
41. Provide as-built control sequences, control diagrams, system diagrams, maintenance schedules and construction drawings for inclusion in the systems manual.
42. Assist with the preparation of systems manuals.
43. The Contractor will ensure the subcontractors are responsible for the above as well as the following:
    a. The Contractor will ensure the subcontractors' vendors are involved and participate as required by the Commissioning Authority.
    b. Participate in Pre-Construction Commissioning Orientation meeting that will review procedures, testing, and demonstration requirements.
    c. Conduct and participate in Construction-Phase Commissioning Coordination meetings.
    d. Develop and continually update and track schedule for specified submittals.
    e. Submit specified technical data, including start-up checklists and functional test procedures for each piece of major equipment.

1.06 ABBREVIATIONS AND DEFINITIONS

A. Abbreviations
1. A/E: Architect and Design Engineers
2. BAS: Building Automation System
3. BOD: Basis of Design
4. Cx: Commissioning
5. CxA: Commissioning Authority
6. CC: Controls Contractor
7. CD: Contract Documents
8. CM: Construction Manager
9. DD: Design Develop Documents
10. EC: Electrical Contractor
11. FT: Functional Test
12. GC: General Contractor (Prime)
13. LC: Landscape Irrigation Contractor
14. MC: Mechanical Contractor
15. OPR: Owner Project Requirements
16. O&M: Operations and Maintenance
17. OR: Owner's Representative
18. PFC: Pre-Functional Checklist
19. PC: Plumbing Contractor
20. PM: Project Manager (of the Owner)
21. SUBS: Subcontractor to General Contractor
22. TAB: Testing, Adjusting and Balancing

B. Definitions
1. Approval: Acceptance that a document/piece of equipment/system has been properly prepared/installed/tested and is complaint with the requirements of the Contract Documents.
2. Architect/Engineer (A/E): The prime consultant (Architect) and sub-consultants who comprise the design team, generally the HVAC mechanical design/engineer and the electrical design/engineer.
3. Basis of Design (BOD): A document that records concepts, calculations, decisions, and

product selection used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

4. Commissioning Authority (CxA): An independent agent, not otherwise associated with the A/E team members or the Contractor, hired by the Owner. The CxA directs and coordinates the day-to-day commissioning activities. The CxA does not take an oversight role like the CM. The CxA is part of the Construction Manager (CM) team or shall report directly to the CM.
5. Commissioning Plan (Cx Plan): A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
6. Cx Alloy (Online Commissioning Tool): Cx Alloy is an online commissioning tool used to facilitate the commissioning process. It is used as a platform to host the commissioning plan, commissioning spec, design reviews, site observations, meeting minutes, project files, issue logs, pre-functional checklists, functional tests and all things commissioning related. Each person that is a part of the commissioning team will be required to log in to Cx Alloy in order to stay up to date with commissioning activities, respond to issues, complete pre-functional checklists, comment on functional test scripts, upload all necessary commissioning documents and track progress of equipment being commissioned.
    a. Also available from Cx Alloy is an application for smart phones that allows users to respond to issues and complete pre-functional checklists.
7. Data Logging: Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone data loggers separate from the control system.
8. Deferred Functional Tests: FT's that are performed later, after substantial completion, due to partial occupancy, equipment performed.
9. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).
10. Factory Testing: Testing of equipment on-site or at the factory, by factory personnel with an Owner's Representative present.
11. Functional Test (FT): Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g. the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The CxA develops the functional test procedures in a sequential written form, coordinates, oversees and documents that actual testing, which is usually performed by the installing contractor or vendor. FTs are performed after pre- functional checklists and startup are complete.
12. Functional Testing Prerequisites: A list of items that need to be provided/completed prior to the start of functional testing.
13. General Contractor (GC): The prime contractor for this project. Generally, refers to all the GC's subcontractors as well. Also referred to as the contractor, in some contexts.
14. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.
15. Non-Compliance: See Deficiency.

16. Non-Conformance: See Deficiency.
17. Over-written Value: Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50F to 75F to verify economizer operation). See also “Simulated Signal.”
18. Owner's Project Requirements (OPR): A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
19. Phased Commissioning: Commissioning (functional testing) that is completed in phases (by floors, for example) due to the size of the building or other scheduling issues, in order to minimize the total construction time.
20. Pre-Functional Checklist (PFC): A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CxA to the Sub. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system). The word pre-functional refers to before functional testing. Pre-functional checklists augment and are combined with the manufacturer’s start-up checklist. Even without a commissioning process, contractors typically perform some, if not many, of the pre-functional checklist items a CxA will recommend. However, few contractors document in writing the execution of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own.
21. Sampling: Functionally testing a fraction of the total number of identical or near identical pieces of equipment.
22. Seasonal Performance Tests: FT’s that are deferred until the system(s) will experience conditions closer to their design conditions.
23. Simulated Condition: Condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).
24. Simulated Signal: Disconnecting a sensor and using a signal generator to send an amperage, resistance, or pressure to the transducer and DDC system to simulate a sensor value.
25. Startup: The initial starting or activating of dynamic equipment, including executing pre-functional checklists.
26. Subs: The subcontractors to the GC who provide and install building components and systems.
27. Test Procedures: The step-by-step process, which must be executed to fulfill the test requirements. The CxA develops the test procedures.
28. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures. The test requirements are specified in the Contract Documents.
29. Trending: Monitoring using the building automation system
30. Vendor: Supplier of equipment.
31. Warranty Period: Warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.07 COORDINATION

A. Commissioning Team:

1. The members of the commissioning team consist of the Commissioning Authority (CxA), the Owner, the designated representative of the owner's Project Management firm (PM), the General Contractor (GC or Contractor), the Architect and Design Engineers (A/E), the Mechanical Contractor (MC), the Electrical Contractor (EC), the TAB representative, the Controls Contractor (CC), and any other installing subcontractors or suppliers of equipment. If known, the Owner's building or plant operator/engineer is also a member of the commissioning team.
2. Management: The Architect hires the CxA directly. The CxA directs and coordinates the commissioning activities and reports to the Architect. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.
3. Scheduling: The CxA will work with the CM and GC according to established protocols to schedule the commissioning activities. The CxA will provide sufficient notice to the CM and GC for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

1.08 SUBMITTALS

A. Commissioning Work Products:
1. The commissioning process generates a number of written work products during construction that are to be submitted to the CxA as described in Division specifications and sections specifying related equipment. The written products to be developed by the Contractor and uploaded to Cx Alloy are:
2. Revised construction schedule including commissioning tasks.
3. Equipment submittals for all commissioned systems.
4. Sequences of Operation for all commissioned systems.
5. Control diagrams and computer graphics.
6. Final Testing and Balancing report.
7. Energy Code Compliance Forms – if applicable.
8. Pre-Functional Checklists for all commissioned systems.
9. Equipment Manufacturer start-up reports.
10. Commissioning deficiency Reports.
11. Manufacturer installation, Operation and Maintenance manuals for commissioned systems.
12. Trend logs (in CSV format) from the controls system.
13. Training plan/agenda & sign-in sheets for commissioned systems.
14. As-built control sequences, control diagrams, system diagrams, maintenance schedules and construction drawings for inclusion in the systems manual.
15. The CxA will review and comment on all documents relating to the commissioned equipment and commissioning process.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. The following minimum testing equipment required for the execution of Functional Testing shall be provided by the Contractor:
1. Air temperature probes.
2. Immersion temperature probes.

3. Air pressure meter.
4. Water pressure meter.
5. Air flow hood.
6. Air relative humidity or wet bulb temperature probes.
7. Light meter.
8. Voltage meter/Amperage meters with flexible CT's.
9. Electrical power quality/disturbance meters (Dranetz or equal).
10. Electrical phase rotation meter.
11. Thermal imager & thermal imaging camera (FLIR, Fluke or equal).
12. Insulation Resistance Tester.
13. Laser distance meter.

B. The Contractor shall provide two-way radios, extension cords and ladders, as needed, to assist in the commissioning process.

C. During testing, the Contractor shall make available any room or equipment that is required for testing such as electrical or mechanical rooms. This access shall include keys, security badges or escorts for secured areas.

D. During testing, the Contractor shall provide equipment specific keys or access tools and passwords that are to be used as part of the testing process.

E. All test equipment shall be calibrated at 12-month intervals or sooner, where recommended by the manufacturer. Independent certificates of calibration or current calibration tags shall be readily available. If equipment is dropped or damaged, it shall be fixed or replaced and re-calibrated prior to use.

F. Test Equipment Sensor Tolerances (Use values listed below if not specified in mechanical drawings/specs):
1. Outside air, space air, duct air temps: 0.4°F.
2. Watt-hour, voltage & amperage: 1% of design.
3. Pressures, air, water, and gas: 3% of design.
4. Flow rates, air: 10% of design.
5. Flow rates, water: 4% of design.
6. Relative humidity: 4% of design.
7. Barometric pressure: 0.1 in. of Hg.
8. Thermal Imager Accuracy: ±2 °F or 2 % (whichever is greater).

G. Control System Instrument Calibration:
1. All sensors and gauges will be tested to verify accuracy within the specified tolerances. Contractor to provide the necessary artificial smoke/gas aerosol to demonstrate accuracy for field calibrated sensors (ex: CO, CO2).
2. All field-installed sensors, gauges, and actuators shall be calibrated per the manufacturer's recommendations.
3. Alternate calibration methods may be used, if approved by the CxA beforehand.
4. Sensors installed at the factory that are provided with calibration certification need not be field calibrated.

H. Other Testing Equipment:
1. Any required rental or purchase of test equipment, tools and instruments required for commissioning shall be included in the base bid price by the Contractor.
2. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone data logging equipment that may be used by the CxA.

3. Load banks will be required for the testing of the following areas:
    a. MDF Room
    b. IDF Rooms
    c. ATS load
    d. Generator load

PART 3 EXECUTION

3.01 MEETINGS

A. Kick-off Meeting:
    1. The CxA will schedule, plan, and conduct a commissioning Kick-Off meeting with the entire Commissioning Team. This will include the Contractor's commissioning team.

B. Commissioning Meetings:
    1. The CxA will schedule, plan, and conduct all additional commissioning meetings.
    2. Commissioning meetings will be scheduled with each Site Observation, Pre-Functional check and functional Testing site attendance.
    3. Commissioning meetings required to resolve and/or update scheduling, commissioning coordination and design issues will be held at the discretion of the CxA.
    4. All meetings will include the contractors commissioning team.

3.02 REPORTING

A. The Contractor will provide monthly reports to the Owner on the progress of commissioning, keeping the CxA informed of commissioning progress and scheduling changes.

B. Contractor will issue deficiency reports.

C. CxA will issue site observation reports.

D. CxA will issue Cx Issues Logs that record any deviations from the Contract Documents and any functional deficiencies.

E. CxA will issue a final commissioning report.

3.03 PHASED COMMISSIONING

A. The project will not require startup and initial checkout to be executed in phases.

3.04 PRE-FUNCTIONAL CHECKING

A. The Contractor shall execute pre-functional checks and document the process within Cx Alloy using the Pre-Functional Checklists provided by the CxA.

B. The Contractor shall submit completed Pre-Functional Checklists, signed, and dated where required, for approval prior to proceeding to Functional Testing.
    1. Only individuals that have direct knowledge of the system and equipment shall mark Pre-Functional Checklists completed.
    2. The Contractor shall clearly list any outstanding items that were not completed successfully.
    3. By completing the Pre-Functional Checklists in Cx Alloy the Contractor certifies to the Commissioning Authority that MEP and landscape systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

4. By completing the Pre-Functional Checklists in Cx Alloy the Contractor certifies to the Commissioning Authority that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
5. By completing the Pre-Functional Checklists in Cx Alloy the Contractor certifies that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
6. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
7. Inspect and verify the position of each device and interlock identified on checklists.
8. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
9. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

C. The Owner has contracted the CxA to attend site on one (1) occasion to verify that the Pre-Functional Checklists submitted by the Contractor are complete and reflect the site installation. If the Pre-Functional Checklists are not verified as complete the Contractor will be liable for the costs associated with achieving the required verification.

D. Pre-Functional Checking does not exclude or supersede manufacturer's start-up and checkout procedures. Such additional checks and start up procedures will form part of the commissioning documents and need to be uploaded to Cx Alloy.

E. Prior to performance of Testing, Adjusting and balancing work, provide copies of reports, sample forms, checklists, and certificates to the CxA. Upload reports to Cx Alloy.

F. Notify the CxA at least ten (10) days in advance of testing and balancing work and provide access for the CxA to witness testing and balancing work.

G. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

H. The CxA will notify testing and balancing subcontractor ten (10) days in advance of the date of field verification. Notice will not include data points to be verified.

I. The testing and balancing subcontractor shall use the same instruments (by model and serial number) that were used when original data was collected. Failure of an item includes a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report.

J. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

K. Sensor and Actuator Calibration.
1. All field-installed temperature, relative humidity, CO, CO_2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described below. Alternate methods may be used, if approved by the Owner and CxA beforehand. All test instruments shall have had a certified calibration within the last 12 months. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
2. All procedures used shall be fully documented on the pre-functional checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate, and final results.
3. Sensor Calibration Methods: All Sensors. Verify that all sensor locations are appropriate and away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or

pressure difference, make sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading, of each other, for pressure. Tolerances for critical applications may be tighter.

4. Sensors without Transmitters--Standard Application. Take a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, install offset in BAS, calibrate, or replace sensor.
5. Sensors with Transmitters--Standard Application. Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the BAS. Record all values and recalibrate controller as necessary to conform to specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, replace sensor and repeat.
6. For pressure sensors, perform a similar process with a suitable signal generator.
7. Critical Applications: For critical applications (process, manufacturing, etc.) more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.

TOLERANCES, STANDARD APPLICATIONS			
Sensor	Required Tolerance (+/-)	Sensor	Required Tolerance (+/-)
Cooling coil, chilled and Condenser water temps	0.4F	Flow rates, water Relative humidity	4% of design 4% of design
AHU wet bulb or dew point	2.0F	Combustion flue temps	5.0F
Hot water coil and boiler water temp	1.5F	Oxygen or CO_2 monitor	0.1 % pts
Outside air, space air, duct air temps	0.4F	CO_2 monitor	0.01 % pts
Watt hour, voltage & amperage	1% of design	Natural gas and oil flow rate	1% of design
Pressures, air, water, and gas	3% of design	Steam flow rate	3% of design
Flow rates, air	10% of design	Barometric pressure	in. of Hg

8. Valve and Damper Stroke Setup and Check: For all valve and damper actuator positions checked, verify the actual position against the BAS readout.
9. Set pumps or fans to normal operating mode. Command valve or damper closed, visually verify that valve or damper is closed and adjust output zero signal as required. Command valve or damper open, verify position is full open and adjust output signal as required. Command valve or damper to a few intermediate positions. If actual valve or damper position does not reasonably correspond, replace actuator, or add pilot positioner (for

pneumatics).

10. Closure for heating coil valves (NO): Set heating setpoint 20°F above room temperature. Observe valve open. Remove control air or power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Set heating setpoint to 20°F below room temperature. Observe the valve close. For pneumatics, by override in the EMS, increase pressure to valve by 3 psi (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change. Restore to normal.
11. Closure for cooling coil valves (NC): Set cooling setpoint 20°F above room temperature. Observe the valve close. Remove control air or power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Set cooling setpoint to 20°F below room temperature. Observe valve open. For pneumatics, by override in the EMS, increase pressure to valve by 3 psi (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change. Restore to normal.

L. Execution of Pre-functional Checklists and Startup: Four weeks prior to startup, the Subs and vendors schedule startup and checkout with the CM, GC and CxA. The performance of the pre-functional checklists, startup and checkout are directed and executed by the Sub or vendor. When completing Pre-Functional Checklists contractors should only complete sections assigned to them.

M. The CxA shall observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units, (in which case a sampling strategy may be used as approved by the CM). In no case will the number of units witnessed be less than ten on any 1 building, nor less than 10% of the total number of identical or very similar units.

N. For lower-level components of equipment, (e.g., VAV boxes, sensors, controllers), the CxA shall observe a sampling of the pre-functional and start-up procedures. The sampling procedures are identified in the commissioning plan and Functional Testing section within the spec.

O. The Subs and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up report, pre-functional checklists and tests uploaded to Cx Alloy.

P. Only individuals that have direct knowledge and witnessed that a line-item task on the pre-functional checklist was actually performed shall check that item. It is not acceptable for witnessing supervisors to fill out these forms.

Q. Deficiencies, Non-Conformance and Approval in Checklists and Startup.

1. The Subs shall create issues of any outstanding items of the initial start-up and pre-functional procedures that were not completed successfully, within Cx Alloy.
2. The CxA reviews the report submitted either a non-compliance report or an approval form to the Sub or Cx. The CxA shall work with the Subs and vendors to correct and retest deficiencies or in complete items. The CxA will involve all parties necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner and shall notify the CxA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CxA recommends approval of the execution of the checklists and startup of each system to the CM using a standard form.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party. Refer to Part 3.07 herein for details.

3.05 FUNCTIONAL TESTING PREREQUISITES

A. Before proceeding with Functional Testing, the following items are required to be complete as they pertain to each discipline:

1. Equipment / System startup by Manufacturer (docs uploaded to CxAlloy)
2. Controls point to point / BAS programming and graphics (including interlocking systems, debugging, loop tuning and sensor calibrations)
3. Lighting programmed according to construction documents
4. Title 24 acceptance testing (lighting)
5. Test, Adjust, and Balance (TAB)
6. TAB report sent to MEOR and CxA (min. 3 days prior to TAB verification)
7. Systems to be commissioned Punch Walk by design team
8. Systems to be commissioned Punch List (minus aesthetic items)
9. All Cx Issues Log items to date are complete / closed (in CxAlloy)
10. Functional test procedures reviewed and approved by installing contractor.
11. Pre-Functional Checklists complete
12. Equipment / Systems pretested using Functional Test forms
13. Trend logs (in CSV format) from the controls systems for review
14. Written acknowledgement from GC / contractors they are complete and ready for functional testing.
15. TAB verification successfully demonstrated in presence of CxA.

B. The testing requirements specified for commissioning are in addition to and do not replace any testing requirements specified elsewhere.

3.06 FUNCTIONAL TESTING

A. Functional Test forms are prepared by the CxA and issued to the Commissioning Team for review.

B. Functional Testing is scheduled by the Commissioning Team and managed by the CxA.

C. Functional Tests are executed by the Contractor and verified by the CxA and/or Owner.

D. The Contractor shall confirm the schedule for execution of Functional Tests at least two weeks prior to execution of any test.

E. The Contractor, relevant subcontractors and manufacturer technicians shall attend and execute the Functional Tests.

F. Provide the necessary calibrated test equipment, temporary floor reinforcing, instruments, test leads, artificial smoke/gas aerosols, tools, temporary power and lighting, handheld communication devices, appropriately skilled technicians, additional code line programming for virtual and simulation control overrides, consumable materials (lubricants, filters, gaskets, drive belts, fuses, cleaners, etc.), miscellaneous incidentals, and other material and labor as necessary to conduct the functional test.

G. The Owner and/or CxA may choose to witness the execution of any Functional Tests.

H. The CxA shall formally list any system deficiencies found during the Functional Testing on the Commissioning Issues Log.

I. The Contractor shall correct deficient or incomplete system elements in a timely manner and shall formally notify the CxA as soon as the system is ready for re-testing.

J. Any Functional Test that fails due to a deficiency will be retested by the Contractor until the Functional Test is passed.

K. The Architect has contracted the CxA to attend site to witness one (1) test attempt for each Functional Test issued by the CxA, plus four (4) hours of retesting. If the test is not passed after the allotted retest time, the Contractor will be liable for the costs associated with additional Functional Tests until the test is passed.

L. Statistical Sampling: The CxA may choose to implement statistically sampling as part of the testing procedures. The use of sampling will be confirmed prior to sampling.
   1. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. It is noted that no sampling by Subs is allowed in pre-functional checklist execution.
   2. A common sampling strategy referenced in the *Specifications* as the "xx% Sampling—yy% Failure Rule" is defined by the following example.
      a. xx = the percent of the group of identical equipment to be included in each sample.
      b. yy = the percent of the sample that if failing, will require another sample to be tested.
   3. The example below describes a 20% Sampling—10% Failure Rule.
   4. Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than ten units in each group. This 20%, or ten, constitute the "first sample."
   5. If 10% (yy) of the units in the first sample fail the functional performance tests, test another 20% of the group (the second sample).
   6. If 10% of the units in the second sample fail, test all remaining units in the whole group.

M. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

N. Functional Testing Objectives and Scope:
   1. The objective of Functional Testing is to demonstrate that each system is operating in accordance with the Contract Documents.
   2. Each system to be commissioned will be tested while operating in all modes of operation.
   3. During the testing process, areas of deficient performance will be identified and corrected.

O. Mechanical Functional Testing Outline:

AIR HANDLING UNIT			
Functions to be tested:			
Remove and restore local power	Shutdown	Overrides	Startups
Occupied / Unoccupied modes	Interlocks	Lockouts	Scheduling
Alarms	Cooling / heating	Safeties	
Sampling:			
No			
Conditions under which test shall be performed:			
Normal power			
All equipment and systems in auto			
Equipment / tools required for testing:			
As needed by contractor to demonstrate functionality			
Temperature probe (calibrated)			
Artificial smoke / spray (smoke detectors)			
Velocity Meter / Flow Hood			
Team members required to be present for testing:			
GC, MC, CC, EC, Manufacturer Technician			

BOILER	
Functions to be tested:	
Control parameters	Control
Remove and restore local power	Pump operation
Sampling:	
No	
Conditions under which test shall be performed:	
Normal power	
All equipment and systems in auto	
Equipment / tools required for testing:	
As needed by contractor to demonstrate functionality	
Thermometer (calibrated)	
Team members required to be present for testing:	
GC, MC, Manufacturer Technician	

BUILDING AUTOMATION SYSTEM (BAS)		
Functions to be tested:		
Point-to-point	Alarm management	Control parameters
Graphics	Schedule management	Workstation component verification
Trends	Device calibration	Password and access control
Power interruption	Sensor verification	Software communication
Sampling:		
No		
Conditions under which test shall be performed:		
Normal power		
Emergency power		
All equipment and systems in auto		
Operator workstation installation complete		
Equipment / tools required for testing:		
As needed by contractor to demonstrate functionality		
Temperature / Humidity probe (calibrated)		
Manufacturer's control point map		
Team members required to be present for testing:		
GC, MC, CC		

FAN (EXHAUST) (EF)			
Functions to be tested:			
Remove and restore local power	Shutdown	Lockouts	Scheduling
Occupied / Unoccupied modes	Interlocks	Safeties	
Alarms	Overrides	Startup	
Sampling:			
No			
Conditions under which test shall be performed:			
Normal power			
Emergency power			
All equipment and systems in auto			
Equipment / tools required for testing:			
As needed by contractor to demonstrate functionality			
Artificial smoke / spray (smoke detectors)			
Velocity Meter / Flow Hood			
Team members required to be present for testing:			
GC, MC, CC, EC			

PUMPS (HEATING HOT WATER, CHILLED WATER)		
Functions to be tested:		
Control parameters	Control	Shutdown
Remove and restore local power	Alarms	
Sampling:		
No		
Conditions under which test shall be performed:		
Normal power		
Emergency power		
System in auto		
Equipment / tools required for testing:		
As needed by contractor to demonstrate functionality		
Amperage meter		
Team members required to be present for testing:		
GC, MC, CC, EC, Manufacturer Technician		

SPLIT SYSTEM (DUCTED/DUCTLESS) (FC, CU)			
Functions to be tested:			
Remove and restore local power	Shutdown	Overrides	Startup
Occupied / Unoccupied modes	Interlocks	Lockouts	Scheduling
Alarms	Condensate Pump	Safeties	
Sampling:			
No			
Conditions under which test shall be performed:			
Normal power			
All equipment and systems in auto			
Equipment / tools required for testing:			
As needed by contractor to demonstrate functionality			
Temperature probe (calibrated)			
Bucket / bottle of water to fill condensate pan (pump operation)			
Velocity Meter / Flow Hood			
Team members required to be present for testing:			
GC, MC, CC, EC, Manufacturer Technician			

TERMINAL UNIT – VAV (COOLING + HEATING + DCV)			
Functions to be tested:			
Remove and restore local power Occupied / Unoccupied modes Alarms	Shutdown Interlocks Overrides	Lockouts Temperature Controls Demand Control Ventilation	Safeties
Sampling: No			
Conditions under which test shall be performed: Normal power All equipment and systems in auto			
Equipment / tools required for testing: As needed by contractor to demonstrate functionality Artificial smoke / spray (smoke detectors) Velocity Meter / Flow Hood			
Team members required to be present for testing: GC, MC, CC, EC			

P. Electrical Functional Testing Outline:

LIGHTING (EXTERIOR)		
Functions to be tested:		
Control parameters	Schedule	Control (on/off, zoning)
Sampling: No		
Conditions under which test shall be performed: Normal power Emergency power All equipment and systems in auto		
Equipment / tools required for testing: As needed by contractor to demonstrate functionality Light Meter		
Team members required to be present for testing: GC, EC		

LIGHTING (INTERIOR)
Functions to be tested: Control parameters Schedule Daylight Dimming Test (Day / Night Test) Occupancy sensor control (sensitivity, on/off, illumination, timeout, false trigger, zoning) Wall station control (on/off, zoning, scenes, illumination, override) Lighting control panels (schedule, zoning, override, program) Power failure
Sampling: Yes
Conditions under which test shall be performed: Normal power Emergency power All equipment and systems in auto
Equipment / tools required for testing: As needed by contractor to demonstrate functionality Light Meter
Team members required to be present for testing: GC, EC, Manufacturer Technician

Q. Plumbing Functional Testing Outline:

CIRCULATION PUMP (CP)		
Functions to be tested:		
Control parameters	Control	Shutdown
Remove and restore local power	Alarms	
Sampling: No		
Conditions under which test shall be performed: Normal power System in auto		
Equipment / tools required for testing: As needed by contractor to demonstrate functionality Amperage meter		
Team members required to be present for testing: GC, PC, EC, Manufacturer Technician		

WATER HEATER (GAS STORAGE + PUMP) (WH, CP)	
Functions to be tested:	
Control parameters	Control (schedule, heating, temperature setpoint)
Remove and restore local power	Pump operation
Sampling:	
No	
Conditions under which test shall be performed:	
Normal power	
All equipment in auto	
Equipment / tools required for testing:	
As needed by contractor to demonstrate functionality	
Thermometer (calibrated)	
Amperage meter	
Team members required to be present for testing:	
GC, PC, EC	

WATER HEATER (TANKLESS ELECTRIC) (WH)	
Functions to be tested:	
Control parameters	Control (heating, temperature setpoint)
Remove and restore local power	
Sampling:	
No	
Conditions under which test shall be performed:	
Normal power	
All equipment in auto	
Equipment / tools required for testing:	
As needed by contractor to demonstrate functionality	
Thermometer (calibrated)	
Amperage meter	
Team members required to be present for testing:	
GC, PC, EC	

R. Landscape Irrigation Functional Testing Outline:

LANDSCAPE IRRIGATION	
Functions to be tested:	
Control parameters	Control (schedule, overspray, zoning)
Sampling:	
No	
Conditions under which test shall be performed:	
Normal power System in auto Manual schedule override	
Equipment / tools required for testing:	
As needed by contractor to demonstrate functionality Amperage meter	
Team members required to be present for testing:	
GC, LC, EC	

3.07 DEFICIENCY RESOLUTION

A. The CxA will record pre-functional deficiencies on Commissioning Issues Logs and issue to the Contractor.

B. Correction of Pre-Functional deficiencies must be completed prior to Functional Testing. Completion will be verified by the closeout of the Commissioning Issues Log items.

C. The CxA will record the results of the Functional Testing on the Functional Test Forms. Deficiencies or non-compliance issues shall be noted on the test forms and/or on the Commissioning Issues Log.

D. Corrections of minor deficiencies identified may be made during the tests at the discretion of the Cx Authority. In such cases the deficiency and resolution will be documented on the test form.

E. Problem Solving: The CxA may recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the GC, Subs and A/E.

F. Non-Conformance: The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the CM in the issues log. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.

G. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the CM.

H. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.

I. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:

1. The CxA documents the deficiency and the Sub's response and intentions, and they go on to another test or sequence. After the day's work, the CxA submits the issues log to the CM. A copy is provided to the Sub and CxA. The Sub corrects the deficiency, and marks item "complete pending CxA verification" on issues log certifying that the equipment is ready to be retested and notifies CxA.

J. The CxA reschedules the test, and the test is repeated.

K. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
   1. The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the CM and to the Sub representative assumed to be responsible.
   2. Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Project Manager.
   3. The CxA documents the resolution process.
   4. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, responds to the associated issue(s) with correction and photos (as needed) and marks the item(s) "complete pending CxA verification" and provides it to the CxA. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved.

L. Cost of Retesting: For a deficiency identified, not related to any pre-functional checklist or start-up fault, the following shall apply: Up to a maximum of 4 hours is assumed for verification of any retesting of systems during functional testing phase. Retesting required beyond this amount shall be charged on a time and materials basis upon pre-approval of the client. The CxA's time for retesting beyond the amount listed above will be charged to the GC, who may choose to recover costs from the responsible Sub.

M. Approval: The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA and by the CM, if necessary. The CxA recommends acceptance of each test to the CM using a standard form. The CM gives final approval on each test using the same form, providing a signed copy to the CxA and the Contractor.

3.08 OPERATIONS & MAINTENANCE DOCUMENTATION

A. The Contractor will provide the Owner with complete Operations and Maintenance information, per the provisions in Division 01 Specification Sections. Contractor to provide at a minimum:
   1. Basic operation (i.e., narratives of basic equipment operation, interfaces, interlocks & interaction with other equipment & systems, initial maintenance provided by the contractor).
   2. General site operating schedules (i.e., instructions for changes in major system operating schedules, instructions for changes in major system holiday & weekend schedules).
   3. Basic troubleshooting (i.e., cite recommended troubleshooting procedures specific to major systems & equipment, manual operation procedures, standby/backup/bypass operation procedures, major system power fail resets and restarts, trend log listing).
   4. Recommended maintenance events log (i.e., HVAC air filler replacement schedule & log, building control system sensor calibration schedule & log).

B. Contractor shall submit two draft copies of the complete operating and maintenance manual to the Owner and/or PM for review by the architect/engineer and CxA within 60 calendar days after review of equipment shop drawings. One copy will be returned to the contractor within 30 days after receipt by the A/E. The O&M manuals are the responsibility of the Contractor.

C. Equipment submittals provided to the CxA do not constitute compliance for O&M manual

documentation.

D. Contractor shall provide O&M documentation to CxA in electronic format.

3.09 TRAINING

A. The Contractor will provide the Owner with complete Operations and Maintenance (O&M) training, per the provisions in Division 01 Specification Sections.

B. Each Sub and vendor responsible for training will submit a written training plan to the CxA for review and approval 1 month prior to training. The plan will cover the following elements:
   1. Equipment (included in training).
   2. Intended audience.
   3. Location of training.
   4. Objectives.
   5. Subject covered (description, duration of discussion, special methods, etc.).
   6. Duration of training on each subject.
   7. Instructor for each subject.
   8. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.).
   9. Instructor and qualifications.
   10. System/equipment overview (i.e., what it is, what it does, and with what other systems and/or equipment it interfaces).
   11. Review and demonstration of servicing & preventative maintenance.
   12. Review of the information in the Systems Manual.
   13. Review of the record drawings on the system/equipment.

C. For the primary HVAC equipment, the Controls Contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.

D. The Contractor shall record the training sessions and provide the Owner with a training manual and edited DVD of the training sessions.

3.10 SYSTEMS MANUAL

A. The CxA shall be responsible for coordinating the production of the systems manual.

B. The Contractor shall provide the following information to the CxA 30 days prior to substantial completion for inclusion to the systems manual.
   1. Prime Contractor contact information.
   2. Subcontractor information.
      a. Mechanical
      b. Electrical
      c. Plumbing
      d. Controls
      e. Test and Balance
      f. Fire Alarm
   3. Equipment supplier contact information.
   4. Spare parts inventory.
   5. Frequently required parts and supplies.
   6. Special equipment required to operate or maintain systems.
   7. Special tools required to operate or maintain systems.
   8. Copies of all special inspection verifications required by the enforcing agency of CALGreen.

9. Final control drawings and schematics and final control sequences.
10. Current requirements (i.e., building operating schedules, space temperature, humidity, pressure, CO2 setpoints, summer and winter setback schedules, chilled and hot water temperatures, as-built control setpoints & parameters).

C. A/E Contribution: The A/E will include in the beginning of the O&M Manuals a separate section describing the systems including:
1. The design intent narrative (Basis of Design) prepared by the A/E and provided as part of the bid documents, updated to as-built status by the A/E.
2. Simplified professionally drawn single line system diagrams on 8 ½" x 11" or 11" x 17" sheets. These shall include chillers, water system, condenser water system, heating system, supply air systems, exhaust systems and electrical distribution system. These shall show major pieces of equipment such as pumps, chillers, boilers, control valves, expansion tanks, coils, service valves, switchboards, motor control centers, panel boards, etc.

D. CxA Review and Approval: Prior to substantial completion, the CxA shall review the O&M manuals, documentation and redline as-builts for systems that were commissioned to verify compliance with the Specifications.

E. Final Report Details: The final commissioning report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the CxA regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas:
1. Equipment meeting the equipment specifications.
2. Equipment installation.
3. Functional performance and efficiency.
4. Equipment documentation and design intent.
5. Operator training.
6. All outstanding non-compliance items shall be specifically listed.
7. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed.

F. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

G. The CxA will retain other documentation: The Contractor shall provide as-built control sequences, control diagrams, system diagrams, maintenance schedules and construction drawings for inclusion in the system manual.

3.11 WRITTEN WORK PRODUCT

A. The commissioning process generates a number of written work products described in various parts of the *Specifications.* The *Commissioning Plan—Construction Phase,* lists all the formal written work products, briefly describes their contents, who is responsible to create them, their due dates, who receives and approves them and the location of the specification to create them. In summary, the written products are:

Product	Developed By
Final commissioning plan	Commissioning Authority
Cx meeting minutes	Commissioning Authority

Product	Developed By
Commissioning schedules	Commissioning Authority with GC and CM
Equipment documentation submittals	Subs
Sequence clarification	Subs and A/E (as needed)
Pre-functional checklists	Commissioning Authority
Startup and initial checkout plan	Subs and CxA (compilation of existing documents)
Startup and initial checkout forms filled out	Subs
Final TAB report	TAB
Issues log (deficiencies)	Commissioning Authority
Commissioning Progress Record	Commissioning Authority
Deficiency reports	Commissioning Authority
Functional test forms	Commissioning Authority
Filled out functional tests	Commissioning Authority
O&M manuals	Subs
Overall training plan	GC and CM
Specific training agendas	Subs
Final commissioning report	Commissioning Authority
Misc. approvals	Commissioning Authority

3.12 PROJECT CLOSEOUT

A. The Commissioning process shall be completed when:
   1. All Pre-Functional Checklists are complete and signed by the Commissioning Authority.
   2. All Functional Tests are completed, and all test elements are passed.
   3. All issues recorded on the Commissioning issues log are closed.
   4. Training and post construction review of the commissioned systems is complete.
   5. Controls system trend logs have been reviewed and approved by the Commissioning Authority.
   6. The commissioned systems are installed and operate in accordance with the Contract Documents, as determined by the Commissioning Authority and Owner.
   7. The commissioning process shall continue past substantial completion of the Project, until all non-compliance issues have been resolved.
   8. Closeout docs and systems manual are complete and submitted to the Owner.

END OF SECTION

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SECTION 02 4100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.

B. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

C. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Site Plan: Showing:
   1. Areas for temporary construction and field offices.

C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fill Material: As specified in Section 31 2323 - Fill.

PART 3 EXECUTION

3.01 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   3. Provide, erect, and maintain temporary barriers and security devices.

4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
5. Do not close or obstruct roadways or sidewalks without permit.
6. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Protect existing structures and other elements that are not to be removed.
1. Provide bracing and shoring.
2. Prevent movement or settlement of adjacent structures.
3. Stop work immediately if adjacent structures appear to be in danger.

3.02 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.03 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
1. Verify that construction and utility arrangements are as indicated.
2. Report discrepancies to Architect before disturbing existing installation.
3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Remove existing work as indicated and as required to accomplish new work.
1. Remove items indicated on drawings.

C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
3. Verify that abandoned services serve only abandoned facilities before removal.

4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

D. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

3.04 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

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SECTION 03 0516
UNDERSLAB VAPOR BARRIER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sheet vapor barrier under concrete slabs on grade.

1.02 RELATED REQUIREMENTS

A. Section 03 1000 - Concrete Forming and Accessories: Forms and accessories for formwork.
B. Section 03 2000 - Concrete Reinforcing.
C. Section 03 3000 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.
D. Section 07 1300 - Sheet Waterproofing: Below-grade waterproofing.

1.03 DEFINITIONS

A. See 01 4216 - Definitions, for technical definitions of vapor retarder, vapor barrier, and hydrostatic pressure.

1.04 REFERENCE STANDARDS

A. ACI 302.2R-06: Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
B. ACI 302.1R-15: Guide to Concrete Floor and Slab Construction.
C. ACI PRC-302.2 - Concrete Slabs that Receive Moisture-Sensitive Flooring Materials - Guide; 2022.
D. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.
E. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturers' data on manufactured products.
C. Shop Drawings: Provide project-specific plans and details to show extents, penetrations, and termination conditions.
D. Evaluation Service Reports: From ICC or similar. Show compliance with specified requirements.
E. Test Data: Submit report of tests showing compliance with specified requirements and paragraph 9.3 of ASTM E1745.
F. Samples: Submit samples of underslab vapor barrier to be used.
G. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction per ASTM E1643.

H. All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.

I. Manufacturer verify in writing a 20-year track record of the selected vapor barrier with no reported product failures.

J. Field Quality Control Reports: As specified in Part 3 of this Section.

1.06 COORDINATION

A. Confirm with vapor barrier manufacturer that selected vapor barrier membrane is appropriate for soil and site conditions.
   1. Confirm presence or future concern of termites.
   2. Confirm presence of volatile organic compounds in soil.
   3. Confirm anticipated slab movement or ground settlement.

B. Where under-slab vapor barrier ties into below-grade waterproofing, confirm compatibility of materials.

1.07 QUALITY ASSURANCE

A. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.
   2. Confirm products to be used and installation details, including edge, permanent penetrations, and temporary penetrations (board form stakes) treatment.
   3. Confirm tie-in with below-grade waterproofing.

1.08 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials and products in the original, unopened containers with seals unbroken, labeled with the manufacturer's name, product brand name and type, date of manufacture, and directions for storage and use.

C. Store and handle materials in strict compliance with manufacturer’s requirements. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Store material off of ground and keep dry.

D. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.09 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.
   1. Warranty: (a) compliance with the designated ASTM E1745 classification, and (b) no manufacturing defects in the product for, at least, the Life of the Building.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Permeance (ASTM E1745): Less than 0.01 perms, maximum, as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
   1. Sensitive Flooring (ACI PRC-302.2): Vapor barrier with permeance of 0.01 perms maximum, or as otherwise required by flooring manufacturer.

2.02 MANUFACTURERS

A. Manufacturers:
   1. ISI Building Products.
   2. Polyguard.
   3. Raven.
   4. Reef Industries.
   5. Stego Industries.
   6. Tex-Trude.
   7. W.R. Meadows.
   8. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Single Source: Provide all components from single manufacturer.

2.03 UNDER-SLAB VAPOR BARRIER SYSTEMS, GENERAL

A. General: Provide all components required, including membrane and accessories, to provide complete vapor barrier system.

2.04 UNDER-SLAB VAPOR BARRIER SYSTEMS

A. Underslab Vapor Barrier:
   1. Strength complying with ASTM E1745 Class A.
   2. Thickness: 20 mils.
   3. Basis of Design Product:
      a. Stego Industries LLC; Stego Wrap Vapor Barrier.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.

2.05 VAPOR BARRIER ACCESSORIES

A. General: Accessories by membrane manufacturer only.

B. Tapes: High-density polyethylene tape with pressure-sensitive adhesive.
   1. Single-Sided Tape: For lapped membrane seams and penetrations.
   2. Double-Sided Tape: To adhere membrane to cured concrete.
   3. Textured Tape: Single-sided adhesion, with textured top surface, to form mechanical bond with poured wet concrete.

C. Mastic: Manufacturer's mastic to seal holes in membrane at penetrations and penetration clusters.

D. Premanufactured Components: Pipe boots and other factory-fabricated components.

E. Termination Bar: Manufacturer's plastic termination bar to mechanically secure edge of vapor barrier.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

B. Contact vapor barrier manufacturer to schedule a pre-construction meeting and to coordinate a review, in-person or digital, of the vapor barrier installation.

3.02 INSTALLATION

A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
   1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
   2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments, such as dowels, water stops, or any other site condition requiring early termination of the vapor barrier. At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself.
      a. Seal vapor barrier to the entire slab perimeter using manufacturer’s textured tape with a surface that creates a mechanical seal to freshly-placed concrete, per manufacturer's instructions.
      b. Seal vapor barrier to the entire perimeter wall or footing/grade beam with manufacturer’s double-sided tape, or both termination bar and double-sided tape, per manufacturer’s instructions. Ensure the concrete is clean and dry prior to adhering tape.
   3. Overlap joints 6 inches and seal with manufacturer’s seam tape.
   4. Apply seam tape/textured tape/double-sided tape to a clean and dry vapor barrier.
   5. Seal all penetrations (including pipes) per manufacturer’s instructions.
   6. Avoid the use of stakes driven through vapor barrier by utilizing screed and forming systems that will not leave punctures in the vapor barrier.
   7. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile.

3.03 REPAIR

A. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches on all 4 sides, and taping all four sides with tape, or as otherwise recommended by manufacturer.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Manufacturer's Representative to provide site monitoring and inspection services as specified in Section 01 4000.
   1. Manufacturer's representative to prepare site review and inspection reports and deliver to Contractor.
   2. Submit field quality control reports to Architect.

3.05 PROTECTION

A. Limit direct traffic on vapor barrier when possible.

B. Protect vapor barrier from damage during installation of reinforcing steel, utilities, and during placement of concrete slabs.

END OF SECTION

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SECTION 03 1000
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes cast-in-place concrete formwork and accessories, for the following:
   1. Retaining Walls and Footings.
   2. Shear Walls.
   3. Slabs-on-grade.
   4. Concrete Toppings.
   5. Post-Installed Reinforcing Bars Connections.

B. Related Sections:
   1. Section 033000 "Cast-In-Place Concrete”.
   2. Section 032000 "Concrete Reinforcement”.

1.03 REFERENCES

A. Abbreviations & Acronyms
   1. ACI – American Concrete Institute

B. Reference Standards
   1. ACI 301-10: Specification for Structural Concrete Buildings.
   2. ACI 117-10: Specification for Tolerances for Concrete Construction and Materials
   3. ACI 347-04: Guide to Formwork for Concrete

1.04 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:
   1. Form materials and form-release agents.

1.05 QUALITY ASSURANCE

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301-10, “Specifications for Structural Concrete for Buildings”
   2. ACI 117-10, “Specification for Tolerances for Concrete Construction and Materials”

PART 2 PRODUCTS

2.01 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
   a. High-density overlay, Class 1 or better.
   b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
   c. Structural 1, B-B or better; mill oiled and edge sealed.
   d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 EXECUTION

3.01 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
   1. Class A, 1/8 inch for smooth-formed finished surfaces.
   2. Class C, 1/2 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

G. Chamfer exterior corners and edges of permanently exposed concrete.

H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.03 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces exposed to public view or to receive a rubbed finish.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
   1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform

color and texture. Do not apply cement grout other than that created by the rubbing process.

2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.04 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. All concrete work is subject to special inspection and testing. This section specifies the minimum testing and inspection required. Additional testing and inspection may be required by the Testing Agency, the Owner, or the Engineer/Architect if project conditions warrant.

C. Special Inspector Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, and qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

D. Tests and inspections shall be in conformance with Division 1, Section "Quality Requirements".

E. Independent Testing Agency shall check batch tickets for compliance with required mix design(s).

F. Continuous Field Inspection: The Independent Testing Agency shall be present at all times during the placing of structural reinforced concrete. Work shall not proceed until all inspections are completed. Prior to placing concrete, the Inspector shall inspect:
   1. Accuracy, configuration, and cleanliness of all formwork
   2. Quantity, cleanliness, and placement of all reinforcing steel.
   3. Testing Agency need not be present during entire reinforcing steel placing operations, provided he has inspected for conformance with the approved placement drawings prior to closing of forms or the delivery of concrete to the job site.

G. No concrete shall be placed until placement of reinforcement steel has been inspected and approved. Provide 48 hours notice to the Inspector prior to placing concrete.

END OF SECTION 03 1000

SECTION 03 1513
WATERSTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Waterstop systems for use at horizontal and vertical concrete cold joints and penetrations.
   1. Waterstop systems are to be installed in addition to waterproofing membranes and below-grade vapor barriers, not as a substitute.

1.02 RELATED SECTIONS

A. Section 03 3000 - Cast-in-Place Concrete: For below-grade vapor barriers.
B. Section 07 1300 - Sheet Waterproofing.
C. Section 07 1400 - Fluid-Applied Waterproofing

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements.
B. Product Data: For each item to be installed.
C. Shop Drawings: Show locations and extent of each waterstop system, with details for both cold joints and penetrations, as applies.
D. Samples: For waterstops.
E. Manufacturer's installation instructions.
F. Field Quality Control Reports: As specified in Part 3 of this Section.

1.04 QUALITY ASSURNACE

A. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.
B. Deliver materials and products in the original, unopened containers with seals unbroken, labeled with the manufacturer's name, product brand name and type, date of manufacture, and directions for storage and use.
C. Store and handle materials in strict compliance with manufacturer’s requirements. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Store material off of ground and keep dry.
D. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

PART 2 PRODUCTS

2.01 PERFORAMANCE REQUIREMENTS

A. Hydrostatic Head Resistance: 200 feet minimum.

B. Wet-Dry Cycling: No effect.

C. Self-Expanding Waterstops: Volumetric expansion 100 percent.

2.02 WATERSTOP SYSTEMS

A. Waterstop systems include primer, waterstop material, adhesive, and mechanical fasteners, as required to achieve performance requirements listed above, and to meet requirements of manufacturer's written installation instructions.
   1. Waterstop system is not to be installed at joints subject to movement.

B. Source Limitations: Obtain all components of waterstop systems from single source from single manufacturer.

2.03 SELF-EXPANDING WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete.
   1. Products:
      a. Carlisle Coatings & Waterproofing; MiraSTOP BW.
      b. CETCO; Volclay Waterstop-RX.
      c. GCP Applied Technologies; Adcor 500S.
      d. Henry Company, Sealants Division; Hydro-Flex.
      e. JP Specialties, Inc.; Earth Shield Type 20.
      f. Sika; Swellstop.
      g. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Locations:
      a. Joints in 8-inch or greater concrete with a minimum concrete coverage of 3 inches and subject to a hydrostatic head no greater than 200 feet.
      b. Joints around penetrations in 8-inch or greater concrete.

B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic rubber, for adhesive bonding to concrete.
   1. Products:
      a. Adeka; KBA-1510FP.
      b. Carlisle Coatings & Waterproofing; MiraSTOP NBW.
      c. Concrete Sealants Inc. (ConSeal); Conseal CS-231.
      d. Kryton; Krytonite Swelling Waterstop.
      e. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Locations:
      a. Joints in 4-inch or greater concrete with a minimum concrete coverage of 1 inch and subject to a hydrostatic head no greater than 25 feet.
      b. Joints around penetrations in 4-inch or greater concrete.

PART 3 EXECUTION

3.01 EXAMINATION

A. See Section 01 7000 - Execution and Closeout Requirements.

B. Verify surface is clean and free of all contaminants. Remove all debris and loose concrete.

C. Self-Expanding Strip Waterstops:
   1. Verify surfaces are dry.
   2. Verify concrete has cured to a sufficient degree to avoid premature swelling of waterstop material.

3.02 INSTALLATION - GENERAL

A. Install waterstop systems according to manufacturer's written instructions and approved shop drawings.

3.03 INSTALLATION - SELF-EXPANDING STRIP WATERSTOPS

A. Apply primer as required by manufacturer.

B. Install in construction joints and at other locations indicated to form a continuous diaphragm. Install in longest lengths practicable, according to manufacturer's written instructions and approved shop drawings.
   1. Single Waterstops: Install one waterstop strip at concrete connections with thicknesses less than 9 inches wide.
   2. Double Waterstops: Install two parallel waterstop strips at concrete connections with thicknesses 9 inches wide or greater. Retain edge clearances as listed above.

C. Adhesive: Set all waterstops in manufacturer’s adhesive.
   1. At irregular concrete, set waterstops in 1/2 inch bed of adhesive.
   2. Fill all gaps at material splices.

D. Waterstop Splice: At the intersection of two pieces of waterstop material, install one piece directly on top of the second, with a minimum 4 inch overlap. Install two fasteners in 4 inch overlap, through both pieces of waterstop material.

E. Penetrations: Apply 1/2 inch bead of adhesive and tool with a brush or trowel. When adhesive is dry to touch, press waterstop material firmly into place. Mechanical fasteners are not required.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Manufacturer's Representative to provide site monitoring and inspection services as specified in Section 01 4000.
   1. Manufacturer's representative to prepare site review and inspection reports and deliver to Contractor.
   2. Submit field quality control reports to Architect.

3.05 PROTECTION

A. Support and protect exposed waterstops during subsequent work.

B. Inspect waterstop system for damage just prior to placement of concrete and make repairs in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 032000
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes concrete reinforcement for the following:
   1. Retaining Walls and Footings.
   2. Shear Walls.
   3. Slabs-on-grade.
   4. Concrete Toppings.
   5. Post-Installed Reinforcing Bars Connections.

B. Related Sections:
   1. Section 031000 “Concrete Forming and Accessories”
   2. Section 033000 “Cast-In-Place Concrete”

1.03 REFERENCES

A. Abbreviations & Acronyms
   1. ACI – American Concrete Institute
   2. CRSI – Concrete Reinforcing Steel Institute

B. Reference Standards
   1. ACI 301-10: Specification for Structural Concrete Buildings.

1.04 ACI 117-10: SPECIFICATION FOR TOLERANCES FOR CONCRETE CONSTRUCTION AND MATERIALS.

1.05 ACTION SUBMITTALS

A. Submit in accordance with Division 01 Section "Administrative Requirements."

B. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
   1. Provide details of fabrication, bending, and placement, prepared according to ACI 315, “Details and Detailing of Concrete Reinforcement.” Include special reinforcement required for openings through concrete structures.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For welder

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Steel reinforcement and accessories.

1.07 QUALITY ASSURANCE

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301-10, “Specifications for Structural Concrete for Buildings”
   2. ACI 117-10, “Specification for Tolerances for Concrete Construction and Materials”
B. CRSI Publications: Comply with the following, unless more stringent provisions are indicated:
   1. Manual of Standard Practice
   2. Documents 63 and 65.
C. Qualifications
   1. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

1.08 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 PRODUCTS

2.01 STEEL REINFORCEMENT

A. Reinforcing Bars: See Structural Drawings
B. Plain-Steel Wire: See Structural Drawings
C. Deformed-Steel Wire: See Structural Drawings

2.02 DEFORMED BAR ANCHORS

A. Nelson, Type D2L automatically end-welded deformed bar

2.03 REINFORCEMENT ACCESSORIES

A. Tie Wire: Minimum 16 gage, ASTM A 82, or acceptable patented system.
B. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
C. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.
D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
   1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.04 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 EXECUTION

3.01 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
   1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Defective Work: The following reinforcing steel work will be considered defective, and shall be removed and replaced by the Contractor at no additional cost to the Owner:
   1. Bars with kinks or bends not shown on the drawings.
   2. Bars damaged due to bending or straightening.
   3. Bars heated for bending.
   4. Reinforcement not placed in accordance with the drawings.

3.02 DEFORMED BAR ANCHOR INSTALLATION

A. Install in accordance with ICC ESR-2907

3.03 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. All concrete work is subject to special inspection and testing. This section specifies the minimum testing and inspection required. Additional testing and inspection may be required by the Testing Agency, the Owner, or the Engineer/Architect if project conditions warrant.

C. Special Inspector Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, and qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

D. Tests and inspections shall be in conformance with Division 1, Section "Quality Requirements".

E. Independent Testing Agency shall check batch tickets for compliance with required mix design(s).

F. Inspections:
   1. Steel reinforcement placement.
   2. Steel reinforcement welding.

G. Reinforcing Steel Testing: Independent Testing Agency will perform the following:
   1. All steel bars that can be positively identified as to heat number and mill analysis shall have one tensile test bending test for each 10 tons, or fraction thereof, for all #5 bars and larger.
   2. All steel bars that cannot be identified shall have one tensile and one bend test made for each 2 1/2 tons, or fraction thereof, of each size and kind of reinforcing steel.
   3. Testing procedure shall conform to ASTM A 615.

H. Reinforcement Welding: All shop and field welds of reinforcing steel will be inspected. The Special Welding Inspector will check the materials and equipment, the qualifications and ability of the welder, and details of construction and procedure, as well as the welds themselves. The

I. Inspector may use gamma ray, magneflux, trepanning, ultrasonics, or any other aid to visual inspection which the Inspector may deem necessary to determine the adequacy of the welding.

J. No concrete shall be placed until placement of reinforcement steel has been inspected and approved. Provide 48 hours notice to the Inspector prior to placing concrete.

END OF SECTION 03 2000

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes cast-in-place concrete, including, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Retaining Walls and Footings.
   2. Shear Walls
   3. Slabs-on-grade.
   4. Concrete Toppings.
   5. Post-Installed Reinforcing Bars Connections.

B. Related Sections:
   1. Section 031000 “Concrete Forming and Accessories”
   2. Section 032000 “Concrete Reinforcing”

1.03 REFERENCES

A. Abbreviations & Acronyms
   1. ACI – American Concrete Institute
   2. NRMCA – National Ready Mixed Concrete Association

B. Definitions
   1. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
   2. W/C Ratio: The ratio by weight of water to cementitious materials.

C. Reference Standards
   1. ACI 301-10: Specification for Structural Concrete Buildings.
   2. ACI 117-10: Specification for Tolerances for Concrete Construction and Materials

1.04 ADMINISTRATIVE REQUIREMENTS:

A. Steel and Concrete Preconstruction Coordination Meeting: Conduct coordinate meeting at project site a minimum of 3 weeks prior to submitting any shop drawings or procurement of materials.
   1. Require representatives of each entity directly concerned with steel fabrication and erection and concrete placement to attend, including but not limited to the following:
      a. Construction Manager
      b. Steel Fabricator
      c. Steel Erector
      d. Concrete Contractor
      e. Structural Engineer of Record

f. Architect of Record

2. Review and coordinate the following:
   a. Anchor rod installation requirements and tolerances
   b. Method for securing anchor rods against movement during concrete placement
   c. Steel Embed Plates
   d. Submittal Schedules
   e. Critical Path and Long Lead Items
   f. Any and all items that require cross-trade coordination

B. Preinstallation Meeting: Conduct meeting at project site
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Construction Manager
      b. Independent testing agency responsible for concrete design mixtures
      c. Ready-mix concrete manufacturer
      d. Concrete contractor
      e. Special concrete finish contractor
      f. Structural Engineer of Record
      g. Architect of Record
   2. Review the following:
      a. Special inspection and testing and inspecting agency procedures for field quality control.
      b. Concrete finishes and finishing.
      c. Cold- and hot-weather concreting procedures.
      d. Curing procedures.
      e. Construction contraction and isolation joints.
      f. Forms and form removal limitations.
      g. Shoring and re-shoring procedures.
      h. Vapor-retarder installation.
      i. Anchor rod and anchorage device installation tolerances.
      j. Steel reinforcement installation.
      k. Floor and slab flatness and levelness measurement.
      l. Concrete repair procedures.
      m. Concrete protection.

1.05 ACTION SUBMITTALS

A. Submit in accordance with Division 01 Section "Administrative Requirements."

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Submit proposed mix designs at least 15 days in advance of placing operations for each concrete mixture. The submitted mix design shall include the following:
      a. Supporting strength test data not more than 12 months old. At the Engineer’s request, reports from the independent testing agencies may be required to document the test data. Reports from the independent testing agencies will be required if fly ash is used in the design mix.
      b. Statistical analysis in compliance with ACI 301.
      c. Gradation of fine and coarse aggregates not more than 90 days old (ASTM C 33). No substitution of aggregate type or size from those submitted will be permitted.

d. Proportions of all ingredients, including all admixtures added either at time of batching or at job site. Aggregate weights shall be based upon saturated surface dry conditions.
e. Water/cement ratio.
f. Slump (ASTM C 143): When high range water-reducing admixtures are used, slump before and after addition of admixture are required.
g. Air content of freshly mixed concrete (ASTM C 231).
h. Material Certificates for the following:
   1) Cementitious Materials
   2) Admixtures
i. Certification that all ingredients in each mix design are compatible
j. Locations or intended use of each mix design.
k. Source of all materials.
l. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating postconsumer and pre-consumer recycled content and cost
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
5. Each product permanently installed shall meet the following criteria in accordance with the 2022 California Green Building Code.

BUY CLEAN CALIFORNIA MATERIALS PRODUCT CATEGORY	**MAXIMUM ACCEPTABLE GWP VALUE (unfabricated) (GWP allowed)**	**UNIT OF MEASUREMENT**
Concrete reinforcing steel	1.56	MT CO_2e/MT
NW Ready-Mixed Concrete (3500-4499 psi)	566	KG CO_2E/M^3
NW Ready-Mixed Concrete (4500-5499 psi)	661	KG CO_2E/M^3
LW Ready-Mixed Concrete (2500-3499 psi)	956	KG CO_2E/M^3
LW Ready-Mixed Concrete (3500-4499 psi)	1039	KG CO_2E/M^3

D. Embedded Item Placement Drawings: Drawings indicating the location and type of plates, anchorages, or other items to be embedded in the finished concrete surfaces. Include wall elevations, slab plans, and details required to locate and install embeds.

E. Samples: For waterstops and vapor retarder.

F. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Location of construction joints is subject to approval of the Architect.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, and testing agency.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:
   1. Form materials and form-release agents.
   2. Steel reinforcement and accessories.
   3. Waterstops.
   4. Curing compounds.
   5. Floor and slab treatments.
   6. Bonding agents.
   7. Adhesives.
   8. Semirigid joint filler.
   9. Joint-filler strips.
   10. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Written curing procedure, including curing procedures for hot- and cold-weather placement.

F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.07 QUALITY ASSURANCE

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301-10, “Specifications for Structural Concrete for Buildings”
   2. ACI 117-10, “Specification for Tolerances for Concrete Construction and Materials”

B. CRSI Publications: Comply with the following, unless more stringent provisions are indicated:
   1. Manual of Standard Practice
   2. Documents 63 and 65.

C. Qualifications
   1. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
   2. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
      a. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
   3. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
      a. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
      b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Coordinate chemical and adhesion compatibility of curing compounds used for curing concrete with coatings, stains, paints, liquid flashings, sealers, waterproofing membranes, joint sealants and other materials that penetrate, adhere to or otherwise come into contact with concrete surfaces that are specified in other sections.

F. Batch Tickets: Provide batch tickets for review by inspector for each truckload of concrete used in the work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of cement and water introduced.

G. Concrete Finishing and Curing:
   1. Obtain each type, composition, and variety of liquid membrane-forming curing compound used for the Project from the same manufacturer.
   2. Products from more than one approved manufacturer may be used for different applications, however all products for like applications shall be by the same manufacturer.
   3. Liquid membrane curing compound manufacturer qualifications: Obtain materials only from a manufacturer that will send an experienced technical field representative to the Project site before the start of work to verify existing conditions, and during the execution of work to perform manufacturer’s field services.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store materials in accordance with ACI 301. Admixtures which have been in storage at the project site for longer than six months or which have been subjected to freezing shall not be used, unless retested and proven to meet the specified requirements.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.09 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

   When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

   1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and as follows:
   1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
   2. Products: Subject to compliance with requirements, provide one of the products specified.
   3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type II Supplement with the following:
      a. Fly Ash: ASTM C 618, Class C.
      b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
      c. Silica Fume: ASTM C 1240, amorphous silica.

B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate, graded. Provide aggregates from a single source.
   1. Unless maximum aggregate size is listed specifically under "Project Mix Requirements," the maximum aggregate size shall not exceed:
      a. Three-fourths of the minimum clear spacing between reinforcing bars.
      b. One-fifth of the narrowest dimension between the sides of the forms.
      c. One-third of the thickness of the slabs or toppings.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.03 ADMIXTURES

A. General
   1. Admixtures certified by manufacturer to contain not more than 0.05 percent water-soluble chloride ions by mass of cementitious material. Do not use admixtures containing calcium chloride or thiocyanate.
   2. Where more than one admixture is used in the mix, furnish manufacturer's certification to the Architect that the admixtures to be used are compatible in combination with the cement and aggregates.
   3. Accelerating admixtures shall not be used.

B. Air-Entraining Admixture: ASTM C 260.

C. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

D. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.
   1. Products:
      a. Axim Italcementi Group, Inc.; CATEXOL CN-CI.
      b. BASF Construction Chemicals – Building Systems; Rheocrete CNI.
      c. Euclid Chemical Company (The); Eucon, CIA.
      d. Grace Construction Products, W.R. Grace & Co.; DCI.
      e. Sika Corporation; Sika CNI.

E. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
   1. Products:
      a. BASF Construction Chemicals – Building Systems; Rheocrete 222+.
      b. Cortec Corporation; MCI 2000 or 2005NS.
      c. Grace Construction Products, W.R. Grace & Co.; DCI-S.
      d. Sika Corporation; FerroGard-901.

2.04 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513 for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
   1. Profile: As indicated.
   2. Dimensions: 6 inches by 3/8 inch thick; nontapered.

B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

2.05 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Fortifiber Building Systems Group; Moistop Ultra 15
      b. Meadows, W.R., Inc; Perminator 15 mil.
      c. Raven Industries Inc.; Vapor Block 15.
      d. Reef Industries, Inc; Griffolyn 15 Green
      e. Stego Industries, LLC; Stego Wrap 15 mil Class A.

2.06 LIQUID FLOOR TREATMENTS

A. Refer to section 033562 – Burnished Concrete Floor Finish

2.07 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

2.08 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
   1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.09 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
   4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
   4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash: 25 percent.
   2. Combined Fly Ash and Pozzolan: 25 percent.
   3. Ground Granulated Blast-Furnace Slag: 50 percent.
   4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
   5. Silica Fume: 10 percent.

6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Slump: 4 inches plus or minus 1 inch

E. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Concrete mix design shall comply with the requirements of the structural drawings.

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
2. Install connection plates, angles, or other embedded items flush with concrete surface and at accurate locations per the approved embedded item placement drawings required by Part 1, "Submittals," section.

3.02 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls at maximum of 30-foot spacing. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
8. Provide roughened surfaces at joints where shown on the drawings. Roughen to a full amplitude of approximately 1/4-inch.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. V-Grooved Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. V-Groove top with 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
   2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
   3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.03 WATERSTOP INSTALLATION

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

3.04 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer’s written instructions.
   1. Place vapor retarder directly on top of granular course
   2. Lap joints 6 inches and seal with manufacturer’s recommended tape.

3.05 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Maintain reinforcement in position on chairs during concrete placement.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.06 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces exposed to public view or to receive a rubbed finish.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
   1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
   2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland

cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.07 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.

1. Apply scratch finish to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

E. Broom Finish: Apply a broom finish to exterior concrete, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic rout. Coordinate required final finish with Architect before application.

3.08 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.09 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
      a. Moisture cure or use moisture-retaining covers to cure concrete surface to be burnished.
      b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
      c. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

3.10 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
   1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.11 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar
   2. before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   3. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
   4. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
   1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
   2. After concrete has cured at least 14 days, correct high areas by grinding.
   3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
   4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
   5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
   6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
   7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.All concrete work is subject to special inspection and testing. This section specifies the minimum testing and inspection required. Additional testing and inspection may be required by the Testing Agency, the Owner, or the Engineer/Architect if project conditions warrant.

B. Special Inspector Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, and qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

C. Tests and inspections shall be in conformance with Division 1, Section "Quality Requirements".

D. Independent Testing Agency shall check batch tickets for compliance with required mix design(s).

E. Continuous Field Inspection: The Independent Testing Agency shall be present at all times during the placing of structural reinforced concrete. Work shall not proceed until all inspections are completed. Prior to placing concrete, the Inspector shall inspect:
   1. Accuracy, configuration, and cleanliness of all formwork
   2. Quantity, cleanliness, and placement of all reinforcing steel.
   3. Testing Agency need not be present during entire reinforcing steel placing operations, provided he has inspected for conformance with the approved placement drawings prior to closing of forms or the delivery of concrete to the job site.

F. Inspections:
   1. Headed bolts and studs.
   2. Verification of use of required design mixture.
   3. Concrete placement, including conveying and depositing.
   4. Curing procedures and maintenance of curing temperature.

G. No concrete shall be placed until placement of reinforcement steel has been inspected and approved. Provide 48 hours notice to the Inspector prior to placing concrete.

H. Concrete Sampling: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
   5. Compression Test Specimens: ASTM C 31/C 31M.
      a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
      b. At the Contractor's expense and direction, cast and field-cure standard cylinder specimens as may be required for construction. Number of specimens and testing age shall be determined by the Contractor based on construction sequence

requirements.Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

6. Test field-cured specimens at the Contractor's direction.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Linear Shrinkage Tests: Test for linear shrinkage in accordance with ASTM C 157 (air storage method for 28 days. Take a minimum of 3 test samples from each mix, at the Project Representative's direction, of concrete for elevated slabs and beams. Take samples at truck and discharge end of pumped mix. Consistency of the concrete must not be altered after test samples have been taken.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

I. Measure floor and slab flatness and levelness according to ASTM E 1155 within 8 hours of finishing.
   1. Finish surfaces to the following tolerances, for a randomly trafficked floor surface:
      a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
      b. Specified overall values of flatness, F(F) 30; with minimum local values of flatness, F(F) 24; for suspended slabs.
      c. Specified overall values of flatness, F(F) 40; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for concrete receiving polished concrete finish.

3.13 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03 3000

SECTION 03 3511
CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete stains.

B. Film-forming sealers.

1.02 REFERENCE STANDARDS

A. ANSI A326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials; 2021.

B. ASTM D2370 - Standard Test Method for Tensile Properties of Organic Coatings; 2016 (Reapproved 2021).

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Manufacturer's installation instructions.

E. Qualification Statements: For manufacturer and installer.

F. Preconstruction Testing Reports: As specified in Part 1 of this Section.

G. Preinstallation Testing Reports: As specified in Part 3 of this Section.

H. Field Quality Control Reports: As specified in Part 3 of this Section.

I. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.04 COORDINATION

A. Confirm with manufacturer that products are appropriate to Project scope and conditions.

B. Verify required concrete surface profile with manufacturer.

C. Confirm with manufacturer minimum required concrete cure duration prior to installation.

D. Confirm accceptable concrete moisture content with manufacturer.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Manufacturer: Company specializing in manufacturing product specified in this Section for minimum 10 years documented experience.
   2. Installer: Minimum 5 years documented experience installing products specified in this Section and approved by the manufacturer.

B. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.
C. Preconstruction Testing: See Section 01 4000 - Quality Requirements.
   1. Owner to engage a qualified testing agency to perform tests and inspections.
      a. Concrete floor finishes will be considered defective if they do not pass tests and inspections.
      b. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
         1) Do not install product on the Project until passing test is achieved.
      c. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
      d. Submit preconstruction testing reports to Architect.
   2. Tests:
      a. Slip-Resistance.
         1) Confirm the dynamic coefficient of friction meets or exceeds the value in Performance Requirements article below. Test to ANSI A326.3.

1.06 MOCK-UPS

A. See Section 01 4000 - Quality Requirements, for additional information.
B. Build mockups to verify selections made under sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
C. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.
D. Locate where directed by Architect.
E. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.
B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.
C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.
D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.08 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.
B. Do not finish floors until interior heating system is operational.
C. Maintain ambient temperature of 50 degrees F minimum.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 10-year manufacturer warranty for concrete floor finish products that fail in material or workmanship within specified warranty period, commencing on the Date of Substantial Completion.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. Dynamic Coefficient of Friction (DCOF): Finished concrete floors to be minimum 0.42, in accordance with ANSI A326.3.

2.03 MANUFACTURERS

A. Concrete Topical Treatment Manufacturers:
   1. ChemMasters.
   2. CureCrete.
   3. Dayton Superior.
   4. Dur-A-Flex.
   5. Laticrete.
   6. Prosoco.
   7. Rust-Oleum.
   8. Sika.
   9. W.R. Meadows.
   10. Substitutions: See Section 01 2500 - Substitution Procedures.

2.04 COATINGS

A. Film-Forming Concrete Sealing System: 2-component high-solids sealer system applied to surface of ground concrete.
   1. Locations:
      a. Interior applications, to protect against staining of concrete and infection control.
      b. Where shown on the Architectural drawings.
   2. Products:
      a. Dur-A-Flex; Dur-A-Glaze Grind and Seal.
      b. Westcoat; Gind and Seal System.
      c. Substitutions: See Section 01 2500 - Substitution Procedures.
   3. Physical Properties:
      a. Sheen: Semi
      b. Thickness: 15 to 20 mils.
      c. Tensile Strength (ASTM D2370): 3,550 psi.

B. Concrete Stain: Penetrating compound for interior and exterior use.
   1. Basis of Design Product:
      a. NewLook International; Original Solid Color Stain.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.

2. Color: As shown on the Architectural drawings.
3. Number of Coats: As recommended by manufacturer.
4. Location: Contrasting stripes at concrete stairs and as otherwise shown on the Architectural drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.

B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

C. Preinstallation Testing:
   1. Owner to engage a qualified testing agency to perform tests and inspections.
      a. Concrete substrates will be considered defective if they do not pass tests and inspections.
      b. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
      c. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
      d. Submit preinstallation testing reports to Architect.
   2. Tests:
      a. Concrete Substrate Moisture and Alkalinity: Substrate moisture content and alkalinity to be confirmed by testing. See Section 09 0561 - Common Work Results for Flooring Preparation, for additional information.

3.02 PREPARATION

A. See Section 01 7000 - Execution and Closeout Requirements.

B. Prepare substrates according to manufacturer's written instructions to ensure adhesion of concrete floor finishes. Provide remediation as necessary.
   1. See Section 09 0561 - Common Work Results for Flooring Preparation, for additonal information

3.03 INSTALLATION, GENERAL

A. Apply materials in accordance with manufacturer's instructions.

B. Do not exceed pot life of material as documented in writing by manufacturer.

3.04 COATING APPLICATION

A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.

B. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

C. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Owner to engage a qualified testing agency to perform tests and inspections.
   1. Concrete floor finishes will be considered defective if they do not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
   4. Submit field quality control reports to Architect.

C. Tests:
   1. Slip-Resistance.
      a. Confirm the dynamic coefficient of friction (DCOF) meets or exceeds the value in Performance Requirements article above. Test to ANSI A326.3.

D. Manufacturer's Representative to provide inspection services as specified in Section 01 4000.
   1. Manufacturer's representative to prepare site inspection reports and deliver to Contractor.
   2. Submit field quality control reports to Architect.

3.06 PROTECTION

A. See Section 01 7000 - Execution and Closeout Requirements, for additional information.

B. Provide barrier or other delineation to prevent damage to installed Work from subsequent construction activities.

END OF SECTION

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SECTION 03 3710
SHOTCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Provisions of Division 01 apply to this section

B. Section Includes:
   1. Pneumatically placed concrete.

C. Related Sections:
   1. Section 03 2000: Concrete Reinforcement.
   2. Section 03 3000: Cast-In-Place Concrete.

1.02 SYSTEM DESCRIPTION

A. Regulatory Requirements: Comply with CBC requirements, such as Section 1910A.

1.03 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings indicating locations to receive shotcrete. Provide details of installation and reinforcement.

B. Product Data: Submit detailed product information identifying types and quality of materials, including admixtures.

C. Submit a mix design of each proposed mix to be provided for the Work. If data from prior experience is not available or applicable, provide and perform specimen testing of proposed mix designs.

1.04 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:
   1. ACI 506.2 - Specification for Materials, Proportioning and Application of Shotcrete.
   2. ASTM C 150 - Portland Cement.
   3. Perform Work in accordance with ACI 506.2.
   4. Testing: Refer to general notes on plans

B. Qualifications of Installer:

C. Mock-ups:
   1. Test Panels: Construct a test panel of the thickness and reinforcing that reproduces the thickest and most congested area specified in the structural drawings. The IOR and special inspector will witness the assembly, reinforcing, installation, and disassembly of the test panel. The panel shall be at least 4 feet x 4 feet. After installation, but before the concrete has fully set, the panel shall be disassembled and inspected. The panel shall be free of voids, sags and defects.
   2. Application of structural wet mix shotcrete in the finished Work shall not proceed until the test panel had been furnished, disassembled, and inspected by the IOR and special inspector.

1.05 DELIVERY, STORAGE AND HANDLING

A. Ensure materials and surrounding air temperature are a minimum 50 degrees F. prior to, during, and for at least 7 days after completion of Work.

B. During freezing or near freezing weather, provide equipment and cover to maintain 50 degrees F and to protect Work completed or in progress.

C. Suspend installation during high winds, rainy weather, or near freezing temperature when Work cannot be protected.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement: ASTM C 150 Type II/V, low alkali.

B. Aggregate: Conform to ACI 506, Graduation No. 1 or No. 2, ASTM C 33.

C. Curing compound not detrimental to application of subsequent surface finish materials.

2.02 SHOTCRETE MIX

A. Conform to following requirements:
   1. Compressive strength as indicated on Drawings; 28 day minimum.
   2. Aggregate size (maximum): 3/8 inch.
   3. Slump (plus or minus 1/2 inch): 1 inch to 2 inches.

B. Thoroughly mix shotcrete. Apply mix within 45 minutes.

C. Develop mix design to provide compaction and low percentage of rebound, but stiff enough not to sag.

D. Maintain quality control records during production of shotcrete. Submit records to the Architect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive shotcrete and verify unsuitable conditions have been corrected before proceeding. Verify that field conditions are acceptable and are ready to receive Work.

B. Verify fabricated forms are true to line and dimension, adequately braced against vibration, and constructed to permit escape of air and rebound during installation.

C. Ensure correct placement of reinforcement. Provide sufficient clearance around reinforcement to permit complete encasement.

D. Provide safe access to shotcrete surfaces for screeding and finishing, to permit uninterrupted application.

3.02 PREPARATION

A. Remove existing unsound concrete from substrate surfaces by chipping.

B. Minimize abrupt changes in thickness of repair. Remove square external corners from substrate by rounding the edge.

C. Sandblast existing surfaces that do not require chipping to remove oil, grease, and other contaminants, and to provide a roughed surface for proper bonding of the material.

D. Determine operating procedures for placement in close quarter, extended distances, or around unusual obstructions where placement velocities and mix consistency must be adjusted.

E. Clean and wet cementitious surfaces prior to installation. Maintain porous surfaces damp for several hours before installation. Do not install when there is visible free water present.

3.03 BATCHING AND MIXING

A. Shotcrete Mixes: Shall be designed based on the following minimum proportions:
   1. Provide shrinkage tests, as specified under Section 03 3000: Cast-In-Place Concrete.
   2. Provided mix with fine and 3/8 inch coarse aggregates shall contain between 20 and 30 percent pea gravel as specified, shotcrete-graded fine aggregate, at least 6.5 sacks of portland cement per cubic yard and sufficient water to produce a maximum slump of 2 inches plus-or-minus 1/2 inch.
   3. Shotcrete mixes shall be proportioned, batched and transported to assure complete mixing. Truck mixers shall be charged to not more than 75 percent of their rated capacity. Mixes shall be batched to provide a maximum 2 inch slump plus-or-minus 1/2 inch at the mixer at time of discharge. Water may be added at the Project site and in no case may the slump at the pump exceed 2 inches plus-or-minus 1/2 inch.

B. Thoroughly mix cement and aggregate for at least one minute before adding water.

3.04 APPLICATION

A. Install with suitable delivery equipment and procedures that will result in meeting the requirements of the Drawings and Specifications. Whenever possible, except when enclosing reinforcing steel, the nozzle shall be held at right angles to the surface to be placed and at a distance from 30 inches to 36 inches. When enclosing reinforcing steel, the nozzle shall be held so as to direct the material behind the bars. Each side of each bar shall be installed separately. Any deposits of loose sand or rebound shall be installed separately. Any deposits of loose sand or rebound shall be carefully removed from surfaces before material is installed. A second experienced nozzle operator equipped with an air jet shall attend the operators whenever reinforcing steel is being enclosed and shall carefully precede the nozzle and blow out rebound and sand which may have lodged behind the steel. Horizontal members shall not be installed from the top unless special methods are specified to eliminate rebound. The use of "puddled" shotcrete in which the water content of the mix is increased to facilitate the installation in difficult locations is not permitted. Shotcrete shall not be installed where the stream from the nozzle cannot directly impinge on the surface on which the shotcrete is to be installed.

B. No rebound material shall be installed in the Work.

C. The film of laitance, which forms on the surface of the shotcrete, shall be removed within approximately 2 hours after installation by brushing with a stiff broom. If this film is not removed within 2 hours, it shall be removed by wire brushing or sand blasting. Construction joints over 8 hours old shall be thoroughly cleaned before the installation of shotcrete.

D. Damage: Pneumatically placed concrete subsiding after installation shall be removed and replaced. Rebound pockets, sags, sloughing or other defects shall be cut out and replaced.

E. Surfaces to receive shotcrete shall have their entire surface thoroughly cleaned and roughened by sand blasting. Concrete and masonry shall be wetted before shotcrete is installed, but not so wet as to inhibit the installation. Sand for sand blasting shall be clean, sharp and uniform size, with no particles that will pass a 50 mesh screen.

F. Reinforcement: Before installing shotcrete around or upon reinforcement, reinforcement shall be thoroughly cleaned of grease, oil, paint, loose mill scale, heavy rust and hydrated concrete.Reinforcing shall be supported and secured in place in such a manner that resulting vibrations from shotcrete installation will not damage and or dislodge reinforcing.

G. Walls: Where structural wet mix shotcrete is to be installed to walls, minimum spacing of reinforcing steel shall be 6 bar diameters for walls with one curtain of steel. Where 2 curtains of steel are provided, curtain nearest nozzle shall be provided with a minimum spacing of 12 bar

diameters and remaining curtain shall be provided with a minimum spacing of 6 bar diameters. Reinforcing steel shall be provided with a minimum of 3 bar diameters at splices. Minimum clear distance between reinforcing bars, other than mesh, shall be a minimum of 3 times maximum aggregate size.

1. Contact splices shall not be provided for bars larger than No. 5. Splices shall be non-contact back to back.

H. Shotcrete forms shall be substantial and rigid. Forms shall be fabricated and installed to permit the effects of rebound.

1. Rigid or other required backing shall be installed against earth during application of wet mix shotcrete. Rigid or other required backing shall be provided where a void in embankment is to be bridged. Forms to be provided where required.

I. Line and Thickness Control: Provide adequate wires or other required means to establish thickness, surface planes, and finish lines of shotcrete. Maintain specified tolerances by maintaining wires secure and taut.

J. Placement Precautions: Do not install shotcrete if hydrating or stiffening of mix takes place at any time before delivery to nozzle.

K. The height of a layer shall be limited to not more than 3 feet and a succeeding layer shall not be installed in less than 3 hours. Sloughing or sagging is not permitted.

3.05 FINISHING

A. Install to a true, even surface by floating or rodding and providing a wood float finish to surfaces. Finish surfaces shall be within a tolerance of 1/8 inch in 10 feet. Finish to match existing conditions, if applicable.

3.06 CURING AND PROTECTING

A. Initial Curing: Immediately after finishing, maintain shotcrete continuously moist for at least 20 days by one of the following materials or methods:

1. Continuous sprinkling.
2. Absorptive mat or other covering maintained continuously wet.

B. Final Curing: Provide additional curing immediately following the initial curing and before shotcrete has hydrated with one of the following materials or methods:

1. Continue the method provided for initial curing.
2. Material conforming to ASTM C 171.

C. Duration Of Curing. Maintain curing for the first 14 days after installation. During the curing period, maintain shotcrete above 40 degrees F. and in a moist condition as specified previously. Prevent rapid drying at end of curing period.

3.07 FIELD QUALITY CONTROL

A. Shotcrete Work shall be continuously inspected during installation. A special inspector, approved by the City of Inglewood to inspect the Work of this section, shall inspect the materials, placing equipment, details of construction, and construction procedure. The IOR shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.No less than 2 cores each day shall be obtained from the Work at locations designated by the special inspector. At least one core shall be obtained for each 5,000 square feet of floor or wall area. Cores shall be tested at approximately 28 days. Cores shall be 4 inches in diameter or larger. In addition, cores shall be obtained from 2 test panels each day. Test panels must be correlated with locations of wall being installed at same time as test panels.

B. The special inspector shall observe coring operations and will prepare a report of coring operations for the testing laboratory.

C. Obtain representative core samples in accordance with CBC recommendations, and test in accordance with ASTM C 42.

D. Remove and replace shotcrete which lacks uniformity, exhibits segregation, honeycombing, or lamination, or which contains any dry patches, slugs, voids, or sand pockets.

E. Remove and replace damaged shotcrete, which cannot be satisfactorily repaired.

F. Repair core holes in accordance with Chapter 9 of ACI 301. Do not fill core holes with shotcrete. Repair holes with non-shrink non-staining concrete.

3.08 PROTECTION

A. Before installation, protect interior and exterior trim, sash, doors, transoms, floors, ceilings and equipment. Debris shall be immediately cleaned up after installation but not less than once each day.

B. Protect the Work of this section until Substantial Completion.

3.09 CLEAN-UP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION 03 3710

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SECTION 03 4123
PRECAST CONCRETE STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Precast concrete stairs.

1.02 RELATED REQUIREMENTS

A. Section 01 4113.11 - Regulatory Requirements - Global Warming Potential (GWP).

1.03 REFERENCE STANDARDS

A. ABA Standards - ABA Accessibility Standards; 2004, with Amendments (2015).
B. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
C. ANSI A326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials; 2021.
D. ASTM A27/A27M - Standard Specification for Steel Castings, Carbon, for General Application; 2020.
E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
F. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
G. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.
H. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
I. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
J. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
K. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
L. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
M. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.
N. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.
O. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
P. ASTM A675/A675M - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties; 2014 (Reapproved 2019).

Q. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2022a.

R. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

S. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

T. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

U. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

V. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).

W. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

X. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements; 2021.

Y. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2023, with Editorial Revision.

Z. ASTM C642 - Standard Test Method for Density, Absorption, and Voids in Hardened Concrete; 2021.

AA. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.

BB. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars; 2022.

CC. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

DD. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2020.

EE. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2022.

FF. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry; 2023.

GG. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.

HH. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.

II. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use; 2019.

JJ. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.

KK. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

LL. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars; 2018, with Amendment (2020).

MM. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

NN. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products; 2021.

OO. PCI MNL-120 - PCI Design Handbook; 2017, with Errata (2021).

PP. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction; 2000.

QQ. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals; 2016.

RR. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

SS. SSPC-SP 3 - Power Tool Cleaning; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal requirements.

B. Global Warming Potential (GWP): Environmental product declaration (EPD) to identify GWP less than or equal to maximum allowable value. See 01 4113.11 - Regulatory Requirements - Global Warming Potential (GWP), for additional information.

C. Product Data: For each item to be installed.

D. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.
   2. Recycled content data.

E. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.

F. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

G. Certificates: Products to meet or exceed specified requirements.

H. Delegated Design Documents: See Section 01 3000 - Administrative Requirements.
   1. Provide design documentation prepared by Contractor's Licensed Professionals.

I. Welding certificates.

J. Material Test Reports: For aggregates.

K. Source Quality Control Reports: As specified in Part 2 of this Section.

L. Field Quality Control Reports: As specified in Part 3 of this Section.

1.05 COORDINATION

A. Coordinate installation of anchorages for precast concrete stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to the Project site in time for installation.

1.06 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Fabricator: A firm that assumes responsibility for engineering precast concrete stairs to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.

C. Mock-ups: See Section 01 4000 - Quality Requirements.
   1. Build mockups to verify selections made under sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   2. Approved mock-ups may remain as part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.08 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions by field measurement before fabrication. Show recorded measurements on shop drawings.

1.09 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 DELEGATED DESIGN

A. Delegated Design: See Section 01 3000 - Administrative Requirements.

B. Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design precast concrete stairs.

2.02 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. Recycled Content: Products in this Section to meet minimum recycled content thresholds specified in Section 01 6000.

2.03 PERFORMANCE REQUIREMENTS

A. Design Standards: Comply with ACI CODE-318 and design recommendations of PCI MNL-120, applicable to types of architectural precast concrete units indicated.

B. Structural Performance of Stairs: Precast concrete stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
   1. Uniform Load: 100 lbf/sq. ft.
   2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
   3. Uniform and concentrated loads need not be assumed to act concurrently.
   4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
   5. Limit deflection of treads, platforms, and framing members to L/360.

C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL-116.

D. Dynamic Coefficient of Friction (DCOF): Stair treads to be minimum 0.42, in accordance with ANSI A326.3.

2.04 REGULATORY REQUIREMENTS

A. See Section 01 4100 - Regulatory Requirements.

B. Concrete, Concrete Reinforcement, Structural Steel, and Steel Plate: Global Warming Potential (GWP) less than or equal to maximum allowable value. See Section 01 4113.11 - Regulatory Requirements - Global Warming Potential (GWP), for additional information.

C. Accessibility: Comply with applicable provisions in the ADA Standards, ABA Standards, and ICC A117.1.

2.05 PRECAST CONCRETE STAIRS

A. Precast Concrete Stairs:
   1. Basis of Design Product:
      a. Stepstone; Steptread.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Tread Style: Closed riser modern profile.
   3. Warning Stripes: Integral detectable aggregate warning stripes where indicated on drawings.
   4. Finish: Light sandblast.
   5. Color: Selected by Architect from manufacturer's full range.

B. Landing
   1. Basis of Design Product:
      a. Stepstone; Steptread Planks.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Layout: As indicated on drawings.
   3. Finish and Color: Match precast concrete stairs.

2.06 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL-116.

2.07 CONCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type III, gray, unless otherwise indicated.

B. Supplementary Cementitious Materials:
   1. Fly Ash: ASTM C618, Class C or F, with maximum loss on ignition of 3 percent.
   2. Metakaolin: ASTM C618, Class N.
   3. Silica Fume: ASTM C1240, with optional chemical and physical requirement.
   4. Ground Granulated Blast-Furnace Slag: ASTM C989/C989M, Grade 100 or 120.

C. Normal-Weight Aggregates: Except as modified by PCI MNL-116, ASTM C33/C33M, with coarse aggregates complying with Class 5M. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL-116.

E. Air-Entraining Admixture: ASTM C260/C260M, certified by manufacturer to be compatible with other required admixtures.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

2.08 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A36/A36M.

B. Carbon-Steel-Headed Studs: ASTM A108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or Type B, with arc shields and with minimum mechanical properties of PCI MNL-116.

C. Carbon-Steel Plate: ASTM A283/A283M, Grade C.

D. Malleable Iron Castings: ASTM A47/A47M, Grade 32510 or Grade 35028.

E. Carbon-Steel Castings: ASTM A27/A27M, Grade 60-30.

F. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.

G. Carbon-Steel Structural Tubing: ASTM A500/A500M, Grade B or Grade C.

H. Wrought Carbon-Steel Bars: ASTM A675/A675M, Grade 65.

I. Deformed-Steel Wire or Bar Anchors: ASTM A496 or ASTM A706/A706M.

J. Carbon-Steel Bolts and Studs: ASTM A307, Grade A or ASTM F1554, Grade 36; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A563/A563M; and flat, unhardened steel washers, ASTM F844.

K. High-Strength Bolts and Nuts: ASTM A325, Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A563/A563M; and hardened carbon-steel washers, ASTM F436/F436M.

L. Zinc-Coated (Galvanized) Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A123/A123M or ASTM A153/A153M.
   1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with SSPC-Paint 20.

M. Shop-Primed Finish: Prepare surfaces of nongalvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.

2.09 BEARING PADS

A. Provide bearing pads for precast concrete stairs as recommended by precast fabricator for application.

2.10 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144 or ASTM C404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218 / C1218M.

B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218 / C1218M.

C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C881/C881M, of type, grade, and class to suit requirements.

2.11 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

B. Limit use of fly ash and ground granulated blast-furnace slag to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.

C. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.

D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI CODE-318 or PCI MNL-116 when tested according to ASTM C1218 / C 218M.

E. Normal-Weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28 Days): 5000 psi minimum.

F. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to ASTM C642, except for boiling requirement.

G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL-116.

H. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.12 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
   1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4.

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast concrete to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in precast concrete as indicated on the Contract Drawings.

D. Reinforcement: Comply with recommendations in PCI MNL-116 for fabricating, placing, and supporting reinforcement.

E. Reinforce precast concrete to resist handling, transportation, and erection stresses and specified in-place loads.

F. Comply with requirements in PCI MNL-116 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

G. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.

H. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL-116.

I. Comply with PCI MNL-116 for hot- and cold-weather concrete placement.

J. Identify pickup points of precast concrete and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast concrete on a surface that does not show in finished structure.

K. Cure concrete, according to requirements in PCI MNL-116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

L. Discard and replace precast concrete that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL-116 and Architect's approval.

2.13 FABRICATION TOLERANCES

A. Fabricate precast concrete to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL-116 product tolerances as well as position tolerances for cast-in items.

2.14 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Fabricator to perform tests and inspections, prior to shipment of precast concrete stairs to Project site.
   1. Precast concrete stairs will be considered defective if they do not pass tests and inspections.
   2. Fabricator to prepare reports and deliver to Contractor.
   3. Submit source quality control reports to Architect.

C. Tests and Inspections:
   1. Test and inspect precast structural concrete according to PCI MNL-116 requirements and ASTM C1610 / C1610M, ASTM C1611 / C1611M, ASTM C 621 / C1621M, and ASTM C1712 / C1712M.
   2. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Erect precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
   1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
   2. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.

C. Connect precast concrete in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

D. Field cutting of precast units is not permitted without approval of Architect.

E. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

F. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

G. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.

3.02 TOLERANCES

A. Erect precast concrete level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL-135.

B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Architect.

3.03 REPAIR

A. Repair precast concrete if permitted by Architect.
   1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780/A780M.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged precast concrete that cannot be repaired or when repairs do not comply with requirements as determined by Architect.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Owner to engage a qualified special inspector to perform the following special inspections and prepare reports
   1. Erection of precast structural concrete members.

C. Owner to engage a qualified testing agency to perform tests and inspections.
   1. Precast concrete stairs will be considered defective if they do not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
   4. Submit field quality control reports to Architect.

D. Inspections:
   1. Visually inspect field welds and test according to ASTM E165/E165M or to ASTM E709. High-strength bolted connections are subject to inspections.

3.05 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements.

B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
   1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
   2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION

SECTION 03 9300
FIBER REINFORCED POLYMER (FRP) STRENGTHENING SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This specification is intended to define the minimum requirements of structural strengthening using externally bonded fiber reinforced polymer (FRP) composite systems.

B. The work includes the furnishing of all materials, labor, equipment and services for the supply, installation and finish of all structural strengthening using externally bonded FRP composite system.

C. The general contractor or subcontractor shall furnish all materials, tools, equipment, transportation, necessary storage, access, labor and supervision required for the proper installation of the externally bonded FRP composite system.

1.02 WORK INCLUDED

A. This Section of the Specification is not necessarily complete in itself. Read in conjunction with the Contract Document.

1.03 REFERENCE STANDARDS

A. General
   1. The publications listed below form a part of this specification to the extent referenced. Where a date is given for referenced standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of the Notice of Invitation to Bid shall be used.

B. American Standard for Testing and Materials (ASTM)
   1. ASTM D7290, Standard Practice for Evaluating Material Property Characteristic Values for Polymeric Composites for Civil Engineering Structural Applications.
   2. ASTM D7565, Standard Test Method for Determining Tensile Properties of Fiber Reinforced Polymer Matrix Composites Used for Strengthening of Civil Structures.
   3. ASTM D3039, Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials.
   4. ASTM D7522, Standard Test Method for Pull-Off Strength for FRP Bonded to Concrete Substrate; 2015.
   5. ASTM D4541, Standard Test Method for Pull-off Strength of Coating Using Portable Adhesive-Testers; 2009.

C. International Association of *Plumbing* and Mechanical Officials (IAPMO)
   1. IAPMO EC 038, Evaluation Criteria for Diaphragm Strengthening using Fiber Reinforced Polymers

D. International Code Council (ICC)
   1. ICC AC125, Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Externally Bonded Fiber Reinforced Polymer (FRP) Composite Systems.
   2. ICC AC178, Interim Criteria for Inspection and Verification of Concrete and Reinforced and Unreinforced Masonry Strengthening Using Externally Bonded Fiber Reinforced (FRP) Composite Systems.

E. International Concrete Repair Institute (ICRI)
   1. ICRI Technical Guideline No. 310.2-2013 (formerly No. 03732), Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.

F. American Concrete Institute (ACI)
   1. ACI 440.2R-17, Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures.

1.04 MATERIAL QUALIFICATIONS

A. FRP manufacturers must provide all items listed in Section 1.05 of this specification with their bid. FRP composite properties (tensile modulus) shall be determined by ASTM D7290. Systems without complete submittals shall be considered non-compliant.

1.05 SUBMITTALS

A. Quality Control and Quality Assurance
   1. Properties of the composite materials (tensile modulus and stress) as computed in accordance with ASTM D7290 (Weibull distribution) for the proposed fiber composite system based on a minimum of 30 test specimens.
   2. Submit product data indicating product standards, physical and chemical characteristics, technical specifications, limitations, installation instructions, maintenance instructions and general recommendations regarding each individual material.
   3. Only epoxy resins will be accepted for construction of FRP systems referenced in this specification. Other resins, such as polyesters/vinyl esters, are not allowed as substitutes. The manufacturer shall clearly define the epoxy resin working time. Any batch that exceeds the batch life shall not be used.
   4. The proposed FRP systems shall provide a current IAPMO and/or ICC Evaluation Report and be compliant with testing requirements per ICC AC125.
   5. Written consent from the FRP manufacturer that the surface bonded FRP composite systems are installed by trained certified applicators as per Section 2.02

B. Fiber Anchors
   1. Independent laboratory testing verifying the tensile design properties of the fiber anchors as per ASTM D7205. A minimum of 20 specimens shall be submitted.
   2. Independent Laboratory anchor testing per ACI 355.4 shall be submitted to validate the minimum bond shear strength of the fiber anchors embedded into both cracked and uncracked concrete.
   3. Large-scale test results validating the fiber anchor performance on relevant test specimens. Compatibility between composite anchors and the composite system must be verified through large-scale testing.

C. Design and Working Drawings:
   1. Design and working drawings shall be based on performance as per Section 1.06.
   2. Stamped and signed structural calculations and drawings by a professional Civil Engineer. Design shall be based on the clearly written performance criteria defined on the structural drawings.Working shop drawings and calculations prepared and sealed by a professional engineer detailing the type, locations, dimensions, numbers of layers, and orientation of all FRP materials and coatings to be installed.

D. Product Information
   1. Manufacturer shall be from approved list of manufacturers below.
      a. Fyfe Co. LLC. Nancy Ridge Technology Center, 6310 Nancy Ridge Drive, Suite 103, San Diego, CA 92121. Tel: 858-642-0694, Fax: 858-642-0947, email: info@fyfeco.com.

b. Simpson Strong-Tie®, Inc., 5956 W. Las Positas Boulevard, Pleasanton, CA 94588, Phone: 925.560.9000, Fax: 925.847.1605
c. Or equal. In addition to requirements specified in Section 01 25 13, Product Substitution Procedures, furnish the following for a substitution request related to this product:
    1) Submit to the engineer-of-record and/or owner the proposed manufacturers' QA/QC manual for the FRP materials and installation.
    2) Design criteria for the concrete strengthening for seismic forces, including design equations, for all applications shall be submitted for review of the engineer-of-record and/or owner.

2. Provide a current IAPMO and/or ICC Evaluation Report, as per Section 1.05.A.4
3. Installation procedures, maintenance instructions, and general recommendations regarding each material to be used.
4. Manufacturer's material Safety Data Sheets (SDS) for all materials to be used.
5. Manufacturer's product data sheet indicating physical, mechanical and chemical characteristics of all materials used in the FRP system.
6. Certification by the manufacturer that supplied products complies with local regulations controlling use of volatile organic compounds (VOC's).

1.06 PERFORMANCE

A. Design the composite system to achieve the structural performance shown on the structural drawings. Design calculations shall be based on the characteristic design values as determined by ASTM D7290, submitted for approval by the engineer of record and shall be stamped by a registered Civil or Structural Engineer.

B. FRP design values must be lower than the calculated mean determined from the test results received from the ASTM D7565 and/or ASTM D3039 field prepared test specimens per Section 3.03.

C. The Engineer of Record may suspend the work if the Contractor substitutes an unapproved fiber reinforced composite system or unapproved personnel during construction.

1.07 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Deliver epoxy materials in factory-sealed containers with the manufacturer's labels intact and legible with verification of date of manufacture and shelf life.

B. Store materials in a protected area at a temperature between 60°F and 100°F.

C. Products shall be stored according to the manufacturer's requirements and shall avoid contact with soil and moisture. Products shall be stored to avoid UV exposure.

1.08 COORDINATE WITH OTHER TRADES

A. Prior to construction, the trades shall be briefed on any new or unusual construction procedures to ensure that they are aware of special conditions (e.g. new penetrations, construction anomalies).

PART 2 PRODUCTS

2.01 MATERIALS

A. FRP manufacturers must provide all items listed in Section 1.5 of this specification with their bid. Equivalency shall be based on the composite properties as determined by ASTM D7290.

B. Products include:
   1. Reinforcing Fabric: Unidirectional carbon fiber systems & unidirectional glass fiber systems.
   2. Fiber Anchor (as required): Carbon Fiber Composite Anchors & Glass Fiber Composite Anchors. Fiber anchors shall be pre-saturated with epoxy in the field. Anchors shall be prefabricated and shipped directly from the manufacturer. Anchor labels shall have the date of manufacture, the lot number and the minimum weight per unit length for each anchor size.
   3. Epoxy saturant/primer: High-strength two-part epoxy is used as a primer and is also combined with the fiber to form the FRP composite.
   4. Primer/Filler: Thickened epoxy for protective seal coat, filling voids and primer where needed. Field thickened epoxy may be used to patch “bugholes” up to 1” in depth and to fill voids.
   5. Detailing Finish: Thickened epoxy shall be applied to all seams, edges and exposed surfaces.
   6. Top of Slab Finish (as required): Provide thickened epoxy and immediately broadcast coarse, washed, dry sand (10-to-16-mesh) to provide a “key-coat”.
   7. Aesthetic Finish: Two-coats of acrylic or polyurethane paint (approved by the owner and/or engineer-of-record).
   8. Alternate finishes must be approved by the Owner and Manufacturer.

2.02 CERTIFIED APPLICATORS

A. Installations shall be performed by certified applicators only. Certified applicators shall have written verification from the manufacturer that they have received the required certifications and training. At a minimum, the onsite supervisor and/or foreman shall provide written verification from the material manufacturer as being fully trained and certified to install the proposed system. The certifications shall be current (dated within one-year of the project schedule).

B. The contractor shall supply a written description of the training course provided by the manufacturer. The training shall include, at a minimum, training with documented activities that cover the scope of the project.

2.03 OTHER MATERIALS

A. Contractor to provide compatible primer, filler and other materials recommended by the manufacturer as needed for the proper installation of the complete surface bonded FRP composite system.

PART 3 APPLICATION

3.01 SURFACE PREPARATION

A. Column (“Contact-Critical”) Applications
   1. The surface to receive the composite shall be free from fins, sharp edges and protrusions that will cause voids behind the installed casing or that, in the opinion of the Engineer of Record, will damage the fibers. Existing uneven surfaces to receive composite shall be filled with the system epoxy filler or other material approved by the Engineer of Record. Filling of large voids in surfaces to receive composite shall be paid as an extra to the contract work of installing the composite system (small pinholes or micro-bubbles in the concrete surface or resin do not require special detailing). The contact surfaces shall have no free moisture on them at the time of application.

2. Repair all damaged and unsound concrete, spalls, and irregular surfaces to create a flat, or slightly convex, surface. Fill surfaces with thickened epoxy to eliminate air surface voids greater than 0.5” diameter. Well-adhered paint and concrete do not require removal.
3. Round off sharp and chamfered corners to a minimum radius of 0.75” by means of grinding or forming with the system’s thickened epoxy. Variations in the radius along the vertical edge shall not exceed 0.5” for each 12” of column height.

B. Beams/Walls (“Bond-Critical”) Applications
1. Surfaces shall be prepared for bonding by means of abrasive blasting or grinding to remove existing laitance and expose aggregate [minimum ICRI CSP-2 concrete surface profile]. All contact surfaces shall then be cleaned by hand, HEPA vacuum or compressed air. One prime coat of the manufacturer’s epoxy shall be applied and allowed to cure for a minimum of one hour. Prior to the application of the saturated composite fabric apply one-layer of the manufacturer’s thickened epoxy and fill any uneven surfaces. Provide anchorage as detailed on the construction drawings if required.
2. Round off sharp and chamfered corners (to be wrapped around) to a minimum radius of 0.50” by means of grinding or forming with the system’s thickened epoxy. Variations in the radius along the edge shall not exceed 0.5” for each 12” of length.
3. Repair all damaged concrete, spalls, and irregular surfaces to create a flat, or slightly convex, surface. Fill surfaces with thickened epoxy to eliminate air surface voids greater than 0.5” diameter.

3.02 INSTALLATION

A. Preparation work for project: Visit site to ensure that all patch work is complete and cured. Review project specifications in detail.

B. Verify ambient and concrete temperatures. No work shall proceed if the temperature of the concrete surface is less than 50°F or greater than 100°F or as specified on the epoxy component labels. Substrate shall be at least 5°F above the dew point.

C. Prepare the epoxy matrix by combining components at a weight (or volume) ratio specified by the manufacturer. The components of epoxy resin shall be mixed with a mechanical mixer until uniformly mixed, typically 5 minutes at 400-600 rpm at 72°F.

D. Components that have exceeded their shelf life shall not be used.

E. Saturation of the fabric shall be performed and monitored according to the manufacturer’s specified fiber-epoxy resin ratio. Fabric shall be completely saturated prior to application to contact surface in order to ensure complete saturation. Saturation shall be supervised and checked by the certified installer. Both the epoxy resin and fabric shall be measured accurately combined, and applied uniformly at the rates shown on the approved working drawings and per manufacturer's recommendations.

F. All cutting of fabrics, mixing of epoxy and combination thereof shall take place in a protected area away from critical structure functions and any electrical equipment.

G. Drill holes for fiber anchors (if required).

H. Prepare surfaces as required, including corner preparation.

I. Remove dust and debris by vacuum only with HEPA filtration.

J. Clean up and protect area adjacent to element where FRP composite is being applied.

K. Using a roller or trowel, apply one prime coat of epoxy resin to the substrate (2 mil min.). Allow sufficient time for primer to become tacky to the touch or to soak into the substrate and create a damp surface with no standing liquid (saturated surface dry).

L. Apply a uniform layer of thickened epoxy to all marked locations and fill any uneven surfaces or recesses.

M. Apply saturated fabric to substrate surface by hand lay-up, using methods that produce a uniform, constant tensile force that is distributed across the entire width of the fabric, and ensure proper orientation of the fabric. Gaps between composite bands may not exceed 0.5” width in the fabric’s transverse joint unless otherwise noted on project drawings. A lap length is required at all necessary overlaps in the primary fiber direction of the fabric. See shop drawings for required lengths.

N. Fiber Anchors (if required): Pre-saturate the composite anchor in a bath. Installation of dry anchors is prohibited. Fill the drilled hole min. 75% with thickened epoxy prior to installation. Splay anchor as detailed on shop drawing.

O. Apply subsequent layers, continuously or spliced, until designed number of layers is achieved, per project drawings.

P. Using a roller or hand pressure, release or roll out entrapped air, and ensure that each individual layer is firmly embedded and adhered to the preceding layer or substrate.

Q. Detail all fabric edges, including termination points and edges, with thickened epoxy

R. Finish: All seams, edges and exposed surfaces must be finished with thickened epoxy. Use system as directed by the manufacturer. Finish with two coats of exterior grade paint as chosen and approved by the engineer-of-record and/or owner between 24 and 72 hours after final application of epoxy. If after 72 hours the epoxy is cured, the surface must be roughened by hand sanding or brush blasting, prior to finishing.

3.03 INSPECTION AND TESTING

A. Field Inspection
   1. The contractor shall monitor the mixing of all epoxy components for proper ratio and adherence to manufacturer’s recommendations. Record batch numbers for fabric and epoxy used each day and note locations of installation. Measure square footage of fabric and volume of epoxy used each day. Complete report and submit to Owner, engineer-of-record and FRP composite system manufacturer.
   2. If a Qualified Inspector is required, the Qualified Inspector shall periodically observe all aspects of preparation, mixing, and application. All FRP composite applied areas shall be inspected, in accordance with the manufacturer’s specifications for voids, bubbles, and delamination. All defective areas shall be repaired as per Section 3.04 in this specification.

B. ASTM D7522 and/or ASTM D4541 – Direct Tension Adhesion Tests
   1. Direct tension adhesion testing shall be conducted using the method described by ASTM D7522 and/or ASTM D4541. A minimum of one such test shall be performed for each 1,000 ft² of surface area to be covered by the FRP application. Pull-off tests shall be performed on a representative adjacent area to the area being strengthened whenever possible. Tests shall be performed on each type of substrate (i.e. beams & walls) or for each surface preparation technique used.
   2. The epoxy bonded to the prepared surface shall be allowed to cure as per manufacturer’s requirements before execution of the direct tension pull-off test. The locations of the pull-off tests shall be representative and on flat surfaces. If no adjacent areas exist, the tests shall be conducted on areas of the installed FRP system subjected to relatively low stress during service.
   3. The minimum acceptable value for any pull-off test is 175 psi. The average of the tests shall not be less than 200 psi. Additional tests may be performed to qualify the work at each identified area. Each pull-off test is to exhibit a failure mode in the substrate and not the epoxy-to-substrate bond plane.

C. Laboratory Testing
   1. Sampling

a. Record lot number of fabric and epoxy resin used, and location of installation. Measure square footage of fabric and volume of epoxy used each day. Label each sample from each day's production.
b. A "sample batch" shall consist of two 12" by 12" samples of cured composite [note: one 12" by 12" sample creates 5 coupons for ASTM D7565 and/or ASTM D3039 Tension Tests, see 3.3.5 and 3.3.6 of this specification]. A minimum of one "sample batch" shall be made daily. Each sample of the "sample batch" will be taken at appropriate times during the day as to ensure the maximum material deviance in the components of the FRP composite.

2. Preparation of Samples
a. Prepare sample on a smooth, flat, level surface covered with polyethylene sheeting, or 16 mil plastic film, prime with epoxy resin. Then place one layer of saturated fabric and apply additional topping of epoxy. Cover with plastic film and squeegee out all bubbles.
b. Samples shall not be moved for a minimum 48 hours after casting. After removing from sample table, samples shall be stored in a secured location / box. The prepared, identified samples shall be given to a pre-approved and experienced testing laboratory. The laboratory shall then precondition samples for 48 hours at 140°F before testing.

D. ASTM D7565 and/or ASTM D3039 – Material Tension Tests
1. A minimum of fifteen-percent of all 12" x 12" sample panels shall be tested. Testing specimens shall be cut from samples and tested for ultimate tensile strength, tensile modulus and percentage elongation as per ASTM D7565 and/or ASTM D3039 in the longitudinal/primary fiber direction.
2. The reported properties for the ultimate tensile stress and the tensile modulus shall be based on the gross laminate thickness as indicated on the product data sheet and the approved evaluation service report.
3. Tensile properties must meet or exceed FRP composite system properties as defined in project specifications. If one coupon does not achieve the design properties, additional coupons from the same sample shall be tested. If these coupons fail (on average), coupons from the other 12" x 12" sample, from the same batch for that day, shall be tested. If all tested samples of the sample batch do not meet the conditions of acceptance, it is recommended that 25 percent of all samples be tested.

E. Acceptance Criteria
1. FRP design values must be lower than the calculated mean determined from the test results received from the ASTM D7565 and/or ASTM D3039 field test specimens. Acceptable minimum values for ultimate tensile strength and tensile modulus shall not be below the submitted design values unless calculations are performed using the tested values that exhibit an acceptable capacity as per the original design demands and concept.

F. At the termination of the project, the contractor shall provide a field quality control report showing compliance with all aspects of the manufacturer's certification requirements.

3.04 REQUIRED REMEDIATION

A. Small voids [on the order of 3" diameter] shall be injected or back filled with epoxy.

B. Voids and delaminations on the order of 6" in diameter or an area of 5" x 5" shall be reported to the engineer of record and remediation shall be submitted by the contractor for approval.

C. In the event that the FRP system does not meet the Acceptance Criteria as per laboratory testing and calculations (refer to Section 3.03.E of this specification), remedial measures shall be taken. Any structural member where the installed FRP system does not meet the

Acceptance Criteria, additional layers shall be installed until the FRP meets design requirements, or any other remediation directed by the Engineer of Record.

3.05 MAKE GOOD

A. Make good at no cost to the Owner, any damage to the new or existing structures, property or services caused by the installation and testing of the FRP composite.

3.06 CLEAN UP

A. Remove all surplus material, equipment and debris from the site on completion of the work. Leave the site clean.

END OF SECTION 03 9300

SECTION 04 2000
UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.
B. Mortar and grout.
C. Reinforcement and anchorage.
D. Flashings.

1.02 RELATED REQUIREMENTS

A. Section 03 1000 - Concrete Forming and Accessories
B. Section 03 2000 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
C. Section 07 6200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
D. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

A. The applicable version of the standards listed below shall be per Chapter 35 of Part 2 of the 2022 edition of the California Building Code (CBC), including addendums and errata. Where the standard is not listed in the CBC, then the most current version of the standard shall be used or as referenced by other standards.
    1. ACI 216 - Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies.
    2. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    3. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
    4. ASTM C5 - Specification for Quicklime for Structural Purposes.
    5. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
    6. ASTM C91/C91M - Standard Specification for Masonry Cement.
    7. ASTM C110 - Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone.
    8. ASTM C114 - Method for Chemical Analysis of Hydraulic Cement.
    9. ASTM C140 - Sampling and Testing Concrete Masonry Units.
    10. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.
    11. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
    12. ASTM C150/C150M - Standard Specification for Portland Cement.
    13. ASTM C207 - Specification for Hydrated Lime for Masonry Purposes.
    14. ASTM C260 - Specification for Air-Entraining Admixtures for Concrete.
    15. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
    16. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
    17. ASTM C426 - Test Method for Linear Drying Shrinkage of Concrete Masonry Units.
    18. ASTM C476 - Standard Specification for Grout for Masonry.
    19. ASTM C494 - Specification for Chemical Admixtures for Concrete.

20. ASTM C744 - Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
21. ASTM C979 - Specification for Pigments for Integrally Colored Concrete.
22. ASTM C1019 - Test Method of Sampling and Testing Grout.
23. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
24. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

B. California Code of Regulations (CCR):
   1. CBSC, Title 24, Part 2- California Building Code (CBC), 2022 edition.
      a. Chapter 17 - Structural Tests and Inspections.
      b. Chapter 21 - Masonry.

C. ICC Evaluation Service, Inc. (ICC ES), a subsidiary corporation of the International Code Council:
   1. ICC ES Evaluation Reports (ESR) for Materials, Products, Methods, and Types of Construction with current report conforming to the applicable building code.

D. International Association of Plumbing and Mechanical Officials (IAPMO):
   1. IAPMO Uniform Evaluation Service (UES) Report for Materials, Products, Methods, and Types of Construction with current report conforming to the applicable building code.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.

D. Samples: Submit samples of units to illustrate color, texture, and extremes of color range.

E. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

F. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.

G. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 UNIT MASONRY, GENERAL

A. Materials, construction and workmanship shall be in accordance with tms 402/602 and cbc chapter 21.

2.02 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 by 8 inches and by thickness of wall as indicated on conctract drawings
      a. Cap units shall be 2 inches high by 16 inches long by thickness of wall.
   2. Shapes: Provide open end units typically.
      a. Bond Beam Block: Deep cut type.
      b. Provide lintel units over wall openings.
      c. Special Units: Provide cap, end, corner, pilaster, and other special units as required.
   3. Load-Bearing Units: ASTM C90, medium weight.
      a. Hollow block, as indicated.
   4. Nonloadbearing Units: ASTM C129.
      a. Hollow block, as indicated.
   5. Average oven-dry density of solid grouted medium weight CMU block shall not exceed 115 pounds per cubic foot.
   6. Admixture: Add water repellent admixture to block mix used for exterior construction in accordance with recommendations of manufacturer.
   7. Surface Texture:
      a. Buildings: Provide smooth precision block surface, or as indicated on drawings.
      b. Site Walls: Ground-Face (Burnished) Units, or as indicated in drawings.
   8. Block Color:
      a. Smooth: Provide natural color unless noted otherwise on the Contract Drawings.
      b. Ground Face: Provide natural color unless noted otherwise on the Contract Drawings.

2.03 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type II; color as required to produce approved color sample.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Aggregate: ASTM C144.

D. Grout Aggregate: ASTM C404, coarse type.

E. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
   1. Color(s): As indicated on drawings.

F. Water: Clean and potable.

G. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
   1. Use only in combination with masonry units manufactured with integral water repellent admixture.

2. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
3. Meet or exceed performance specified for water repellent admixture used in masonry units.

2.04 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: Type specified in Section 03 2000; size as indicated on drawings.

B. Supports and spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete.

C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

2.05 FLASHINGS

A. Metal Flashing Materials: As specified in Section 07 6200.

2.06 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
1. Type as indicated on drawings.
2. Minimum compressive strength of the mortar shall be as required to achieve the compressive strength (f'm) of masonry specified when combined with masonry units used in the structure.
3. Proportion per CBC Chapter 21 and TMS 402/602.
4. Water Repellent Admixture: Add water repellent admixture to mortar mix in accordance with recommendations of manufacturer.

B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
1. Minimum compressive strength of the grout shall be as required to achieve the compressive strength (f'm) of masonry specified when combined with masonry units used in the structure, with a minimum compressive strength of 2500 psi.
2. Proportions: In accordance with ASTM C376.

C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

D. Mixing: Use mechanical batch mixer and comply with referenced standards.

2.07 PERFORMANCE CRITERIA

A. Minimum specified average net area compressive strength (f'm) of masonry assembly shall be in accordance with the contract drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

C. Verify dowels are properly located.

D. Do not commence installation until foundations are clean, rough, and level, or until floor slabs are structurally sound. Clean projecting dowels free from loose scale, dirt, concrete, and other material that will inhibit bond.

3.03 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 and CBC Chapter 22.

3.04 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
   1. Bond: Running.
   2. Mortar Joints: Concave.

3.05 PLACING AND BONDING

A. Lay hollow masonry units with face shell bedding on head and bed joints.

B. Lay only dry masonry units

C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

D. Remove excess mortar and mortar smears as work progresses.

E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.

F. Interlock intersections and external corners, except for units laid in stack bond.

G. Provide full mortar coverage on horizontal and vertical face shells and webs in courses of the following:
   1. Piers, columns, and pilasters.
   2. Starting course on footings and solid foundation walls. Provide full bedding under both the face shell and web.
   3. Where adjacent to cells or cavities to be filled with grout.

H. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

I. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

J. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

K. If necessary to stop a horizontal run of masonry, rack back one-half block length in each course. Do not use toothing to join new masonry to set or partially set masonry when continuing a horizontal run.

L. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.

M. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

N. Horizontal and Vertical Face Joints:
   1. Thickness: 3/8-inch nominal, and uniform in appearance.
   2. When thumb-print hard, tool joints in exposed surfaces with round jointer for concave joint. Mortar joints shall be tooled only where walls will be left exposed.
      a. Compress and strike off for flush joints when serving as a base for plaster, textured coatings, membrane waterproofing or dampproofing.
   3. Remove mortar protruding into cells of cavities to be reinforced or filled.

3.06 REINFORCEMENT AND ANCHORAGE - GENERAL

A. Provide reinforcing as shown on contract drawings.

B. Install reinforcing in conformance with TMS 402/602.

3.07 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

3.08 GROUTED COMPONENTS

A. Lap splices as indicated on drawings.

B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

C. Place and consolidate grout fill without displacing reinforcing.

3.09 CONTROL JOINTS

A. Continue horizontal joint reinforcement through control joints.

B. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.

3.10 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
   1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

D. Do not build into masonry construction organic materials that are subject to deterioration.

3.11 TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.

3.12 CUTTING AND FITTING

A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.13 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

3.14 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

3.15 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

B. Cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
   2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

C. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

D. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from mud and from mortar splatter by coverings spread on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

END OF SECTION

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SECTION 05 0511
SURFACE PREPARATION AND FINISHING OF METALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation, treatment, and finishing of metals and metal components specified in other Sections, including:
   1. Steel and iron surface preparation.
   2. Steel galvanizing.
   3. Steel Galvaneeling.
   4. Galvalume steel.
   5. Stainless steel.
   6. Aluminum anodizing.

B. Shop priming of metals and metal components specified in other Sections for field finish.

1.02 RELATED REQUIREMENTS

A. Section 05 0513 - Shop-Applied Coatings for Metal; for coil and extrusion coatings for metal.

B. Section 09 9113 - Exterior Painting.

C. Section 09 9123 - Interior Painting.

D. Section 09 9600 - High-Performance Coatings.

1.03 DEFINITIONS

A. Mechanical Finish: Provides a surface texture by only mechanical means; does not use chemical, electrochemical treatment, or additive. Finished textures vary widely, based on grinding, polishing, and buffering operations, or combinations, used..
   1. Directional Textured Finish: Satiny sheen produced by tiny, nearly parallel scratches in the metal surface produced by wheel or belt polishing with fine abrasives, by hand rubbing with stainless steel wool, or by brushing with abrasive wheels.
   2. Non-Directional Textured Finish: Matte finish of varying degrees of roughness, produced by blasting sand, glass beads, or metal shot against the metal under controlled conditions. The smoothest finish is obtained by dust blasting with a very fine abrasive and by vapor honing with a slurry of extremely fine abrasive and water. Non-directional textured finishing is not recommended on material less than 1/4 inch thick, and a surface protective treatment is required.
   3. Patterned Finish: Produced by passing sheet between 2 machined matched design rolls, impressing patterns on both sides of the sheet (embossing), or between a design roll and a smooth roll which "coins" one side of the sheet only.

B. Chemical Treatment: Used as either processing for a final finish, or as a final finish.
   1. Surface cleaning only, such as degreasing.
   2. To produce a clean matte textured surface.
   3. To produce a smooth, bright finish.

4. To chemically convert the surface of the metal, providing a film which is a good substrate for coatings (conversion coating). Can be used to prepare the surface for painting or as a final finish.

C. Anodic Coating (Anodizing): Process in which metal is immersed in an acid solution (referred to as an electrolyte), and a direct current is passed between the aluminum and the electrolyte, with the metal acting as the anode. This results in the controlled formation of a durable aluminum oxide film or coating, which does not affect the surface of the metal, but greatly increases the metal's resistance to corrosion and abrasion.

D. Galvanizing: Process of applying a coating of zinc to steel or iron, to prevent rusting. The zinc protects the underlying metal by sealing the surface from airborne corrodents, and through galvanic action.

E. Galvannealing: Steel which is galvanized, then passed through air knives to remove excess zinc, and finally annealed in a furnace while the zinc is still in a fluid state. This produces a surface layer of zinc-iron alloy. Galvannealed steel has excellent welding and paint adhesion properties.

F. Passivate: To protect a metal from corrosion by creation of an outer layer, through chemical reaction.

G. Weathering Steel: A type of steel which patinas under normal atmospheric conditions, protecting it from corrosion.

1.04 REFERENCE STANDARDS

A. AA DAF-45 - Designation System for Aluminum Finishes; 2003 (Reaffirmed 2009).

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

E. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2023.

F. ASTM D6386 - Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting; 2022.

G. ASTM D7803 - Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Powder Coating; 2019.

H. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals; 2016.

I. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

J. SSPC-SP 3 - Power Tool Cleaning; 2018.

K. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

L. SSPC-SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals; 2020.

1.05 SUBMITTALS

A. Refer to submittals in other Sections which specify finishes in this Section.

B. Maintenance Materials: Where field repair of shop-applied coating is acceptable, provide container of material to perform minor corrective work.

1.06 COORDINATION

A. Confirm treatment of metal is compatible with and allows specified warranty for paint and coating systems specified in other sections.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Apply standard protective coverings to finished surfaces.

1.08 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions by field measurement before fabrication. Show recorded measurements on shop drawings.

B. Ambient Conditions:

1.09 WARRANTY

A. Applicator's Warranty: Applicator agrees to repair finish of replace coated metal products that demonstrate deterioration of factory-applied systems within warranty period.
   1. Class I anodized finish: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. Shop-applied finishes to meet or exceed minimum performance requirements in this Section.

2.03 STEEL AND IRON SURFACE PREPARATION

A. Prepare metal surfaces according to SSPC standards prior to application of coatings listed in this and other Sections.
   1. Structural Steel: See 05 1200 - Structural Steel Framing, for surface preparation of structural steel.
   2. SSPC-SP 3: Power Tool Cleaning.
      a. Description: Requirements for power tool cleaning of steel surfaces. Power tool cleaning removes all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife.
      b. Use for the following:
         1) Steel items not otherwise listed below.
   3. SSPC-SP 6/NACE No.3: Commercial Blast Cleaning.

a. Description: Requirements for commercial blast cleaning of uncoated or coated steel surfaces by the use of abrasives. A commercial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter. Random staining shall be limited to no more than 33 percent of each unit area of surface, and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coating.
b. Use for the following:
    1) Exterior items.
    2) Items indicated to receive zinc-rich primer.

4. SSPC-SP 16: Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
    a. Description: Requirements for roughening and cleaning hot-dip galvanized surfaces to create a profile suitable for painting or coating. Completion of this process produces a profiled surface free of all visible oil, grease, dirt, dust, metal oxides, and other foreign matter when viewed without magnification. The standard also contains unique procedures, including inspection for a passivation treatment and wet storage stain.
    b. Use for the following:
        1) Galvanized-steel items to be painted or coated, including powder coating.
    c. Acceptable alternative preparation method for galvanized items to be painted: ASTM D6386.
    d. Acceptable alternative preparation method for galvanized items to be powder-coated:ASTM D7803.

2.04 STEEL GALVANIZING

A. Galvanizing: Hot-dip galvanize steel and iron items to comply with the following:
    1. Sheet Steel: ASTM A653/A653M. Total both sides weight of coating as follows:
        a. G30 (Z90 metric): 0.30 oz/ft2.
        b. G40 (Z120 metric): 0.40 oz/ft2.
        c. G60 (Z180 metric): 0.60 oz/ft2.
        d. G90 (Z275 metric): 0.90 oz/ft2.
        e. G115 (Z350 metric): 1.15 oz/ft2.
    2. Steel and Iron Hardware: ASTM A153/A153M. Weight of coating as follows:
        a. Class A: Castings, malleable iron, and steel: 2.0 oz/ft2 minimum.
        b. Class B1: Rolled, pressed, and forged articles 5/8 inch in thickness and over 15 inches in length: 2.0 oz/ft2 minimum.
        c. Class B2: Rolled, pressed, and forged articles under 5/8 inch in thickness and over 15 inches in length: 1.5 oz/ft2 minimum.
        d. Class B3: Rolled, pressed, and forged articles, any thickness and less than 15 inches in length: 1.3 oz/ft2. minimum.
        e. Class C: Fasteners over 3/8 inch in diameter and similar, and washers 3/16 inches and greater in thickness: 1.25 oz/ft2 minimum.
        f. Class D: Fasteners 3/8 inch and under in diameter, including rivets, nails, and similar; and washers under 3/16 inch in thickness: 1.0 oz/ft2 minimum.
    3. Steel and iron products made from rolled, pressed, and forged shapes, castings, plates, bars, and strips: ASTM A153/A153M.
    4. Galvanized Steel to be Painted / Coated: Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.

2.05 STEEL GALVANNEALING

A. Galvannealed Steel: Zinc-iron alloy-coated (Galvannealed) steel to comply with the following:
   1. Steel Sheet: ASTM A653/A653M. Total both sides weight of coating as follows:
      a. A25 (ZF75 metric): 0.25 oz/ft2.
      b. A40 (ZF120 metric): 0.40 oz/ft2.
      c. A60 (ZF180 metric): 0.60 oz/ft2.

2.06 GALVALUME STEEL

A. Galvalume Steel: 55 percent aluminum-zinc alloy-coated (Galvalume) steel to comply with the following:
   1. Steel Sheet: ASTM A792/A792M. Total both sides weight of coating as follows:
      a. AZ30 (AZM100 metric): 0.30 oz/ft2.
      b. AZ35 (AZM110 metric): 0.35 oz/ft2.
      c. AZ40 (AZM120 metric): 0.40 oz/ft2.
      d. AZ50 (AZM150 metric): 0.50 oz/ft2.
      e. AZ55 (AZM165 metric): 0.55 oz/ft2.
      f. AZ60 (AZM180 metric): 0.60 oz/ft2.
      g. AZ70 (AZM210 metric): 0.70 oz/ft2.

2.07 STAINLESS STEEL

A. Stainless Steel: Alloys of steel containing greater than 10 percent chromium.
   1. Standard Environments: Exterior, exposed stainless steel to be Type 304, typical unless noted otherwise.
   2. Corrosive Environments: Exterior, exposed stainless steel to be Type 316L, typical unless noted otherwise.
   3. See Section 01 1000 - Summary, for additional information.

B. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

C. Provide finish as specified in other Sections.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.08 ALUMINUM, GENERAL

A. Treat and finish aluminum according to the Aluminum Association Designation System AA DAF-45. Treatment and finish of aluminum components may include combinations of mechanical finishes (M##), chemical treatments and finishes (C##), and anodic coatings (A##), as defined by AA DAF-45.

B. Subject to compliance with requirements, acceptable aluminum treatment and finishing processors include:
   1. ABC Aluminum Solutions.
   2. Linetec.
   3. Lorin.
   4. Pioneer Metal Finishing.
   5. Quality Coatings.
   6. Sierra Aluminum Company.
   7. Southern Aluminum Finishing (SAF).

8. Substitutions: See Section 01 2500 - Substitution Procedures.

2.09 ALUMINUM ANODIZING

A. Class I Anodizing: When specified in other Sections, provide anodizing treatment of aluminum as designated by AA DAF-45 and compliant with AAMA 611, Class I:
   1. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.
   2. Color Anodic Finish: AAMA 611, Class I, AA-M12C22A42/43/44.
      a. Color: As specified in applicable Section or as selected by Architect.
   3. AAMA 611, Class I Minimum Performance Requirements:
      a. Film Thickness: 0.7 mils.
      b. Salt Spray Resistance: 3,000 hours.
      c. Color Retention: Maximum of 5 Hunter units of color change in 10 years.
      d. Gloss Uniformity: 15 unit Variation.
   4. Location:
      a. All exterior applications.
      b. Interior applications subject to excessive wear or abrasion.

B. Class II Anodizing: When specified in other Sections, provide anodizing treatment of aluminum as designated by AA DAF-45 and compliant with AAMA 611, Class II:
   1. Clear Anodic Finish: AAAMA 611, Class II, AA-M12C22A31.
   2. Color Anodic Finish: AAMA 611, Class II, AA-M12C22A32/33/34.
      a. Color: As specified in applicable Section or as selected by Architect.
   3. AAMA 611, Class II Minimum Performance Requirements:
      a. Film Thickness: 0.4 mils.
      b. Salt Spray Resistance: 1,000 hours.
      c. Color Retention: Maximum of 5 Hunter units of color change in 10 years.
      d. Gloss Uniformity: 15 unit Variation.
   4. Location:
      a. Interior applications not subject to excessive wear or abrasion.

2.10 STRUCTURAL STEEL SHOP PRIMING

A. See Section 05 1200 - Structural Steel Framing for additional information.

2.11 SHOP PRIMING FOR FIELD FINISH

A. Shop Primers: Provide primers that comply with field finish, as specified in the following Sections:
   1. Section 09 9113 - Exterior Painting.
   2. Section 09 9123 - Interior Painting.
   3. Section 09 9600 - High-Performance Coatings.

B. Shop Priming: Apply shop primer to comply with SSPC-PA 1.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

2.12 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paint specified to be used over it.

PART 3 EXECUTION

3.01 REPAIR

A. Field Repair: When acceptable to manufacturer, field repair shop-applied coatings per manufacturer's instructions and materials.
   1. When not acceptable, return to shop for corrections.

B. Replace items that cannot be repaired.

END OF SECTION

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SECTION 05 0513
SHOP-APPLIED COATINGS FOR METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Factory-applied, heat-cured coating systems for metal substrates.

1.02 RELATED REQUIREMENTS

A. Section 09 9113 - Exterior Painting: For shop and field applied air-cured paint for steel substrates.

B. Section 09 9600 - High-Performance Coatings: For shop and field applied air-cured high-performance coatings for steel substrates.

1.03 DEFINITIONS

A. Coil Coating: Coating system applied in liquid form to continuous flat metal stock. The finished metal is wound into a circular coil for later fabrication by others. This is a type of pre-painting.

B. Extrusion Coating: Coating system spray-applied to extruded components, flat metal that is too thick to be coil coated (greater than 0.080 inches), and decorative metal with voids and other openings. This is a type of post-painting. Extrusion coatings can be both liquid and powder form.

C. Mica Finish: Utilizes mica, a naturally occurring mineral, which provides a pearlescent appearance. Mica powder provides better color consistency than metal flakes.

D. Metallic Finish: Utilizes metal flakes for a sparkle appearance.

E. Barrier Coat: Used in a four-coat system only, to protect the prime coat below from UV damage.

1.04 REFERENCE STANDARDS

A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

D. ASTM D523 - Standard Test Method for Specular Gloss; 2014 (Reapproved 2018).

E. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2022.

F. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2023.

G. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2023.

H. ASTM D7091 - Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals; 2022.

1.05 SUBMITTALS

A. See Section Section 01 3000 - Administrative Requirements.

B. Refer to submittals in other Sections which specify finishes in this Section.

C. Maintenance Materials: Where field repair of shop-applied coating is acceptable, provide container of material to perform minor corrective work.

D. Qualification Statement: For installer.

1.06 COORDINATION

A. Coordinate substrates and shop-applied coating systems. Where items are indicated to match coatings selected for other items, adjust formulations as required to achieve match.

1.07 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Applicator Qualifications: Coating manufacturer's certified applicator equipped and trained for application of coatings, and approved to provide warranty specified.

1.08 DELIVERY, STORAGE & HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver, unload, and store coated items so that they remain free of damage and deformation. Package and protect items during shipping and handling. Protect stored items from water. Keep coated items out of contact with materials that may adversely affect the coating.

C. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.09 WARRANTY

A. See Section 01 6000 - Product Requirements.

B. Contractor to provide Single Source Specimen Warranty (color, chalk, and fade), as provided by Coating Manufacturer, as part of Total System Executed Warranty (corrosion, adhesion) as provided by end manufacturer for both coil and extrusion products.

C. Special Coating Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which coatings do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Superior Coatings (AAMA 2605) Warranty Period: 20 years from date of Substantial Completion.
   3. High-Performance Coatings (AAMA 2604) Warranty Period: 10 years from date of Substantial Completion.

4. Pigmented Coatings (AAMA 2603) Warranty Period: 1 year from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Coatings in this Section are divided into three performance levels, from highest to lowest, as defined by organization standards and supported by manufacturer's warranty:
   1. Superior.
   2. High-Performance.
   3. Pigmented.

B. Refer to referenced standards for additional performance requirements not listed here.

C. Superior Coatings:
   1. Warrantied Substrates:
      a. Aluminum extrusions (AAMA 2605).
      b. Aluminum coil (AAMA 2605 Appendix).
      c. Galvanized steel coil (AAMA 2605).
   2. Minimum Performance Requirements:
      a. Test Duration: 4,000 hours.
      b. Dry Film Thickness (ASTM D7091): 1.2 mils minimum.
      c. Abrasion Resistance (ASTM D968): Coefficient of 40 minimum.
      d. Color Retention (ASTM D2244): Maximum of 5 Hunter units of color change.
      e. Chalk Resistance (ASTM D4214): No more than No. 8 rating for color, No. 6 rating for whites, after 10 years.
      f. Gloss Retention (ASTM D523): More than 50 percent retention after 10 years.

D. High-Performance Coatings:
   1. Warrantied Substrates:
      a. Aluminum extrusions (AAMA 2604).
      b. Aluminum coil (AAMA 2604 Appendix).
   2. Minimum Performance Requirements:
      a. Test Duration: 3,000 hours.
      b. Dry Film Thickness (ASTM D7091): 1.2 mils minimum.
      c. Abrasion Resistance (ASTM D968): Coefficient of 20 minimum.
      d. Color Retention (ASTM D2244): Maximum of 5 Hunter units of color change.
      e. Chalk Resistance (ASTM D4214): No more than No. 8 rating for color after 5 years.
      f. Gloss Retention (ASTM D523): Minimum 30 percent retention after 5 years.

E. Pigmented Coatings:
   1. Warrantied Substrates:
      a. Aluminum extrusions (AAMA 2603).
      b. Aluminum coil (AAMA 2603 Appendix).
   2. Minimum Performance Requirements:
      a. Test Duration: 1,500 hours.
      b. Dry Film Thickness (ASTM D7091): 0.8 mils minimum.
      c. Color Retention (ASTM D2244): Slight change allowed.
      d. Chalk Resistance (ASTM D4214): Slight change allowed.
      e. Gloss Retention (ASTM D523): Slight change allowed.

2.02 MANUFACTURERS

A. Manufacturers:
   1. AkzoNobel.
   2. Sherwin Williams (formerly Valspar).
   3. PPG.
   4. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Single Source: For each coating system, provide all components of system from same manufacturer.

2.03 SHOP-APPLIED COATINGS, GENERAL

A. Comply with coating manufacturer's written instructions for cleaning, conversion coating, applying, and baking finish.

B. UV-Stable Primers: For finish coats that are transparent, translucent, iridescent, and metallic, provide UV-stable primer to protect coating system integrity.

C. Gloss: As selected by Architect from manufacturer's range for specific system, typical.

D. Clear coat: Optional protection to color coat, except for metallic flake or as another barrier coat that can easily be rinsed with fresh water to eliminate salt residue or used to improve chalk and fade resistance.

2.04 SUPERIOR COATINGS (AAMA 2605)

A. 70 percent PVDF Fluoropolymer, Two-Coat: Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
   1. System Components: Primer and PVDF color coat.
   2. Extrusion Products:
      a. AkzoNobel; Trinar Ultra.
      b. PPG; Duranar.
      c. Sherwin Williams; Fluropon.
   3. Coil Products:
      a. AkzoNobel; Trinar Ultra.
      b. PPG; Duranar.
      c. Sherwin Williams; Fluropon.
   4. Color: See Architectural drawings.
   5. Gloss: As selected from manufacturer's full range.
   6. Duranar GR Graffiti Resistant Coating System - as supplied by AEP Span consisting of a PVDF Fluoropolymer with a Standard Primer of 0.15 - 0.30 mil, a Standard Topcoat of 0.70 - 0.80 mil, and a GR Clear of 0.45 - 0.55 mil, formulated to work in conjunction with PPG's DuraPrep 400 Graffiti Remover.

1.02 FIELD TOUCH-UP MATERIAL

A. Field Touch-Up Material: Field-applied, air-dry system recommended by coating manufacturer for substrate and location.

1.03 FACTORY AND SHOP FINISHING

A. Pretreatment: Mechanically clean and chemically pre-treat fabricated items in accordance with coating manufacturer's requirements and AAMA requirements for finish indicated.

B. Apply primer and finish coats in accordance with coating manufacturer's requirements for finish indicated.

C. Thermally cure coating immediately following application.

D. Process coil coatings in one production run for metallic coatings.

E. Surface Appearance: Cured coating must be visibly free from flowlines, streaks, blisters and other surface imperfections on exposed surfaces.
   1. Surfaces shall have no signs of mill finish aluminum or galvanized material showing.
   2. No rack or gripper marks caused by the finishing process on exposed aluminum surfaces will be permitted.

PART 3 EXECUTION

2.01 EXAMINATION

A. See Section 01 7000 - Execution and Closeout Requirements.

B. Examine finished metal products to confirm no damage has occurred.
   1. Damaged products that cannot be fixed by field touch-up, to the satisfaction of the Architect, will be rejected.

2.02 REPAIR AND TOUCH-UP

A. Repair with coating manufacturer's recommended products or system.

B. Apply to all minor areas of exposed metal due to scratches, abrasions, in-field end cuts or of the like typically occurring during transit or installation of product, to ensure protection of the metal substrate.

2.03 PROTECTION

A. See Section 01 7000 - Execution and Closeout Requirements.

B. Provide barrier or other delineation to prevent damage to installed Work from subsequent construction activities.

END OF SECTION

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SECTION 05 1200
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Grout.

B. Related Requirements
   1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.

1.03 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preconstruction Coordination Meetings
   1. Steel and Concrete Preconstruction Coordination Meeting: Conduct coordination meeting at project site a minimum of 3 weeks prior to submitting any shop drawings or procurement of materials.
      a. Require representatives of each entity directly concerned with steel fabrication and erection and concrete placement to attend, including but not limited to the following:
         1) Construction Manager
         2) Steel Fabricator
         3) Steel Erector
         4) Concrete Contractor
         5) Structural Engineer of Record
         6) Architect of Record
      b. Review the following:
         1) Anchor rod installation and tolerances
         2) Method for securing anchor rods against movement during concrete placement
         3) Steel Embed Plates
         4) Submittal Schedules
         5) Critical Path and Long Lead Items
         6) Any and all items that require cross-trade coordination

B. Pre-installation Conference: Conduct conference at project site before submitting shop drawings.
   1. Require representatives of each entity directly concerned with steel fabrication and erection to attend, including the following:Construction Manager

a. Steel Fabricator
b. Steel Erector
c. Buckling Restrained Braced Frame Supplier
d. Special Inspector
e. Structural Engineer of Record

2. Review the following:
a. Shop drawing development and review procedures.
b. Special inspection and testing and inspecting agency procedures for field quality control.
c. Procedures for fabricating, locating and erecting sloped columns
d. Fabrication and erection tolerances.
e. Anchor rod and anchorage device installation tolerances.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating postconsumer and pre-consumer recycled content and cost
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
5. Each product permanently installed shall meet the following criteria in accordance with the 2022 California Green Building Code.

BUY CLEAN CALIFORNIA MATERIALS PRODUCT CATEGORY	MAXIMUM ACCEPTABLE GWP VALUE (unfabricated) (GWP allowed)	UNIT OF MEASUREMENT
Hot-rolled structural steel sections	1.77	MT CO_2e/MT
Hollow structural sections	3.00	MT CO_2e/MT
Steel plate	2.61	MT CO_2e/MT

C. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Identify demand critical welds.

D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint qualified by testing, including the following:
1. Power source (constant current or constant voltage).

2. Electrode manufacturer and trade name, for demand critical welds.

1.06 INFORMATION SUBMITTALS

A. Qualification Data: For qualified Installer and fabricator.

B. Welding certificates.

C. Mill test reports for structural steel, including chemical and physical properties.

D. Product Test Reports: For the following:
   1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   2. Shear stud connectors.
   3. Tension-control, high-strength, bolt-nut-washer assemblies.
   4. Shop primers.
   5. Nonshrink grout.

E. Shop drawings for temporary bracing required to erect the structure prior to completion

F. Source quality-control reports.

G. Field quality-control and special inspection reports.

1.07 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU.

B. Erector Qualifications: A qualified steel erector who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE, ACSE, or CSEA.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

D. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 341.
   3. AISC 360.
   4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.09 COORDINATION

A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: See Structural Drawings
B. Channels, Angles, and Tees: See Structural Drawings
C. Plate and Bar: See Structural Drawings
D. Cold-Formed Hollow Structural Sections: See Structural Drawings
E. Steel Pipe: See Structural Drawings
F. Welding Electrodes: Comply with AWS requirements, indicated on Drawings.

2.02 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers:
   1. Grade: See Structural Drawings, Type 1, heavy-hex steel structural bolts
   2. Nuts: ASTM A 563, Grade C, heavy-hex carbon-steel
   3. Washers: ASTM F 436, Type 1, hardened carbon-steel
   4. Finish: Plain
B. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
C. Unheaded Anchor Rods: See Structural Drawings, weldable.
   1. Configuration: Straight.
   2. Nuts: ASTM A 56 heavy-hex carbon steel.
   3. Plate Washers: ASTM A 36 carbon steel.
   4. Washers: ASTM F 436, Type 1, hardened carbon steel.
   5. Finish: Plain.
D. Threaded Rods: ASTM A 36.
   1. Nuts: ASTM A 563 heavy-hex carbon steel.
   2. Washers: ASTM F 436, Type 1, hardened carbon steel.
   3. Finish: Plain Hot-dip zinc coating, ASTM A 153, Class C.
E. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
F. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
G. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.03 PRIMER

A. Primer: SSPC-Paint 25, Type I, zinc oxide, alkyd, linseed oil primer.
B. Galvanizing Repair Paint: ASTM A780

2.04 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.05 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A6 and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

C. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."

G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

H. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Baseplate Holes: Cut, drill, or punch holes perpendicular to steel surfaces.
   3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.06 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

B. Joint Type: Snug tightened.

C. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.07 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections.
   4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).

5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Prepare steel and apply a one-coat, primer complying with SSPC-Paint 25, Type I, zinc oxide, alkyd, linseed oil primer to provide a dry film thickness of not less than 1.5 mils.

2.08 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
   1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

B. Galvanize lintels, shelf angles, and other steel exposed to weather unless specified as painted.

2.09 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   3. Ultrasonic Inspection: ASTM E 164.
   4. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:
   1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
   1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.03 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Provide temporary bracing as required to maintain support structure during construction, prior to completion of the superstructure.

C. Baseplates and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.
   3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

E. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

F. Splice members only where indicated.

G. Do not use thermal cutting during erection.

H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.04 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: See structural drawings

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
   3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, field-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:
   1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A780.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC- PA 1 for touching up shop-painted surfaces.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 1200

SECTION 05 1210
WELDING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Work included in This Section:
   1. Provisions for the welding of all structural steel members. This includes both field and shop welding.
   2. All Welding shall be performed in full accordance with the latest edition of the AWS D1.1 Structural Welding Code-Steel, except as supplemented or modified by this specification. Reiteration or amplification of code provisions as contained in the specification shall not reduce the necessity of compliance with all other code requirements.
   3. Shop welding may be by any of the AWS D1.1 approved welding processes except electroslag (ESW) and electrogas (EGW) without specific approval by the engineer.

B. Related Sections:
   1. All pertinent provisions of Division 01, “General Requirements.”
   2. Section 03 2000: Concrete Reinforcement
   3. Section 05 1200: Structural Steel Framing
   4. Section 05 3100: Metal Floor and Roof Decking
   5. Section 01 8113: Sustainable Design Requirements

1.03 REFERENCES

A. References as specified in Section 05 1200, “Structural Steel Framing.”

B. Applicable portions of specification section 05 1200 apply to the work of this section. Contractor shall be responsible to incorporate all applicable portions of specification section 05 1200 into this section.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Division 01, “Submittal Procedures.”

B. Welding Procedure specification (WPS):
   1. All WPS's shall be submitted to the Structural Engineer of Record (SEOR) for review and approval prior to use.
   2. For WPS's that have been qualified by test, the supporting Procedure Qualification Record (PQR) shall be submitted to the Engineer for review and approval. All WPS's and PQR's shall be in accordance with the forms shown in this section.
   3. Manufacturer’s product data sheets or catalog data for SMAW, FCAW and GMAW composite (cored) filler metals to be used. The data sheets shall describe the product, limitations of use, recommended or typical welding parameters, and storage and exposure requirements, including baking, if applicable.Copies of the manufacturer’s typical certificate of conformance for all electrodes, fluxes and shielding gases to be used.

Certificates of conformance shall satisfy the applicable AWS A5 requirements. For demand critical welds, submit applicable manufacturer's certifications that the filler metal meets the supplemental notch toughness requirements.

4. Included shall be WPS for repair welds.

C. Submit current valid certificate issued by an independent testing agency for all welders, welding operators, and tack welders.

D. Submit qualification credentials of all inspectors.

E. Submit to the Engineer for approval, a step-by-step welding sequence for the field welding of beam-to-column CP-welded and beam-to-beam CP-welded splice connections.

F. Submit a quality control plan that addresses all inspection issues, including in-process and final inspection that are addressed in AWS D1.1.

1.05 LEED SUBMITTALS

A. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:

B. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for that clearly indicates the percentage by weight of pre-consumer and post-consumer recycled content.

C. MRc3 - Sourcing of Raw Materials - Regional Material: For materials contributing to LEED credit MRc3 that are manufactured and extracted within 100 miles of the project site, provide product data indicating the location of harvesting, processing, and manufacturing and proximity from the project site.

1.06 QUALITY ASSURANCE

A. Comply with all pertinent provisions of Division 01, "Quality Requirements."

B. Standards:
   1. American Welding Society
      a. Structural Welding Code (AWS D1.1)
      b. Structural Welding Code – Seismic Supplement (ASWS D1.8)
   2. American Institute of Steel Construction
      a. Specification for Structural Steel Buildings (AISC 360)
      b. Code of Standard Practice for Steel Buildings and Bridges (AISC 303).
      c. Seismic Provisions For Structural Steel Buildings including Supplement No. 1 (AISC 341).

C. Welder Qualification:
   1. All welders, welding operators, and tack welders shall be qualified by test with the largest diameter electrodes to be used on the work and hold a current valid certificate issued by an independent testing agency, to perform the type of welds required by the work; including the process, position, and thickness of materials used per AWS D1.1 section 4.
   2. In addition to meeting the requirements above (section 1.4.B.1), welders that will make welds with restricted access such as, but not limited to, the flange to column welds through a cope hole or access hole in the beam web, or where access to the bottom of a groove is restricted by the presence of a column flange, shall be qualified by the contractor using the same welding procedure as will be used for production and a mock-up assembly that simulates the construction configuration. Qualification test per Annex C of AWS D1.8 is acceptable. Qualifications for welders that have been qualified on previous projects who meet the activity requirements of specification section 05 12 00, section 3.3.B, will be accepted.

3. All Welders on the project shall be capable of understanding and following the requirements of the written WPS.
4. Each welder employed on the project shall understand all the requirements of this welding specification before welding on the project.
5. Copies of the Welder Performance Qualification Records (WPQR), including supplemental testing requirements shall be made available for the SEOR and Inspection team.

PART 2 PRODUCTS

2.01 WELDING PROCESSES

A. Weld Procedure Specifications, including Procedure Qualification Records shall be submitted and approved by the SEOR prior to welding. PQRs shall include test results that demonstrate all-weld metal CVN values meet the requirements of Paragraph 2.2A.1 and a minimum tensile strength of 70KSI. CVN and minimum tensile strength conformance of the filler metal may be established by submitting with the PQR the results of heat input envelope testing as per AWS D1.8 section 6.3.8.1.

2.02 MATERIALS

A. Electrodes:
   1. Filler metals shall conform to the requirements of the latest edition of ANSI/AWS Specifications for Electrodes as listed herein and shall meet Charpy V-Notch Impact Energy of 20 ft-lbs. at 0°F. Filler metals for demand critical welds shall meet Charpy V-Notch Impact Energy of 20 ft-lbs. at -20°F and 40 ft-lbs at 70°F as per AWS D1.8 Section 6.3.5.
      a. SMAW A5.1 or A5.5 E70XX Low Hydrogen
      b. SAW A5.17 or A5.23 F7XX-EXXX or F7XX-EXXX-XX
      c. GMAW A5.18 or A5.28 ER70S-X
      d. FCAW A5.20 or A5.29 E7XT-X except T8-K6

      The Charpy V-Notch requirement above does not apply to welds used in the construction of stairs, elevator guiderail supports, steel supports for partitions or exterior walls, steel supports for exterior architectural appendages, steel supports for MEP equipment, rooftop screen walls, and light gage metal stud framing.
   2. The use of E70-T4 Electrode is not allowed for any welding application.
   3. The manufacturer shall certify that consumables used in the Work conform with AWS D1.8 Section 6.3.

PART 3 EXECUTION

3.01 WELDING PROCEDURE SPECIFICATION (WPS)

A. All welding shall be performed in strict adherence to a written WPS, whether the WPS be pre-qualified or qualified by test. Electrodes shall be limited to the diameters listed herein and welding shall preferably use a stringer bead technique. If weave beads are used, they shall be limited to the following diameter widths:
   1. SMAW – Maximum diameter (d) 3/16 inch and maximum widths shall be:
      a. 4d for 3/32 inch electrodes
      b. 3d for 1/8 inch electrodes
      c. 2 ½ d for 5/32 inch electrodes
      d. 2 d for 3/16 inch electrodes limited to flat and horizontal positions

e. These weave widths shall be strictly adhered to except final (cover) pass(s) may be a maximum of 5/8 inches.

B. All WPS's shall be prepared by qualified individuals and the same individual responsible for the suitability of the WPS.

C. The written WPS shall be available to the welder, welding supervisor, and inspector.

D. All welding equipment shall be properly maintained. Current/amperage and voltage shall be tested for compliance to WPS required ranges by calibrated instruments and also such gauges on the equipment shall be checked for manufacturers stated accuracy.

E. WPS's for SMAW, SAW and FCAW-G may be pre-qualified providing they meet all the requirements of AWS D1.1, paragraph 3.2.1. Any deviation from the pre-qualified WPS requirements shall necessitate qualifications by test.

F. WPS's that are not pre-qualified shall be subject to the qualification testing specified in AWS D1.1, section 4. For WPS's that have not been qualified by test, the supporting procedure qualification record (PQR) shall be submitted with the WPS for approval by the Engineer.

G. The written WPS shall contain all the necessary information required by the code, this specification, and any other information necessary to produce the welds that are in compliance with these requirements.

H. The WPS shall list the applicable base metal types and thicknesses.

I. The WPS shall contain a sketch of the joint and shall list the welding joint details, including type, weld type, joint geometry, and applicable dimensions. Individual weld passes shall be identified in the sketch and numbered to identify the maximum layer thickness and bead widths. Layer thickness shall conform to AWS D1.1 table 3.7 or as qualified by the PQR.

J. The WPS shall list the applicable welding processes.

K. The WPS shall indicate the minimum preheat requirements. The preheat and inter-pass temperatures shall be determined in accordance with AWS D1.1 Table 3.2. Maximum inter-pass temperature shall be 550°F.

L. The WPS shall list all applicable electrical characteristics for the process employed and shall include, as a reference, the electrode manufacturer’s cutsheet. The product data sheets or catalog data for SMAW FCAW and the WPS shall clearly indicate the acceptable values required for each welding pass. These electrical characteristics shall include at a minimum the following:
   1. Type of current, and acceptable ranges of current measures in amperage. For wire feed process both wire feed and amperage should be listed.
   2. Voltage
   3. Travel speed (range)
   4. Electrode extension for wire feed processes
   5. Amperage, voltage and electrode extension (as applicable) shall be within the filler metal manufacturer's recommendation

M. The diameter of the electrodes specified on the WPS shall not exceed the limits listed in section 3.1.A. of this specification section.

3.02 FABRICATION AND ERECTION

A. Assembly:
   1. Assembly shall not exceed those for pre-qualified joint detail employed, or the limits of AWS D1.1, Figures 5.3 and 5.4, as applicable. The minimum root opening dimension shall be maintained for the length of the joint. For joints where the minimum root opening dimension is less than the minimum requirement, compensation may be made by increasing the root opening by gouging, chipping or grinding. At the contractor's option, or alternate approved written WPS suitable for the smaller root opening may be employed.

Root openings that exceed the maximum allowable may be corrected by welding to acceptable dimensions prior to joining the parts by welding. The Engineer shall be notified when the root opening exceeds the allowable tolerance range.

B. Tack Welds: All tack welds shall be of the same quality as the final welds. This includes the requirements for preheat except as noted in AWS D1.1 section 5.18.5.

C. Weld Access Holes: Weld Access holes shall be sized to ensure adequate access for the welding process being used. Minimum sizes shall be in accordance with AWS D1.1, 5.17 and Figure 5.2

D. Weld Termination:
   1. Weld tabs shall be employed as shown in the Structural Drawing. Minimum length shall be the thickness of groove joint or 1 inch, whichever is greater, but not exceed 2 inches as per AWS D1.8 section 6.11.1.
   2. End dams shall not be allowed.
   3. Weld tabs shall be removed in accordance with AWS D1.8 section 6.10.

E. Steel Backing: Remove steel backing where so indicated on drawings. If backing bars are removed, the removal area shall be tested for defects or a reinforcing fillet weld, at least ¼ of the flange thickness, but not greater than 3/8 inch, shall be applied.

F. Preheating: To ensure the work place is properly heated, the temperature of the part shall be measured at a distance from the axis of the weld equal to twice the thickness of the thickest part being welded, but in no case less than 3 inches in all directions, including the through thickness dimension of the part being welded, for the full length of the weld joint. Preheat shall be verified by the inspector before welding commences.

G. Peening: Peening shall not be allowed except if approved by the SEOR.

H. Technique for making Welds involving Weld Access Holes:
   1. After the joint is assembled (bolts not fully torqued), the weld shall be completed as follows:
      a. The root pass shall initiate near the center of the joint, in the area of the weld access hole. The welder shall extend the electrode through the weld access hole approximately 1" beyond the opposite side of the web. After the arc is initiated, travel shall progress toward the end of the joint, and the weld shall be terminated on the weld tab.
      b. The half-length of root pass shall be thoroughly cleaned.
      c. The start of the weld in the weld access hole area shall be visually inspected to ensure fusion, soundness, freedom from slag inclusions, and excessive porosity, the resulting lead profile shall be suitable for obtaining good fusion by the subsequent pass to be initiated on the opposite side of the beam web. If the profile is not conducive to good fusion, the start of the first root pass shall be ground, gouged, chipped or otherwise prepared to ensure adequate fusion.
      d. The second half of the weld joint shall have the root pass applied before any other weld passes are performed. The arc shall be initiated in the area of the start of the
      e. first root pass, and travel shall progress to the end of the joint, terminating on the weld tab.
      f. Each new layer shall be completed on both sides of the joint before a new layer is deposited.
      g. Deviation from the preceding procedure may be made, providing the contractor submits in writing an alternate sequence that is approved by the Engineer prior to fabrication.

3.03 QUALITY CONTROL AND QUALITY ASSURANCE

A. Where there is a conflict with the above specifications and the drawings, the more stringent of the two shall prevail.

B. Comply with pertinent provisions of Division 01, “Quality Requirements.”

C. Inspection provided by the Owner:

1. ``nel, other than UT, shall also submit their experience and qualification on like type weldments when required by the Engineer

WELDING PROCEDURE SPECIFIC ATION (WPS)				Yes	☐
PREQUALIFIED			QUALIFIED BY TESTING		
Or PROCEDURE QUALIFICATION RECORDS (PQR)				Yes	☐
Company Name			Identification #		
Welding Process			Revision	Date	By
Supporting PQR No. (s)			Authorized by		Date
			Type: Manual ☐	Semi-Automatic	☐
			Machine ☐	Automatic	☐
JOINT DESIGN USED			POSITION		
Type:	Single ☐ Double Weld ☐		Position of Groove	Fillet:	
Backing: Yes ☐ No ☐			Vertical Progression:	Up ☐ Down ☐	
Backing Material					
Root Opening		Root Face Dim.		ELECTRICAL CHARACTERISTICS	
Groove Angle		Radius (J-U)		Transfer Mode (GMAW)	Short Circuiting / Spray
Back Gouging	Y ☐ N ☐	Method			Globular ☐
				Current: AC ☐ DCEP ☐	DCEN ☐ Pulsed ☐
BASE METALS				Other	
Material Spec.				Tungsten Electrode (GTAW):	Size
Type or Grade					Type
Thickness	Groove	Fillet		TECHNIQUE	
Diameter (Pipe)				Stringer or Weave Bead	
				Multi-pass or Single Pass (per side)	
FILLER METALS				Number of Electrodes	
AWR Specification				Electrode Spacing:	Longitudinal
AWS Classification					Lateral
MNFR ID					Angles
SHIELDING				Contact Tube to Work Distance	
Flux	Gas			Peening	
	Composition			Interpass Cleaning	
Electrode-Flux (Class)	Flow Rate				
	Gas Cup Size			POSTWELD HEAT TREATMENT	
				Temp.	
PREHEAT				Time	
Preheat Temp. Min.					
Interpass Temp. Min.		Max			

WELDING PROCEDURE

Pass or Weld Layer (s)	Process	Filler Metals		Current		Volts	Travel Speed	Joint Details
		Class	Diam.	Type & Polarity	Amps or Wire Feed Speed			

PROCEDURE QUALIFICATION RECORD

Fabricator					Test Date
Process					Filler Metal
Position					
Electrode(s) Mfg. Designation					
Flux Mfg. Designation					
Electrode Extension					
	Diam.	Current	WFS	Voltage	Current & Polarity
Electrode (1)					
(2)					
(3)					
Calculated Heat Input (see 5.2.4)					
Shielding Gas			Flow Rate		
Dew Point			Travel Speed		
Base Metal Specification & Thickness					
	(attach certified copy of mill test report)				
Preheat Temp.	Interpass Temp. Minimum		Maximum		
SPECIMEN			TEST RESULTS		
A Weld Metal Tension (AWMT)	Tensile Strength (psi)				
	Yield Strength (psi)				
	Elongation in 2 in. (%)				
	Reduction in area (%)				
Side Bends	1)	2)	3)	4)	
Reduced Section Tension	Tensile Strength 1)		Location of Break 1)		
		2)		2)	
Charpy V-Notch Impact					
Toughness of Weld Metal	Avg. Ft. lb.	@		Degrees F.	
SMAW, SAW, FCAW, GMAW – 5 Reg.					

Toughness of Weld Metal	Avg. Ft. lb.		@		Degrees F.
Chemistry of Deposited Weld Metal	C	Mn	Si	P	S
When Required by Contract Documents	Ni	Cr	Mo	V	Cu
REMARKS	Visual				
	Radiographic Test				
Wire feed may be used in lieu of current when a correlation curve for the same electrode diameter and same					
electrode extension.					
Test Witness:		Agency:			
Results Reviewed:	State Acceptance:				Date:

END OF SECTION 05 1210

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SECTION 05 1213
ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Architecturally exposed structural steel (AESS).
   2. Section 051200 "Structural Steel Framing" requirements that also apply to AESS.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.
   2. Section 099113 "Exterior Painting" Section 099123 "Interior Painting" for surface preparation and priming requirements.

1.02 DEFINITIONS

A. AESS: Architecturally exposed structural steel.

B. Category AESS 4: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 4 and is designated as AESS 4 or Category AESS 4 in the Contract Documents.

1.03 ACTION SUBMITTALS

A. Product Data:
   1. Tension-control, high-strength, bolt-nut-washer assemblies.
   2. Filler.
   3. Primer.
   4. Etching cleaner.

B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and pre-consumer recycled content and cost
   2. Environmental Product Declaration: For each product
   3. Health Product Declaration: For each product
   4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer

C. Shop Drawings: Show fabrication of AESS components.
   1. Identify AESS category for each steel member and connection, including transitions between AESS categories and between AESS and non-AESS.
   2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   3. Include embedment Drawings.
   4. Indicate orientation of mill marks and HSS seams.
   5. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
   6. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation and location of bolt heads.

7. Indicate exposed surfaces and edges and surface preparation being used.
8. Indicate special tolerances and erection requirements.
9. Indicate weep holes for HSS and vent holes for galvanized HSS.
10. Indicate surface preparation, primer, and coating requirements, including systems specified in other Sections.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, and shop-painting applicator.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172) and is experienced in fabricating AESS similar to that indicated on this Project.

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program, is designated an AISC-Certified Erector, Category ACSE, and is experienced in erecting AESS similar to that indicated on this Project.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3.

D. Mockups: Build mockups of AESS to set quality standards for fabrication and installation.
   1. Build mockup of typical portion of AESS as shown on Drawings.
   2. Coordinate painting requirements with Section 099123 "Interior Painting."
   3. Coordinate high-performance coatings requirements with Section 099600 "High-Performance Coatings."
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Use special care in handling AESS to prevent twisting, warping, nicking, and other damage during fabrication, delivery, and erection. Store materials to permit easy access for inspection and identification. Keep AESS members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect AESS members and packaged materials from corrosion and deterioration.
   1. Do not store AESS materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.07 FIELD CONDITIONS

A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with requirements of ANSI/AISC 303, Sections 1 through 9 and as modified in Section 10, "Architecturally Exposed Structural Steel."

2.02 FILLER

A. Polyester filler intended for use in repairing dents in automobile bodies.

2.03 PRIMER

A. Steel Primer:
   1. Comply with Section 099123 “Interior Painting”.
   2. SSPC-Paint 23, latex primer.
   3. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.04 FABRICATION

A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
   1. Use special care handling and fabricating AESS before and after shop painting to minimize damage to shop finish.

B. Category AESS 4:
   1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
   2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC- SP 6 (WAB)/NACE WAB-3.
   3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
   4. Make intermittent welds appear continuous, using filler or additional welding.
   5. Seal weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates.
   6. Limit butt and plug weld projections to 1/16 inch (1.6 mm).
   7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
   8. Remove weld spatter, slivers, and similar surface discontinuities.
   9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
   10. Grind tack welds smooth unless incorporated into final welds.
   11. Remove backing and runoff tabs, and grind welds smooth.
   12. Limit as-fabricated straightness tolerance to one-half that permitted for structural-steel materials in ANSI/AISC 303.
   13. Limit as-fabricated curved structural steel tolerance to that permitted for structural-steel materials in ANSI/AISC 303.
   14. Limit as-fabricated straightness tolerance of welded built-up members to one-half that permitted by AWS D1.1/D1.1M.
   15. Conceal fabrication and erection markings from view in the completed structure.
   16. Make welds uniform and smooth.
   17. Cut out mill marks from mill material or hide these markings from view in the completed structure. Where neither method is possible, remove mill marks by grinding and filling surfaces as approved by Architect.
   18. Grind butt and plug welds smooth or fill, removing weld splatter exposed to view.
   19. Orient HSS seams as indicated or away from view.
   20. Align and match abutting member cross sections.

21. At visible open joints of copes, miters, and cuts, maintain uniform clear gaps of 1/8 inch (3.2 mm). At closed joints, maintain uniform contact within 1/16 inch (1.6 mm).
22. Fabricate with exposed surfaces smooth, square, and of surface quality approved by Architect.
23. Treat HSS seams to appear seamless.
24. Contour and blend welds and weld transitions between members, removing splatter exposed to view.
25. Fill surface imperfections with filler and sand smooth to achieve surface quality approved by Architect.
26. Minimize weld show-through and distortion on the opposite side of exposed connections by grinding to a smooth profile aligned with adjacent material.

2.05 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.06 SHOP PRIMING

A. Shop prime steel surfaces, except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections.

B. Surface Preparation: Clean nongalvanized surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. SSPC-SP 6 (WAB)/NACE WAB-3.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
   1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments, showing dimensions, locations, angles, and elevations.

B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.03 ERECTION

A. Take special care during erection to avoid marking or distorting the AESS and to minimize damage to shop painting. Set AESS accurately in locations and to elevations indicated and according to ANSI/AISC 303 and ANSI/AISC 360.
   1. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Take care to avoid any blemishes, holes, or unsightly surfaces resulting from the use or removal of temporary elements.
   2. Grind tack welds smooth.
   3. Remove backing and runoff tabs, and grind welds smooth.
   4. Orient bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
   5. Remove erection bolts in Category AESS 4 AESS, fill holes with weld metal or filler, and grind or sand smooth to achieve surface quality approved by Architect.
   6. Fill weld access holes in Category AESS 4 AESS with weld metal or filler and grind, or sand smooth to achieve surface quality as approved by Architect.
   7. Conceal fabrication and erection markings from view in the completed structure.

B. In addition to ANSI/AISC 303, Section 10 requiermemnts, comply with the following
   1. Erection of Category AESS 4:
      a. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
      b. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
      c. Remove weld spatter, slivers, and similar surface discontinuities.
      d. Grind off butt and plug weld projections larger than 1/16 inch (1.6 mm).
      e. Continuous welds are to be of uniform size and profile.
      f. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
      g. Splice members only where indicated on Drawings.
      h. No torch cutting or field fabrication is permitted.
      i. Weld profiles, quality, and finish are be as approved by Architect.
      j. Make joint welds, including tack welds, appear continuous by filling intermittent welds.
      k. Grind welds smooth.
      l. Minimize weld show-through and distortion on the opposite side of exposed connections by grinding to a smooth profile aligned with adjacent material.
      m. Oversize welds where ground, contoured, or blended, and grind to provide a smooth transition, matching profile approved by Architect.

3.04 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

3.05 REPAIR

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and touchup galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:
   1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting, to comply with SSPC-PA 1 for touching up shop-painted surfaces.
      a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
   2. Cleaning and touchup painting are specified in Section 099123 "Interior Painting."

C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to inspect AESS as specified in Section 051200 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.

B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

END OF SECTION 05 1213

SECTION 05 3100
METAL FLOOR AND ROOF DECKING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Steel roof deck with accessories.
   2. Bent plate and sheet metal closures at decking edges and openings.

B. Related Sections
   1. All Pertinent Provisions of Division 01, “General Requirements.”
   2. Section 03 2000: Concrete Reinforcing
   3. Section 05 1200: Structural Steel Framing
   4. Section 05 1210: Welding
   5. Section 01 8113: Sustainable Design Requirements

1.03 SUBMITTALS

A. Comply with all pertinent provisions of Division 01, “Submittal Procedures.”

B. Shop Drawings: Submit drawings fully detailing and dimensioning all steel decking including accessories, fastenings, welding, holes with reinforcing, flashings, and closures. Indicate welding according to AWS Standard Welding Symbols. Show dimensioned layouts for openings and reinforcing details.

C. Calculations and Data: If steel decking of type differing from that indicated or specified is proposed, submit the manufacturer's calculations and supporting data showing that proposed decking conforms to requirements indicated and specified. Include the decking manufacturer's technical product data and copies of code approvals for proposed decking. Submit with shop drawings and obtain approval prior to fabrication and delivery of decking.

D. Weld Procedure Specifications (WPS): Submit WPS for deck welding for review and approval by SEOR prior to their use.

1.04 LEED SUBMITTALS

A. Complete the LEED Material Buyout Form (MBoF) with all materials provided to the project. A complete submittal includes providing all material costs in the MBoF and all of the supporting documentation for the following credits:
   1. MRc2 - Environmental Product Declarations (EPD): Provide Industry-Wide or Product-Specific EPD, if available.
   2. MRc3 - Sourcing of Raw Materials - Recycled Content: Provide product data for that clearly indicates the percentage by weight of pre-consumer and post-consumer recycled content.

3. MRc3 - Sourcing of Raw Materials - Regional Material: For materials contributing to LEED credit MRc3 that are manufactured and extracted within 100 miles of the project site, provide product data indicating the location of harvesting, processing, and manufacturing and proximity from the project site.

1.05 QUALITY ASSURANCE

A. Comply with all pertinent provisions of Division 01, “Quality Assurance Requirements.”

B. Qualifications of Welders: Employ welding operators currently tested and qualified in accordance with AWS D1.3.

C. Requirements of Regulatory Agencies: Provide steel floor and roof deck system that, with concrete fill, meets UL and code requirements for 2 hour fire-rated deck system.

D. Source Quality Control: Conform to 2019 CBC, Section 2203; unidentified decking is not acceptable. Furnish deck manufacturer's certified mill analyses and test reports for each heat covering decking having Fy of 38 Ksi or less. In addition, for decking having Fy greater than 33 Ksi, Testing Laboratory shall perform one tension and elongation test and one bend or flattening test for each gage.

E. Metal Decking Shall be in conformance with the following:
   1. AISI “Specification for Design of Light Gauge Steel Members”.
   2. AISI “Specification for Design of Cold Formed Steel Members”.
   3. Steel Deck Institute Publication No. 29 “Design Manual for Composite Decking, Form Decks and Roof Decks.
   4. 2019 California Building Code.

1.06 DELIVERY, HANDLING AND STORAGE

A. Comply with all pertinent provisions of Division 01, “Common Product Requirements”.

B. Deliver, store, and handle all material to prevent damage.

C. Deliver all materials in timely manner to ensure uninterrupted progress of the Work.

D. Store materials by methods that prevent damage and provide ready access for inspection and identification.

PART 2 PRODUCTS

2.01 DECKING MATERIALS

A. Furnish metal roof decking having galvanized coating conforming to ASTM A653, G60. Decking shall be fabricated of steel conforming to ASTM A653, SS, Grade 33, unless otherwise noted.

B. Roof Decking: Type and manufacture noted on the drawings, lengths to span over at least three spans unless otherwise shown, each panel factory slotted or having rolled-in moisture venting provisions.

C. Composite Floor Deck: Type and manufacture noted on drawings, lengths to span over at least three spans unless otherwise indicated, manufactured from ASTM A653, SS, Grade 33 steel, with minimum yield strength of 38,000 psi. Each panel shall be factory slotted or have rolled-in moisture venting provisions.

D. Decking Accessories: Provide indicated and required decking accessories including, without limitation, welding washers and welding anchors, closures, transitions, and filler strips, as required for complete installations. Provide bent plate closures, angles, channels, and attachments as required for openings through decking for ducts, shafts, piping, and other

penetrations; where decking changes direction; and at decking perimeter; fabricated of 16 gage galvanized steel unless otherwise shown on the Structural Drawings. Provide roof drain and overflow sumps of minimum 14 gage galvanized steel.

E. Galvanizing Repair Paint: Zinc rich paint conforming to Mil Spec MIL-P-21035 (SHIPS).

PART 3 EXECUTION

3.01 INSTALLATION OF DECKING

A. Verify dimensions and actual site conditions to ensure proper fit and installation.

B. Placing: Place steel decking on supports with full bearings, end joints centered over supports, and adjust to correct final position before completing permanent attachments. Place units in straight alignment for the entire length of run of flutes with close registration of flutes and with maximum 1/8" gap between ends of units, minimum 2" bearing on the supports. Do not splice units except at supports. Conform to code approvals and approved submittals.

C. Cutting and Fitting: Perform cutting and fitting at columns, perimeters, shafts, stairs, and other openings. Provide tight fitting closures at the open uncovered ends and edges of decking, and all miscellaneous supports required to carry the metal decking. Secure hole reinforcement to decking with fillet welds placed on both sides of reinforcing members. Place reinforcement channels and angles across flutes and to project a distance beyond sides of openings equal to the maximum size of the opening unless otherwise shown. Perform field cutting and trimming square and neat, equal to factory cutting.

D. Welding: Use materials and methods in accordance with recommendations of steel decking manufacturer and approved submittals. Hold decking tight to the supporting elements with screws or other means as directed for proper welding or crimping of the decking edges. Conform to AWS D1.3 and to the patterns and weld types indicated, with all finished welds free of sharp points or edges. Field coat welds and abraded surfaces at completion with an approved anodic type galvanizing repair paint. Omit the field paint coating where welds or abrasions are covered by concrete fill or sprayed fireproofing.

E. Damaged Decking: Remove and replace all metal decking showing denting or other damage that adversely affects decking strength or subsequent materials, as directed.

3.02 CLEANING AND TOUCH-UP

A. Remove surplus materials. Clean and touch-up raw edges of decking cut for openings with anodic galvanizing repair paint. Leave decks ready to receive subsequent materials.

3.03 FIELD QUALITY CONTROL

A. Inspection: Install steel decking under continuous inspection according to 2019 CBC, Sections 2209 and 1705.2, welding approved and recorded by welding inspector before being covered.

B. Inspection and Testing of Welded Shear Studs: In accordance with Section 05 0650 including pre-production testing and production inspection and testing.

END OF SECTION 05 3100

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SECTION 05 4000
COLD FORMED METAL FRAMING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Exterior non-load-bearing wall framing.
   2. Interior non-load-bearing wall framing.
   3. Soffit framing.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
   2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load- bearing, metal-stud-framed, shaft-wall assemblies, with height limitations.
   3. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.02 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Cold-formed steel framing materials.
   2. Exterior non-load-bearing wall framing.
   3. Interior non-load-bearing wall framing.
   4. Vertical deflection clips.
   5. Single deflection track.
   6. Double deflection track.
   7. Drift clips.
   8. Soffit framing.
   9. Post-installed anchors.
   10. Power-actuated anchors.
   11. Sill sealer gasket.
   12. Sill sealer gasket/termite barrier.

B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and pre-consumer recycled content and cost
   2. Environmental Product Declaration: For each product
   3. Health Product Declaration: For each product
   4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer

C. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates

C. Product Certificates: For each type of code-compliance certification for studs and tracks.

D. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
   1. Steel sheet.
   2. Expansion anchors.
   3. Power-actuated anchors.
   4. Mechanical fasteners.
   5. Vertical deflection clips.
   6. Horizontal drift deflection clips
   7. Miscellaneous structural clips and accessories.

E. Research Reports:
   1. For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
   2. For sill sealer gasket/termite barrier, showing compliance with ICC-ES AC380.

1.04 QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

B. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, the Steel Stud Manufacturers Association, or the Supreme Steel Framing System Association.

C. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads: As indicated on Drawings
   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height.

b. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).

B. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and AISI S240.

C. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.02 COLD-FORMED STEEL FRAMING MATERIALS

A. Framing Members, General: Comply with AISI S240 for conditions indicated.

B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
1. Grade: ST33H (ST230H) or ST50H (ST340H)
2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZM150), or GF30 (ZGF90) or G90 (Z275) or equivalent.

C. Steel Sheet for Drift Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
1. Grade: 33 (230) or 50 (340), Class 1
2. Coating: G60 (Z180) or G90 (Z275)

2.03 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm)
2. Flange Width: 1-5/8 inches (41 mm)
3. Gross Section Modulus: 0.954 in3, Gross Moment of Inertia: 2.861 in4, Allowable Moment: 23.00 in-kips

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
2. Flange Width: 1-1/4 inches (32 mm).

C. Vertical Deflection Clips, Exterior: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
2. Flange Width: 1 inch (25 mm) plus twice the design gap for other applications.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
   a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
   b. Flange Width: 1 inch (25mm) plus twice the design gap for other applications.
2. Inner Track: Of web depth indicated, and as follows:
   a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
   b. Flange Width: Dimension equal to sum of outer deflection track flange width plus 1 inch (25 mm).

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.04 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
   2. Flange Width: 1-3/8 inches (35 mm).
   3. Section Properties: As indicated on Structural Drawings

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
   2. Flange Width: 1-1/4 inches (32 mm).

C. Vertical Deflection Clips, Interior: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
   2. Flange Width: 1 inch (25 mm) plus twice the design gap for other applications.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
   1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
      a. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
      b. Flange Width: 1 inch (25 mm) plus twice the design gap for other applications.
   2. Inner Track: Of web depth indicated, and as follows:
      a. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
      b. Flange Width: 1 inch (25 mm) plus twice the design gap for other applications.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.05 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
2. Flange Width: 1-5/8 inches (41 mm), minimum.
3. Section Properties: Gross Section Modulus: 0.954 in^3, Gross Moment of Inertia: 2.861 in^4, Allowable Moment: 23.00 in-kips

2.06 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. Anchor clips.
   5. End clips.
   6. Foundation clips.
   7. Gusset plates.
   8. Stud kickers and knee braces.
   9. Joist hangers and end closures.
   10. Hole-reinforcing plates.
   11. Backer plates.

2.07 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel, hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers, zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
   1. Uses: Securing cold-formed steel framing to structure.
   2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
   3. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1)] stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
   1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.08 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M.

B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

F. Sill Sealer Gasket/Termite Barrier: Minimum 68-mil (1.7-mm) nominal thickness, self-adhering sheet consisting of 64 mils (1.6 mm) of rubberized asphalt laminated on one side to a 4-mil-(0.10-mm-) thick, polyethylene-film reinforcement, and with release liner on adhesive side**;** formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
   1. Physical Properties:
      a. Peel Adhesion: 17.0 lb/in of width (2.9 N/mm of width) when tested in accordance with ASTM D412.
      b. Low-Temperature Flexibility: Pass at minus 25 deg F (minus 32 deg C) when tested in accordance with ASTM D146/D146M.
      c. Water Vapor Permeance: 0.05 perm (0.44 ng/Pa x s x sq. m) maximum when tested in accordance with ASTM E96/E96M, Method B.
      d. Resistance to Termite Penetration: Comply with ICC-ES AC380.

2.09 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
   4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.03 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

H. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.04 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: 16 inches 9406 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single deep-leg deflection tracks and anchor to building structure.
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
   4. Connect drift clips to cold-formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
   1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
   2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
   3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
   1. Install solid blocking at 96-inch (2440-mm) centers.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.05 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: 16 inches (406 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single deep-leg deflection tracks and anchor to building structure.
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to studs and anchor to building structure.
   4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
   1. Install solid blocking at 96-inch (2440-mm) centers.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.06 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.07 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.08 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.09 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 4000

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SECTION 05 5000
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel, aluminum, and metal items.
B. Slotted channel framing.
C. Abrasive metal nosings.

1.02 REFERENCE STANDARDS

A. ASTM A1 - Standard Specification for Carbon Steel Tee Rails; 2000 (Reapproved 2018).
B. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
G. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2021.
H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
I. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
J. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
K. ASTM A1018/A1018M - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018.
L. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
M. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
N. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
O. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings; 2018, with Editorial Revision.
P. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

Q. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

R. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

S. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

T. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

U. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.

V. MFMA-4 - Metal Framing Standards Publication; 2004.

W. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

X. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. Recycled content data.

C. Delegated Design Documents: See Section 01 3000 - Administrative Requirements.
   1. Provide design documentation prepared by Contractor's Licensed Professionals.

D. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
      a. Include the following, as applicable:
         1) Design criteria.
         2) Engineering analysis depicting stresses and deflections.
         3) Member sizes and gauges.
         4) Details of connections.
         5) Support reactions.
         6) Bracing requirements.

E. Designer's Qualification Statement.

F. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.04 QUALITY ASSURANCE

A. Design metal fabrications under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.

C. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.01 DELEGATED DESIGN

A. Delegated Design: See Section 01 3000 - Administrative Requirements.

B. Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design fabricated metal items.

2.02 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. Recycled Content: Products in this Section to meet minimum recycled content thresholds specified in Section 016000.

2.03 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Stainless Steel, General: ASTM A666, Type 304.

F. Stainless Steel Tubing: ASTM A554, Type 304, 16 gauge, 0.0625 inch minimum metal thickness, 1-1/2 inch diameter.

G. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.

H. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.

I. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

J. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

K. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.04 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.

C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.

D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.

E. Aluminum-Alloy Sand Castings: ASTM B26/B26M.

F. Aluminum-Alloy Die Castings: ASTM B85/B85M.

G. Bolts, Nuts, and Washers: Stainless steel.

H. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.05 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.06 FABRICATED ITEMS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
   1. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

B. Loose Bearing and Leveling Plates: For steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

C. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; high-performance coating finish.

D. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.

E. Lintels: As detailed; galvanized finish.

F. Door Frames for Overhead Door Openings and Wall Openings: Channel sections; prime paint finish.

G. Elevator Hoistway Divider Beams: Beam sections; prime paint finish.

H. Toilet Partition Suspension Members: Steel channel sections; prime paint finish.

2.07 SLOTTED CHANNEL FRAMING

A. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
   1. Manufacture
      a. ABB Installation Products.
      b. Eaton.
      c. Flex-Strut.
      d. Unistrut (Atkore International).
      e. Wesanco (ZSI-Foster).
      f. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Physical Properties:
      a. Size, Thickness,and Configuration: As indicated, or as otherwise required to support loads.
      b. Material:
         1) Stainless Steel: ASTM A1011/A1011M SS, Grade 33 cold formed steel struts.
            (a) Fittings: ASTM A1018/A1018M SS, Grade 33 steel.
            (b) Hardware AISI Type 304 stainless steel.
         2) Galvanized Steel: ASTM A653/A653M, commercial steel Type B or structural steel Grade 33 (Grade 230), with G90 coating.

c. Closure Strips: Manufacturer's standard snap-in product to close exposed channel openings.
d. Framing channels and fittings shall have the manufacturers name, part number, and material heat code identification number stamped in the part itself for identification.

2.08 ABRASIVE METAL NOSINGS

A. Manufacturers:
   1. American Safety Tread.
   2. Amstep Products.
   3. Balco.
   4. Granger.
   5. Grating Pacific.
   6. Nystrom.
   7. Wooster Products.
   8. Substitutions: See Section 01 2500 - Substitution Procedures.
B. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder.
   1. Apply clear lacquer to concealed surfaces.
C. Cast Units: Cast iron, aluminum, bronze, or nickel silver, with an integral abrasive as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both.
   1. Apply bituminous paint to concealed surfaces.
D. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
E. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches from ends and not more than 12 inches on center.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.
B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
C. Field weld components as indicated on drawings.
D. Perform field welding in accordance with AWS D1.1/D1.1M.
E. Obtain approval prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized , except surfaces to be in contact with concrete.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 05 5100
METAL STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stairs with concrete treads.
B. Stairs with metal treads.
C. Structural steel stair framing and supports.
D. Handrails and guards.

1.02 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
B. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
C. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2023.
D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
G. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
I. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: For each item to be installed.
C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
    1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
    2. Include the design engineer's seal and signature on each sheet of shop drawings.
D. Designer's Qualification Statement.

E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 201.

PART 2 PRODUCTS

2.01 METAL STAIRS - GENERAL

A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
   1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of the contract documents exceed those of regulations, comply with the contract documents.
   2. Dimensions: As indicated on drawings.
   3. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
   4. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
   5. Separate dissimilar metals using paint or permanent tape.

B. Metal Jointing and Finish Quality Levels:
   1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
      a. Welded Joints: Continuously welded and ground smooth and flush.
      b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
      c. Exposed Edges and Corners: Eased to small uniform radius.
      d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.
   2. Service: Exposed joints tight with face surfaces aligned; underside of stair not covered by soffit is not considered exposed to view.
      a. Welded Joints: Welded on back side wherever possible.
      b. Welds Exposed to View: Ground smooth; not required to be flush.
      c. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts or screw threads.
      d. Metal Surfaces to be Painted: Sanded smooth, suitable for satin or matte finish.

C. Nosings: See Section 05 5000 - Metal Fabrications.

D. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

E. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.02 METAL STAIRS WITH CONCRETE TREADS

A. Jointing and Finish Quality Level: Architectural, as defined above.

B. Risers: Closed.

C. Treads: Metal pan with field-installed concrete fill and precast concrete treads. Refer to the Architectural drawings for locations.
   1. Precast Concrete Tread Thickness: 1-1/2 inches, minimum.
   2. Precast Concrete Landing Thickness: As shown on the Architectural drawings.
   3. Precast Concrete Treads:
      a. Concrete Strength: 5,000 psi at 28 days, minimum.

b. Air Content: 4 to 6 percent.
c. Cement Color: Natural gray.
4. Tread Pan Material: Steel sheet.
5. Tread Pan Thickness: As required by design; 14 gage, 0.075 inch minimum.
6. Concrete Finish: Steel troweled.

D. Risers: Same material and thickness as tread pans.
1. Nosing Depth: Not more than 1-1/2 inch overhang.
2. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.

E. Stringers: Rolled steel channels.
1. Stringer Depth: 10 inches.
2. End Closure: Sheet steel of same thickness as risers welded across ends.

F. Railings: Steel pipe railings.

2.03 METAL STAIRS WITH METAL TREADS

A. Jointing and Finish Quality Level: Service, as defined above.

B. Risers: Closed.

C. Treads: Steel plate with abrasive coating.
1. Tread Thickness: 1/4 inch, minimum.
2. Anchorage to Stringers: Welded or bolted to carrier angles welded or bolted to stringers.

D. Risers: Steel sheet.
1. Riser/Nosing Profile: Sloped riser with rounded nosing of minimum radius.

E. Stringers: Rolled steel channels.
1. End Closure: Sheet steel of same thickness as risers welded across ends.

F. Railings: Steel pipe railings.

G. Finish: Galvanized after fabrication, except sheet components are to be galvanized before fabrication. Manufacturer's AAMA 2605

2.04 HANDRAILS AND GUARDS

A. Wall-Mounted Rails: Round pipe or tube rails unless otherwise indicated.
1. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.

B. Guards:
1. Top Rails: Round pipe or tube rails unless otherwise indicated.
a. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.
2. Infill: As shown on the Architectural drawings.

2.05 MATERIALS

A. Steel Sections: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.

C. Steel Plates: ASTM A6/A6M or ASTM A283/A283M.

D. Pipe: ASTM A53/A53M Grade B Schedule 40, black finish.

2.06 SHOP FINISHING

A. Surface Preparation and Shop Finishing: See Section 05 0511 - Surface Preparation and Finishing of Metals.

B. Coating Finish: See 09 9600 - High-Performance Coatings.

C. Galvanizing: Hot-dip galvanize to minimum requirements of ASTM A123/A123M.
   1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. When field welding is required, clean and strip primed steel items to bare metal.

3.03 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.

D. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.

E. Obtain approval prior to site cutting or creating adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

END OF SECTION

SECTION 05 5133
METAL LADDERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop-fabricated metal ladders.

B. Prefabricated ladders.

1.02 REFERENCE STANDARDS

A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).

B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

G. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

H. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

I. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

J. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.

K. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.

L. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

M. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.

N. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

O. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

P. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.

Q. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

D. Designer's Qualification Statement.

E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.04 QUALITY ASSURANCE

A. Design metal ladders under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.

C. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 5-year manufacturer warranty for material and workmanship. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 DELEGATED DESIGN

A. Delegated Design: See Section 01 3000 - Administrative Requirements.

B. Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design fabricated ladders.
   1. Include comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Design fabricated ladders to withstand the effects of gravity loads within limits and under conditions indicated.

B. Seismic Performance: Provide metal fabrications capable of withstanding the effects of earthquake motions determined according to ASCE 7.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
   1. Temperature Change: 120 deg F ambient; 180 deg F material surfaces.

2.03 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Mechanical Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

F. Bolts, Nuts, and Washers: ASTM A307, plain.

G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.04 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B211/B211M, 6063 alloy, T6 temper.

B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.

C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.

D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.

E. Bolts, Nuts, and Washers: Stainless steel.

F. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.05 FABRICATED LADDERS

A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; high-performance coating finish.
   1. Side Rails: 3/8 by 2 inches members spaced at 20 inches.
   2. Rungs: One inch diameter solid round bar spaced 12 inches on center.
   3. Space rungs 7 inches from wall surface.

2.06 PREFABRICATED LADDERS

A. Prefabricated Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
   1. Components: Manufacturer's standard rails, rungs, treads, handrails. returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
   2. Materials: Aluminum; ASTM B211/B211M 6063 alloy, T52 temper.
   3. Manufacturers:
      a. Alaco Ladder.
      b. Industrial Ladder & Scaffolding.
      c. O'Keefe's.
      d. Precision Ladders.
      e. Substitutions: See Section 01 2500 - Substitution Procedures.

2.07 FINISHES - STEEL

A. Galvanized Finish: See Section 05 0511 - Surface Preparation and Finishing of Metals, for additional information.

B. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.

C. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

D. High-Performance Coating System: 09 9600 - High-Performance Coatings.

2.08 FINISHES - ALUMINUM

A. Anodized Finish: See Section 05 0511 - Surface Preparation and Finishing of Metals, for additional information.

B. Exterior Aluminum Surfaces: Class I natural anodized.

C. Interior Aluminum Surfaces: Class I natural anodized.

2.09 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by intermittent welds and plastic filler.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

END OF SECTION

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SECTION 05 5213
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stair railings and guardrails.
B. Free-standing railings at steps.
C. Lighted steel railing system.

1.02 REFERENCE STANDARDS

A. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
D. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).
E. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
    1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
    2. Include the design engineer's seal and signature on each sheet of shop drawings.
C. Fabricator's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.
B. Fabricator Qualifications:
    1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
    2. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

1.05 **QUALITY ASSURANCE**

A. Railings and handrails: CBC Section 11B-505:

1. Top of gripping surfaces of handrails shall be 34 inches minimum and 38 inches maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above such surfaces.
2. Clearance between handrail gripping surfaces and adjacent surfaces shall be 1-1/2 inches minimum. Handrail may be located in a recess if the recess is 3 inches maximum deep and 18 inches minimum clear above the top of the handrail.
3. Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides. The bottoms of handrail gripping surfaces shall not be obstructed for more than 20 percent of their length. Where provided, horizontal projections shall occur 1-1/2 inches minimum below the bottom of the handrail gripping surfaces.
4. Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1-1/4 inches minimum and 2 inches maximum.
5. Handrail gripping surfaces with a non-circular cross section shall have an outside dimension of 4 inches minimum and 6-1/4 inches maximum, and a cross-sectional dimension of 2-1/4 inches maximum.
6. Handrail gripping surfaces and any surfaces adjacecnt to them shall be free of sharp or abrasive elements and shall have rounded edges.
7. Handrails shall not rotate within their fittings.
8. Handrail gripping surfaces shall extend beyond and in the same direction of stair flights and ramp runs in accordance with CBC Section 11B-505.10. Such extensions are not required for continuous handrails at the inside turn of switchback or dogleg stairs and ramps.
9. A 2 inch minimum high curb or a barrier shall be provided to prevent the passage of a 4 inch diameter sphere rolling off the sides of a ramp surface. Such a curb or barrier shall be continuous and uninterrrupted along the entire length of a ramp. CBC Section 11B-405.9.2.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.

B. Allow for expansion and contraction of members and building movement without damage to connections or members.

C. Dimensions: See drawings for configurations and heights.

D. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

E. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

F. Top of gripping surfaces of handrails shall be 34" minimum and 38" maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above such surfaces.

G. Clearance between handrail griping surfaces and adjacent surfaces shall be 1-1/2" minimum. Handrail may be located in a recess if the recess is 3" maximum deep and 18" minmum clear above the top of the handrail.

H. Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides. The bottoms of handrail griping surfaces shall not be obstructed for more than 20% of their length. Where provided, horizontal projections shall occur 1-1/2" minimum below the bottom of the handrail gripping surfaces.

I. Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1-1/4" minimum and 2" maximum.

J. Handrail gripping surfaces with a non-circular cross section shall have an outside dimension of 4" minimum and 6-1/4" maximum, and a cross-sectional dimension of 2-1/4" maximum.

K. Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges.

L. Handrails shall not rotate within their fittings.

M. Handrail gripping surfaces shall extend beyond and in the same direction of stair flights and ramp runs in accordance with **CBC Section 11B-505.10.** Such extensions are not required for continouous handrails at the inside turn of switchback or dogleg stairs and ramps.

N. A 2" minimum high curb or a barrier shall be provided to prevent the passage of a 4" diameter sphere rolling off the sides of a ramp surface. Such a curb or a barrier shall be continuous and uninterrupted along the length of a ramp. **CBC Section 11B-405.9.2.**

2.02 STEEL RAILING SYSTEM

A. Steel Pipe: ASTM A53/A53M Grade B Schedule 40, black finish.

B. Non-Weld Mechanical Fittings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.

C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

D. Exposed Fasteners: No exposed bolts or screws.

E. Galvanizing: In accordance with requirements of ASTM A123/A123M.

F. Finish: High-performance coating.
   1. See Section 09 9600 - High-Performance Coatings, for additional information.

2.03 LIGHTED STEEL RAILING SYSTEM

A. Lighted Steel Railing System: Galvanized steel railing system with integral lighting.
   1. Acceptable Manufacturers:
      a. C.R. Laurence.
      b. Klik.
      c. Wagner.
      d. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Configuration: As shown on the Architectural drawings.
   3. Finish: High-performance coating.
      a. See Section 09 9600 - High-Performance Coatings, for additional information.
      b. Color: As selected by Architect.

2.04 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:
   1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
   2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
   3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Anchor railings securely to structure.

3.02 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 05 7000
DECORATIVE METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Decorative metal.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
H. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
I. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: For each item to be installed. Submit manufacturer's product data including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.
C. Shop drawings.
D. Sample: For each decorative metal component, in manufacturer's standard size.
E. Maintenance Data: Manufacturer's instructions for care and cleaning.
F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 MOCK-UP

A. Provide mock-up of specified decorative metal.

B. See Section 01 4000 - Quality Requirements for additional requirements.
C. Locate where directed by Architect.
D. Mock-up may remain as part of the Work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in factory provided protective coverings and packaging.
B. Protect materials against damage during transit, delivery, storage, and installation at site.
C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.
D. Prior to installation, store materials and components under cover, in a dry location.

1.06 WARRANTY

A. Warranty: Manufacturer's standard one year warranty against defects in materials, fabrication, finishes, and installation.
    1. Duration: One year from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Decorative Metal:
    1. Chemetal.
    2. Hendrick Architectural.
    3. McNichols.
    4. Moz.
    5. Southern Aluminum Finishing (SAF).
    6. Substitutions: See Section 01 2500 - Substitution Procedures.

2.02 DECORATIVE METAL

A. Perforated Metal Panel:
    1. Basis of Design Product:
        a. McNichols; Perforated Metal.
            1) Round, Carbon Steel, HRPO, 11 Gauge (0.1196 inch Thick), 1/2 inch Round on 11/16 inch Staggered Centers, 48 percent Open Area
        b. Substitutions: See Section 01 2500 - Substitution Procedures.
    2. Finish: High-performance coating. See Section 09 9600 - High-Performance Coatings.
        a. Color: As selected by Architect
B. U-Edging:
    1. Basis of Design Product:
        a. McNichols; U-Edging Accessory.
            1) Carbon Steel, Hot Rolled, 14 Gauge (0.0747 inch Thick), Type 402 U-Edging (1/8 inch Opening x 1 inch Width).
        b. Substitutions: See Section 01 2500 - Substitution Procedures.
    2. Finish: High-performance coating. See Section 09 9600 - High-Performance Coatings
        a. Color: As selected by Architect.

2.03 MATERIALS

A. Steel Components:
   1. Sections, Shapes, Plate and Bar: ASTM A36/A36M.
   2. Tubing: ASTM A501/A501M structural tubing, round and shapes as indicated.
   3. Pipe: ASTM A53/A53M Grade B Schedule 40, black finish.
   4. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230 with G40/Z120 coating.
   5. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
   6. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

2.04 ACCESSORIES

A. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
   1. Exposed Fasteners: No exposed bolts or screws.

B. Carbon Steel Bolts and Nuts: ASTM A307.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate and site conditions are acceptable and ready to receive work.

B. Verify field dimensions of locations and areas to receive work.

C. Notify Architect immediately of conditions that would prevent satisfactory installation.

D. Do not proceed with work until detrimental conditions have been corrected.

3.02 PREPARATION

A. Protect existing work.

B. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.03 INSTALLATION

A. Install according to manufacturer's written instructions, and approved shop drawings.

B. Install components plumb and level, accurately fitted, free from distortion or defects and with tight joints, except where necessary for expansion.

C. Anchor securely to structure.

D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

E. Weld connections that cannot be shop welded due to size limitations.
   1. Weld in accordance with AWS D1.1/D1.1M.
   2. Match shop welding and bolting.
   3. Clean welds, bolted connections and abraded areas.
   4. Touch up shop primer and factory applied finishes.

5. Repair galvanizing with galvanizing repair paint per ASTM A780/A780M.

3.04 CLEANING

A. Remove protective film from exposed metal surfaces.

B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.

3.05 PROTECTION

A. Protect installed components and finishes from damage after installation.

B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
   1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

SECTION 06 2000
FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Finish carpentry items.
B. Upholstery (UP-#).
C. Tambour veneer.
D. Solid oak wood trim.
E. Baltic birch plywood.

1.02 REFERENCE STANDARDS

A. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).
B. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
F. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.
G. PS 1 - Structural Plywood; 2023.
H. PS 20 - American Softwood Lumber Standard; 2021.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.
B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data:
    1. Provide manufacturer's product data, storage and handling instructions for factory-fabricated units.
    2. Provide data on fire retardant treatment materials and application instructions.
    3. Provide instructions for attachment hardware and finish hardware.
C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
    1. VOC content restrictions data.

D. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
   2. Include certification program label.

E. Samples: Submit two samples of finish plywood, 6 x 6 inches in size illustrating wood grain and specified finish.

F. Samples: Submit two samples of wood trim 6 inches long.

G. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

H. Manufacturer's Instructions: Provide manufacturer's installation instructions for factory-fabricated units.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.

B. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

C. Quality Certification:
   1. Provide labels or certificates indicating that work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   2. Provide designated labels on shop drawings as required by certification program.
   3. Provide designated labels on installed products as required by certification program.
   4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver factory-fabricated units to project site in original packages, containers or bundles bearing brand name and identification.
   1. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

C. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.

D. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

E. Handle materials and products to prevent damage to edges, ends, or surfaces.

F. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.07 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet-work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
   1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 FINISH CARPENTRY ITEMS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

C. Interior Woodwork Items:
   1. Moldings, Bases, Casings, and Miscellaneous Trim: Clear white pine; prepare for paint finish.
   2. Custom Children's playtime millwork.
   3. Custom wood stair plinth under 2nd floor stairs.
      a. Top of plinth to be baltic birch plywood with clear sealer.

2.03 LUMBER MATERIALS

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
   2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

2.04 SHEET MATERIALS

A. Softwood Plywood, Not Exposed to View: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.

B. Softwood Plywood, Exposed to View: Face species as indicated, plain sawn, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.
   1. Grading: Certified by the American Plywood Association.

C. Hardwood Plywood: Face species baltic birch, plain sawn, book matched, medium density fiberboard core; HPVA HP-1 Front Face Grade AA, Back Face Grade 1, glue type as recommended for application.

D. Hardboard: ANSI A135.4; Pressed wood fiber with resin binder, Class 1 - Tempered, 1/4 inch thick, smooth one side (S1S).

2.05 UPHOLSTERY

A. Upholstery (UP-#): Installed as part of custom finish carpentry. Refer to Architectural drawings for locations and extent.
   1. Basis of Design Products: See Finish Schedule on the Architectural drawings.

2.06 TAMBOUR VENEER

A. Tambour Veneer (VP-#):
   1. Basis of Design Products: See Finish Schedule on the Architectural drawings.

2.07 FASTENINGS

A. Exterior Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.

B. Interior Wood Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
   1. Paneling Adhesive: Comply with paneling manufacturer's written instructions for adhesives.
   2. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

C. Fasteners for Exterior Applications: Stainless steel; length required to penetrate wood substrate 1-1/2 inch minimum.

D. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

2.08 WOOD TREATMENT

A. Factory-Treated Lumber: Comply with requirements of AWPA U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specific applications.

B. Fire Retardant Treatment (FR-S Type): Chemically treated and pressure impregnated; capable of providing flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.

C. Shop pressure treat wood materials requiring fire rating to concealed wood blocking.

D. Provide identification on fire retardant treated material.

2.09 SITE FINISHING MATERIALS

A. Stain, Shellac, Varnish, and Finishing Materials: Comply with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

2.10 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. Back out or kerf backs of the following members, except those with ends exposed in finished work:
   1. Interior standing and running trim, except shoe and crown molds.
   2. Wood-board paneling.

C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.11 SHOP FINISHING

A. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

B. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 11, Polyurethane, Catalyzed.
      b. Sheen: Flat.
   2. Opaque:
      a. Exterior Paint Finish: See 09 9113 - Exterior Painting.
      b. Interior Paint Finish: See 09 9123 - Interior Painting.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Verify adequacy of backing and support framing.

D. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Install factory-fabricated units in accordance with manufacturer's printed installation instructions.

C. Set and secure materials and components in place, plumb and level.

D. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

3.03 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment in accordance with manufacturer's instructions.

B. Brush apply one coats of preservative treatment on wood in contact with cementitious materials. Treat site-sawn cuts.

C. Allow preservative to dry prior to erecting members.

3.04 PREPARATION FOR SITE FINISHING

A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

END OF SECTION

SECTION 06 4100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Hardware.

1.02 RELATED REQUIREMENTS

A. Section 12 3600 - Countertops.

1.03 DEFINITIONS

A. High-Pressure Decorative Laminate Types, per NEMA LD 3:
   1. General Purpose Types:
      a. HGS: Horizontal, 1.2 mm nominal thickness. Suitable for all applications except those requiring post-forming.
      b. HGL: Horizontal, 1.0 mm nominal thickness. Suitable for flat countertops, with lower levels of impact and radiant-heat resistance than Grade HGS.
      c. VGS: Vertical, 0.7 mm nominal thickness. Suitable for all vertical applications except those requiring post-forming.
      d. VGL: Vertical, 0.5 mm nominal thickness. Suitable for vertical applications with lower impact resistance than Grade VGS.
   2. Postforming Types: Applications with curves such as integral backsplashes or front radii utilizing curves up to 1/2 inch radius.
      a. HGP: Horizontal, 1.0 mm nominal thickness.
      b. VGP: Vertical, 0.7 mm nominal thickness.
   3. Flame Retardant Types: Capable of providing flame retardant characteristics as determined by test methods required by authority having jurisdiction.
      a. SGF: 1.5 mm nominal thickness.
      b. HGF: Horizontal, 1.2 mm nominal thickness.
      c. VGF: Vertical, 0.8 mm nominal thickness.
   4. High Wear Type: Increased surface wear resistance applications.
      a. HDH: 3 mm nominal thickness.
      b. HDM: 1.5 mm nominal thickness.
      c. HDS: 1.2 mm nominal thickness.
   5. Specific Purpose Type: Heavy-duty applications.
      a. HSH: 3 mm nominal thickness.
      b. HSM: 1.5 mm nominal thickness.
   6. Compact Laminate Type:
      a. CGS Type 1: 2 to 6 mm nominal thickness.
      b. CGS Type 2: Thicker than 6 mm and self-supporting.
   7. Cabinet Liner Type: Inside faces of cabinets only.
      a. CLS: 0.5 mm nominal thickness.

8. Backer Type: Backing sheet without a decorative face, for concealed surfaces, to prevent warping.
    a. BKH: 1.2 mm nominal thickness.
    b. BKM: 1 mm nominal thickness.
    c. BKV: 0.7 mm nominal thickness.
    d. BKL: 0.5 mm nominal thickness.

1.04 REFERENCE STANDARDS

A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

D. BHMA A156.9 - Cabinet Hardware; 2020.

E. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.

F. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

G. UL (DIR) - Online Certifications Directory; Current Edition.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting not less than two weeks before starting work of this section; require attendance by all affected installers.
    1. See Section 01 3000 - Administrative Requirements, for additional requirements.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
    1. VOC content restrictions data.

C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
    1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
    2. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
    3. Include certification program label.

D. Product Data: Provide data for hardware accessories.

E. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet substrate and finish.

F. Samples: Submit actual sample items of proposed pulls, hinges, and locksets, demonstrating hardware design, quality, and finish.

G. Field Quality Control Reports: As specified in Part 3 of this Section.

1.07 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
    1. Accredited participant in the specified certification program.
    2. Single Source Responsibility: Provide and install this work from single fabricator.

B. Quality Certification:
   1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   2. Provide designated labels on shop drawings as required by certification program.
   3. Provide designated labels on installed products as required by certification program.

C. Operable parts for all accessible casework shall comply with CBC Section 11B-309.
   1. Provide U-shaped pulls or touch latches at all accessible casework.

1.08 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site labeled with manufacturer's name, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, soiling, and other sources.

D. Protect units from moisture damage. Store in a dry location.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.09 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions by field measurement before fabrication. Show recorded measurements on shop drawings.

B. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

1.10 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 CABINETS

A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
   1. Cabinets and Casegoods: Faced panel casework conforming to the referenced woodwork quality standard, Section 10 requirements for Premium Grade, Construction Type A (framelsss), single-length cabinet sections with Interface Style 1 (flush overlay) cabinet doors and drawers.

B. Plastic Laminate Faced Cabinets: Premium grade.
   1. Standard unless noted otherwise.

2.03 WOOD-BASED COMPONENTS

A. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.

2.04 PANEL CORE MATERIALS

A. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.

2.05 HARDWOOD PLYWOOD PANELS

A. Hardwood Plywood: Plywood manufactured for nonstructural decorative applications; consisting of faces and backs applied to a variety of core types; comply with HPVA HP-1.
   1. Woodwork Quality Standard: Panels complying with specified woodwork quality standard.

2.06 LAMINATE MATERIALS

A. High Pressure Decorative Laminate (PL-#): NEMA LD 3, types as recommended for specific applications.
   1. Basis of Design Products: See Finish Schedule on the Architectural drawings.

B. Provide specific types as follows:
   1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness.
   2. Vertical Surfaces: VGS, 0.028 inch nominal thickness.
   3. Post-Formed Horizontal Surfaces: HGP, 0.039 inch nominal thickness.
   4. Post-Formed Vertical Surfaces: VGP, 0.028 inch nominal thickness.
   5. Flame Retardant Surfaces: HGF, 0.048 inch nominal thickness.
   6. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.07 COUNTERTOPS

A. Countertops: See Section 12 3600.

2.08 ACCESSORIES

A. Plastic Edge Banding: Extruded PVC, flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
   1. Basis of Design Product:
      a. Surteco; Doellken PVC Edgebanding.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Thickness: 3 mm.
   3. Finish: As selected by Architect to match laminate.

2.09 ACCESSORIES

A. Recessed Monitor Mount: Hardware with glass vision panel to mount computer monitor below countertop surface.
   1. Basis of Design Product:
      a. Nova Solutions; Retrofit Kit - Downview.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Viewport Cutout: 16 -1/4 inches deep by 21-1/4 inches wide.
   3. Provide privacy / glare visor.

2.10 HARDWARE

A. Cabinet Hardware: Comply with BHMA A156.9 for hardware types and grades indicated below:
   1. Product Grade: As required by specified woodworking quality grade.

B. Countertop Support Brackets: Fixed, L-shaped, face-of-stud mounting.

C. Countertop Brackets: Fixed, concealed vertical leg, side-of-stud mounting.
   1. Products:
      a. A&M Hardware, Inc; Concealed Brackets: www.aandmhardware.com/#sle.
      b. A&M Hardware, Inc; Concealed Flat Brackets: www.aandmhardware.com/#sle.
      c. Rakks/Rangine Corporation; Inside Wall Flush Mount Brackets: www.rakks.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

D. Drawer and Door Pulls:
   1. Products:
      a. Mocket; DP3 Tab Pull Series.
   2. Profile: 1-1/2 inches.
   3. Length: 4 inches.
   4. Finish: Matte black.

E. Keyed Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with matte black.

F. Keyed Glass Cabinet Door Locks: Keyed cylinder, two keys per lock, master keyed, steel.
   1. Product:
      a. Hafele; Glass Door Lock.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.

G. Cabinet Catches and Latches:
   1. Type: Push latch.

H. Drawer Slides:
   1. Type: Full extension.
   2. Static Load Capacity: Heavy Duty grade.
   3. Mounting: Side mounted.
   4. Stops: Integral type.
   5. Features: Provide self closing/stay closed type.

I. Hinges: European style concealed self-closing type, steel with matte black.

J. Display Case Glass Door Pivots and Locks:
   1. Product:
      a. Hafele; Glass Door Hinge, Sugatsune 180 Degrees Opening Angle, 6mm Glass.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.

K. Adjustable Shelves Bracket:

1. Product:
   a. Hafele; Bookcase Strip, "U" Section, Heavy Duty Superior Strength, for Commercial Bookcases and Shelving.
   b. Substitutions: See Section 01 2500 - Substitution Procedures.

2.11 SHOP TREATMENT OF WOOD MATERIALS

A. Provide UL (DIR) listed and approved identification on fire retardant treated material.

B. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.

2.12 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use fixture attachments in concealed locations for wall mounted components.

D. Use concealed joint fasteners to align and secure adjoining cabinet units.

E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

F. Secure cabinets to floor using appropriate angles and anchorages.

G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspections: Provide inspections of installed Work through AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) program certifying that woodwork, including installation, complies with requirements of the Standard and grade specified.
   1. Architectural woodwork will be considered defective if it does not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   3. Inspection entity shall prepare and submit report of inspection.

4. Submit Field Quality Control reports to Architect.

END OF SECTION

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SECTION 06 8316
FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiberglass reinforced plastic panels (FRP-#).

1.02 REFERENCE STANDARDS

A. 9 CFR 416.2 - Regulatory Requirements Under the Federal Meat Inspection Act and the Poultry Products Inspection Act, Part 416-Sanitation; current edition.

B. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

C. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

1.05 WARRANTY

A. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fiberglass Reinforced Plastic Panels:
   1. Crane.
   2. Marliet.
   3. Nudo Products.
   4. Panolam Industries.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS

A. Wall Panels (FRP-1):
   1. Basis of Design Products: See Finish Schedule on the Architectural drawings.
   2. Attachment Method: Adhesive only, with trim and sealant in joints.
   3. Size, Color, and Finish: As indicated on drawings.

2.03 MATERIALS

A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
   1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Sanitation and Cleanability: Comply with 9 CFR 416.2.

B. Sealant: Type recommended by panel manufacturer; white.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and substrate flatness before starting work.

B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.

B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.

C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.

E. Install panels with manufacturer's recommended gap for panel field and corner joints.

F. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.

G. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

SECTION 07 0513
SELECTIVE ROOF MODIFICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Limited demolition of existing roof assembly for new roof work, including new roof components and penetrations.

B. Temporary roofing.

C. Protection of roof to remain adjacent to area of Work.

D. Installation of new roofing materials at new roof components and penetrations

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Progress photographs.

B. Section 01 7000 - Execution and Closeout Requirements: Cutting and patching.

1.03 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal requirements.

B. Photographs: Of existing roof locations to be modified, and adjacent areas.

C. Product Data: For each item of temporary and permanent roofing systems to be installed.

D. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.
   2. Life cycle data.
   3. Sustainable wood data.
   4. Regional product data.
   5. Recycled content data.

E. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including but not limited to the following:
   1. Extents of Work.
   2. Direction of slope and existing drain locations.
   3. Location and alignment of new pads or supports, including new cricketing as required.
   4. Runs of new electrical, mechanical, and plumbing services and required supports on existing and new roof surfaces.
   5. Transition detail of existing to new roof assemblies.

F. Samples: Permanent roofing material.

G. Certified statement from manufacturer for existing warranted roof system, stating that existing roof warranty has not been affected by work performed under this Section.

H. Test reports.

I. Evaluation Service Reports: From ICC or similar. Show compliance with specified requirements.

J. Manufacturer's installation instructions, including preparation of existing roof to receive new materials.

K. Field Quality Control Reports: As specified in Part 3 of this Section.

L. Qualification Statement: For installer.
   1. Include certificate that installer is approved by warrantor of existing roofing system.

M. Warranty.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Installer: Approved by warrantor of existing roofing system to work on existing roofing.

B. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.
   2. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   3. Review methods and procedures related to Work of this Section, including, but not limited to, the following:
      a. Work preparation, including roofing system manufacturer's written instructions.
      b. Temporary protection requirements for existing roofing system components that are to remain.
      c. Existing roof drains and roof drainage during each stage of Work, and roof-drain plugging and plug removal.
      d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to avoid delays.
      e. Existing roof deck conditions requiring Architect notification.
      f. Condition and acceptance of existing roof substrate for reuse.
      g. Structural loading limitations of roof substrate during reroofing.
      h. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that affect Work.
      i. HVAC shutdown and sealing of air intakes.
      j. Governing regulations and requirements for insurance and certificates if applicable.
      k. Existing conditions that may require Architect notification before proceeding.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.07 FIELD CONDITIONS

A. Weather Limitations: Proceed with Work of this Section only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.
   1. Remove only as much roofing in one day as can be made watertight in the same day.

B. Hazardous Materials: It is not expected that hazardous materials, such as asbestos-containing materials, will be encountered in the Work.
   1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.
   2. Hazardous materials will be removed by Owner under a separate contract.

C. Owner will occupy portions of building immediately below reroofing area.
   1. Conduct reroofing so Owner's operations are not disrupted.
   2. Provide Owner with not less than 72 hours' written notice of activities that may affect Owner's operations.
   3. Coordinate work activities daily with Owner so Owner has adequate advance notice to place protective dust and water-leakage covers over sensitive equipment and furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below work area.

D. Protect building, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from Work of this Section.

1.08 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during Work of this Section, by methods and with materials so as not to void existing roofing system warranty.
   1. Notify warrantor before proceeding with the Work.
   2. Notify warrantor of existing roofing system on completion of Work, and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect.
      a. Submit documentation at Project closeout.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. Life Cycle: Products in this section to have LCA as specified in Section 01 6000.

D. Sustainable Wood: Products in this Section to meet sustainable wood requirements specified in Section 01 6000.

E. Regional Content: Products in this Section to meet regional requirements specified in Section 01 6000.

F. Recycled Content: Products in this Section to meet minimum recycled content thresholds specified in Section 01 6000.

2.02 TEMPORARY PROTECTION MATERIALS

A. EPS Insulation: ASTM C578.

B. Plywood: DOC PS 1, Grade CD, Exposure 1.

C. OSB: DOC PS 2, Exposure 1.

2.03 TEMPORARY ROOFING MATERIALS

A. Design and selection of materials for temporary roofing are Contractor's responsibilities.

2.04 NEW ROOFING MATERIALS

A. Use roofing materials matching existing roofing assembly, unless otherwise indicated and approved by existing roofing material manufacturer.

B. New low-slope roofing materials may include:
   1. Vapor barrier.
   2. Insulation.
   3. Cover board.
   4. Membrane.
   5. Walking pads.
   6. Liquid membrane.
   7. Prefabricated components.
   8. Sheet metal flashing.

2.05 AUXILIARY ROOFING MATERIALS

A. General: Use auxiliary materials recommended by roofing system manufacturer for intended use and compatible with components of existing roofing system.

PART 3 EXECUTION

3.01 EXAMINATION

A. See Section 01 7000 - Execution and Closeout Requirements.

B. Before commencement of work of this Section, take photographs of areas of Work, and areas adjacent. See Section 01 7000 for additional information.

C. Check for evidence of ponding within areas of Work. Discuss with Owner and Architect and modify new roofing material installation design to promote positive drainage.

3.02 PREPARATION

A. See Section 01 7000 - Execution and Closeout Requirements.

B. Protection of In-Place Conditions:
   1. Protect existing roofing system that is to remain.
      a. Loosely lay 1-inch- minimum thick, EPS insulation over existing roofing adjacent to areas of Work.

b. Loosely lay 15/32-inch plywood or OSB panels over EPS. Extend EPS past edges of plywood or OSB panels a minimum of 1 inch.

2. Limit traffic and material storage to areas of existing roofing that have been protected.
3. Maintain temporary protection and leave in place until roofing operations have been completed. Remove temporary protection on completion.
4. Comply with requirements of existing roof system manufacturer's warranty requirements.
5. If necessary, shut off rooftop utilities and service piping before beginning the Work.
6. If necessary, coordinate with Owner to shut down air-intake equipment in the vicinity of the Work.
7. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday.
   a. Prevent debris from entering or blocking roof drains and conductors.
      1) Use roof-drain plugs specifically designed for this purpose.
      2) Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
   b. If roof drains are temporarily blocked or unserviceable due to Work of this Section, provide alternative drainage method to remove water and eliminate ponding.

3.03 DEMOLITION

A. Notify Owner prior to demolition operations.

B. Removing existing roofing down to roof structure and immediately check for presence of moisture.
   1. Notify Owner and Architect if:
      a. Presence of wet or damp materials below existing roofing.
      b. Deterioration and damage to structure.
      c. Broken or loose fasteners that secure deck panels to one another or to structure.
      d. Deck appears or feels inadequately attached.
      e. Deck surface is unsuitable for receiving new Work.
      f. Structural integrity of deck is suspect.

3.04 TEMPORARY ROOFING INSTALLATION

A. Install approved temporary roofing if necessary.

B. Remove temporary roofing before installing new roofing or roof components.

3.05 NEW ROOFING INSTALLATION

A. Install new roofing materials and tie into existing roofing materials for complete watertight assembly, in accordance with manufacturer's written instructions and approved shop drawings.
   1. Extend new roofing materials onto existing roofing materials minimum 6 inches.

B. Do not exceed pot life of material as documented in writing by manufacturer.

3.06 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Owner to engage a qualified testing agency to perform tests and inspections.
   1. New roofing materials will be considered defective if they do not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
4. Submit field quality control reports to Architect.

C. Tests:
1. Low-Slope Roofing Electronic Leak Detection Testing.
a. Testing agency to create a conductive electronic field over the entire installed membrane and determine locations of discontinuities or leaks, if any. Include abutting or overlapping smaller areas as necessary to cover entire installed membrane.

D. Inspections:
1. Final Inspection: At completion of new roofing installation, review installed components with installer and manufacturer’s representative of new roof membrane.

E. Manufacturer's Representative to provide site monitoring and inspection services as specified in Section 01 4000.
1. Manufacturer's representative to prepare site review and inspection reports and deliver to Contractor.
2. Submit field quality control reports to Architect.

3.07 PROTECTION

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements.

B. Protect new roof components from subsequent construction operations.

END OF SECTION

SECTION 07 0553
FIRE AND SMOKE ASSEMBLY IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Identification markings for fire and smoke rated partitions, and fire rated walls.

1.02 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

A. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's printed product literature for each type of marking, indicating font, foreground and background colors, wording, and overall dimensions.

PART 2 PRODUCTS

2.01 FIRE AND SMOKE ASSEMBLY IDENTIFICATION

A. Regulatory Requirements: Comply with "Marking and Identification" requirements of "Fire-Resistance Ratings and Fire Tests" chapter of CBC.

B. Applied Fire and Smoke Assembly Identification: Identification markings applied to partition with paint and a code compliant stencil. See Section 09 9123 for products.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 PREPARATION

A. See Section 09 9123 for substrate preparation for painted markings.

3.03 INSTALLATION

A. Locate markings as required by CBC.

B. Install applied markings in accordance with Section 09 9123.

C. Install neatly, with horizontal edges level.

D. Protect from damage until Date of Substantial Completion; repair or replace damaged markings.

END OF SECTION

SECTION 07 1000
SPLIT SLAB WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preliminary requirements for new waterproofing to tie into existing waterproofing at existing split slab condition.

B. This section will be replaced when existing waterproof membrane has been identified and new waterproof membrane has been selected.

1.02 REFERENCE STANDARDS

A. ANSI A326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials; 2021.

B. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2022.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal requirements.

B. Product Data: For each item to be installed.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Shop drawings.

E. Test reports.

F. Evaluation Service Reports: From ICC or similar. Show compliance with specified requirements.

G. Manufacturer's installation instructions.

H. Testing and Inspection Reports: As specified in Part 2 of this Section.

I. Field Quality Control Reports: As specified in Part 3 of this Section.

1.04 COORDINATION

A. Register project with membrane manufacturer.

B. UV-Resistance: Confirm UV-resistance of material with manufacturer. Do not leave exposed for longer than allowed duration.

C. Compatibility: Confirm that new waterproofing is compatible and warrantable with existing waterproofing products.

D. Confirm with manufacturer that products are appropriate to Project scope and conditions.

1.05 QUALITY ASSURANCE

A. Preconstruction Testing: See Section 01 4000 - Quality Requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.07 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 SPLIT SLAB WATERPROOFING

A. See sheet [ ] for additional information.

B. Existing Waterproofing: Existing waterproof membrane type at existing split slab is unknown.

C. Demolition:
   1. Provide limited demolition of existing topping slab to reveal existing waterproofing membrane. Location and extent of demolition to be decided by Owner's testing agency for testing and inspections specified immediately below.
   2. Owner to engage a qualified testing agency to perform tests and inspections.
      a. Tests:
         1) Hazardous Materials: Testing agency to confirm if existing membrane contains hazardous materials.
      b. Inspections:
         1) Membrane Type and Integrity: Confirm type of membrane and suitability of membrane to remain.
   3. If the existing membrane contains hazardous materials, Owner to engage hazardous materials contractor for extent of demolition and remediation efforts.
   4. If the existing membrane does not contain hazardous materials, continue demolition of existing topping slab to cold joints as shown on the Architectural drawin

D. New Waterproof Membrane System: Provide all components necessary for new waterproof membrane, to retain waterproofing integrity of existing split slab.

1. Membrane Type: To be determined.
2. Drainage Course: If recommended by new membrane manufacturer for Project conditions.
3. Testing and Inspections: Once new waterproofing membrane system has been installed, tests and inspections to be performed as specified in Part 3 of this section.

E. Replacement Topping Slab: Once new waterproof membrane has passed tests and inspections, provide replacement topping slab per Structural drawings and specifications.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's written instructions and approved shop drawings.

B. Do not exceed pot life of material as documented in writing by manufacturer.

3.02 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Owner to engage a qualified testing agency to perform tests and inspections.
   1. New split slab waterproofing will be considered defective if it does not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
   4. Submit field quality control reports to Architect.

C. Tests:
   1. Electronic Leak Detection Testing.
      a. Testing agency to create a conductive electronic field over the entire installed membrane and determine locations of discontinuities or leaks, if any. Include abutting or overlapping smaller areas as necessary to cover entire installed membrane.

D. Manufacturer's Representative to provide site monitoring and inspection services as specified in Section 01 4000.
   1. Manufacturer's representative to prepare site review and inspection reports and deliver to Contractor.
   2. Submit field quality control reports to Architect.

END OF SECTION

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SECTION 07 1300
SHEET WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Self-adhered HDPE sheet membrane.

1.02 RELATED REQUIREMENTS

A. Section 03 1513 - Waterstops: For waterstops used in conjunction with products in this section.

1.03 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

B. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives (T-Peel Test); 2008 (Reapproved 2023).

C. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.

D. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2022.

E. ASTM D5295/D5295M - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems; 2018.

F. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 2020.

G. ASTM D6506/D6506M - Standard Specification for Asphalt Based Protection Board for Below-Grade Waterproofing; 2001, with Editorial Revision (2018).

H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

I. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2019).

J. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).

K. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: For each item to be installed.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditionsIndicate special joint or termination conditions and conditions of interface with other materials.

E. Samples: For each product to be installed, in manufacturer's standard sample size.

F. Certificate: Certify that products meet or exceed specified requirements.

G. Manufacturer's Installation Instructions: Indicate special procedures.

H. Manufacturer's qualification statement.

I. Installer's qualification statement.

J. Field Quality Control Reports: As specified in Part 3 of this Section.

K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 COORDINATION

A. Register project with sheet waterproofing manufacturer.

B. UV-Resistance: Confirm UV-resistance of material with manufacturer. Do not leave exposed for longer than allowed duration.

C. Compatibility: Confirm compatibility of all waterproofing system components that are in direct contact.
   1. Coordinate tie-in of waterproofing system drainage components with storm sewer.

D. Confirm with manufacturer that products are appropriate to Project scope and conditions.

1.06 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Membrane Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years of documented experience.
   2. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

B. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.

1.07 MOCK-UPS

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Build mockups to verify selections made under sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

C. Construct mock-up consisting of 100 sq ft of horizontal and vertical sheet waterproofing panel; to represent finished work including internal and external corners, seam jointing, attachment method, counterflashings, drainage panel, control joints, and expansion joints, as applies.

D. Locate where directed by Architect.

E. Approved mock-ups may remain as part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for pa

1.09 FIELD CONDITIONS

A. Apply waterproofing systems within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to damp or wet substrates.
   1. Do not apply waterproofing in snow, rain, fog, or mist.

1.10 WARRANTY

A. See Section 01 6000 - Product Requirements for additional warranty requirements.

B. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
   1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. All membranes to meet Class A vapor barrier requirements per ASTM E1745.

2.03 MANUFACTURERS

A. Manufacturers:
   1. Carlisle.
   2. GCP Applied Technologies.
   3. Polyguard.
   4. W.R. Meadows.
   5. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

2.04 WATERPROOFING SYSTEMS, GENERAL

A. Waterproofing systems include all components necessary for a complete waterproofing system, including but not limited to surface primer, liquid membrane, premanufactured components, and transition materials, as recommended by waterproofing materials manufacturer for application.

B. Geotechnical Report: Refer to the geotechnical report for soil quality and presence of groundwater. Confirm with manufacturer that intended below-grade waterproofing system is appropriate to Project scope and conditions.

C. Refer to Architectural drawings for locations and extents of waterproofing.

2.05 SHEET WATERPROOFING MATERIALS

A. Pre-Applied (Blindside) Self-Adhered HDPE Sheet Membrane: Recommended by manufacturer for placement below concrete slabs and on outside face of below grade walls before placement of concrete.
   1. Low Temperature Flexibility: Unaffected when tested in accordance with ASTM D1970/D1970M at minus 20 degrees F, 180 degree bend on 1 inch mandrel.
   2. Hydrostatic Pressure Resistance: Membrane resists leakage for at least one hour from pressure equivalent to 231 feet head of water applied in accordance with test method ASTM D5385/D5385M.
   3. Tensile Strength, Film: 3,500 psi, minimum, measured in accordance with ASTM D412.
   4. Adhesion: 150 psi, minimum, measured in accordance with ASTM D4541.
   5. Puncture Resistance (ASTM E154/E154M):
      a. Vertical Orientation: 100 lbf. minimum.
      b. Horizontal Orientation: 200 lbf. minimum.
   6. Water Vapor Permeance: 0.01 perm, maximum, measured in accordance with ASTM E96/E96M.
   7. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
   8. Basis of Design Product:
      a. GCP Applied Technologies; Preprufe 300R Plus/LT: www.gcpat.com/#sle.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   9. Location: Blindside waterproofing at elevator pits.

2.06 ACCESSORIES

A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
   1. Furnish liquid-type auxiliary materials that comply with VOC limits in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Primer: Liquid waterborne primer recommended for substrate by membrane manufacturer.

C. Surface Conditioner: Liquid waterborne surface conditioner recommended for substrate by membrane manufacturer.

D. Liquid Membrane: Manufacturer's standard product, compatible with membrane and adjoining components.

E. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.

F. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic, one of the following:

1. Hardboard, 1/8 inch thick.
2. Polystyrene foam board, 1 inch thick.
3. Multilayer internally-reinforced asphaltic panels, 1/8 inch thick, nominal, complying with ASTM D6506/D6506M.
    a. Adhesive: As recommended by membrane manufacturer.
4. Recycled or reclaimed closed-cell foam plastic with nonwoven filter fabric cover; 1 inch thick.
5. Semi-rigid glass fiber board; unaffected by water, freeze-thaw, fungus, or soil bacteria; containing no formaldehyde, phenol, acrylic, or artificial color; 3/4 inch thick, nominal.

G. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
1. Composition: Dimpled polystyrene, polyethylene, or polypropylene core; polypropylene filter fabric.
    a. Products:
        1) Advanced Building Products, Inc; ABP AdvancedDrain Polymeric Drainage Mat: www.advancedbuildingproducts.com/#sle.
        2) GCP Applied Technologies; Hydroduct System.
        3) Sika Corporation; Drainage Mat: www.usa.sika.com/#sle.
        4) W. R. Meadows, Inc; Mel-Drain 5012: www.wrmeadows.com/#sle.
        5) Substitutions: See Section 01 2500 - Substitution Procedures.

H. Flexible Flashings: Type recommended by membrane manufacturer.

I. Termination Bars: Stainless steel; compatible with membrane and adhesives.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting work.

B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

C. Verify that items penetrating surfaces to receive waterproofing are securely installed.

D. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.

E. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.

C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.

D. Fill nonmoving joints and cracks with a filler compatible with waterproofing materials.

E. Seal moving cracks with sealant and nonrigid filler, using procedures recommended by sealant and waterproofing manufacturers.

F. Prepare building expansion joints at locations as indicated on drawings.

G. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.

H. Concrete Surfaces for Adhesive Bonding: Prepare concrete substrate in accordance with ASTM D5295/D5295M.
   1. Remove substances that inhibit adhesion including form release agents, curing compounds admixtures, laitance, moisture, dust, dirt, grease and oil.
   2. Repair surface defects including honeycombs, fins, tie holes, bug holes, sharp offsets, rutted cracks, ragged corners, deviations in surface plane, spalling and delaminations, as described in reference standard.
   3. Remove and replace areas of defective concrete; see Section 03 3000.
   4. Prepare concrete for adhesive bonded waterproofing using mechanical or chemical methods described in referenced standard.
   5. Test concrete surfaces as described in referenced standards, and verify surfaces are ready to receive adhesive bonded waterproofing membrane system.

3.03 INSTALLATION - MEMBRANE

A. Install membrane waterproofing in accordance with manufacturer's instructions, approved shop drawings, and NRCA (WM) applicable requirements.

B. Roll out membrane, and minimize wrinkles and bubbles.

C. Overlap edges and ends, minimum 3 inches or as otherwise required by membrane manufacturer, seal permanently by method recommended by manufacturer.

D. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.

E. Seal membrane and flashings to adjoining surfaces.
   1. Install termination bar along edges.
   2. Install counterflashing over exposed edges.

3.04 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward; scribe and cut boards around projections, penetrations, and interruptions.

B. Place protection board directly against drainage panel; butt joints, and scribe and cut boards around projections, penetrations, and interruptions.

C. Adhere protection board to substrate with compatible adhesive.

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Owner to engage a qualified testing agency to perform tests and inspections.
   1. Sheet waterproofing will be considered defective if it does not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
   4. Submit field quality control reports to Architect.

C. Tests:
   1. Electronic Leak Detection Testing.
      a. Testing agency to create a conductive electronic field over the entire installed membrane and determine locations of discontinuities or leaks, if any. Include abutting or overlapping smaller areas as necessary to cover entire installed membrane.

D. Manufacturer's Representative to provide site monitoring and inspection services as specified in Section 01 4000.
   1. Manufacturer's representative to prepare site review and inspection reports and deliver to Contractor.
   2. Submit field quality control reports to Architect.

3.06 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

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SECTION 07 1400
FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hot-applied rubberized asphalt waterproofing system.

1.02 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

B. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics; 2016 (Reapproved 2023).

C. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 2020.

D. ASTM D7877 - Standard Guide for Electronic Methods for Detecting and Locating Leaks in Waterproof Membranes; 2024.

E. ASTM D8231 - Standard Practice for the Use of a Low Voltage Electronic Scanning System for Detecting and Locating Breaches in Roofing and Waterproofing Membranes; 2019.

F. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

G. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: For each item to be installed.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.
   2. Life cycle data.
   3. Recycled content data.

D. Certificates: Products to meet or exceed specified requirements.

E. Shop Drawings: Show details for substrate joint and crack treatment, sheet flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination conditions.

F. Test reports.

G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

H. Manufacturer's Installation Instructions: Indicate special procedures.

I. Manufacturer's qualification statement.

J. Installer's qualification statement.

K. Field Quality Control Reports: As specified in Part 3 of this Section.

L. Warranty Documentation:
   1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
   2. Submit installer's documentation that installation complies with warranty conditions for the field-applied waterproofing.

1.04 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 10 years documented experience.
   2. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

B. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.
   2. Conduct conference at Project site.
   3. Review waterproofing requirements, including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.05 MOCK-UPS

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Construct mock-up consisting of 100 sq ft of horizontal and vertical fluid-applied waterproofing; to represent finished work including internal and external corners, drainage panel, base flashings, control joints, expansion joints, counterflashings, and protective cover.

C. Locate where directed.

D. Mock-up may remain as part of Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.07 FIELD CONDITIONS

A. Ambient Conditions: Maintain ambient temperature and humidity as required by manufacturer for each product to be installed, before and after installation.

1.08 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Special Warranty: Manufacturer agrees to repair or replace waterproofing systems that do not comply with requirements or that fail to remain watertight within specified warranty period.
   1. Warranty includes removing and reinstalling protection board, drainage panels, and overburden.
   2. Warranty Period: 10 years from date of Substantial Completion.

C. Special Installer's Warranty: Specified form signed by Installer, covering Work of this Section, for warranty period of two years from date of Substantial Completion.
   1. Warranty includes removing and reinstalling protection board, drainage panels, and overburden.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. Life Cycle: Products in this section to have LCA as specified in Section 01 6000.

D. Recycled Content: Products in this Section to meet minimum recycled content thresholds specified in Section 01 6000.

2.02 MANUFACTURERS

A. Hot-Applied Rubberized Asphalt Waterproofing:
   1. American Hydrotech (Sika).
   2. Barrett Company.
   3. Carlisle.
   4. Cetco.
   5. Henry.
   6. Hydro-Gard.
   7. Soprema.
   8. Tremco.
   9. W.R. Meadows.
   10. Substitutions: See Section 01 2500 - Substitution Procedures.

2.03 FLUID-APPLIED WATERPROOFING, GENERAL

A. Refer to Architectural drawings for locations and extents of assembly types.

B. Provide all components necessary for a complete system.

2.04 HOT-APPLIED RUBBERIZED ASPHALT WATERPROOFING SYSTEM

A. Hot-Applied Rubberized Asphalt Waterproofing: Elasticized rubberized asphaltic compound, hot-applied and quick setting.
   1. Assembly:

a. Primer.
b. Membrane, 90 mils minimum first pass.
c. Reinforcement:
    1) Fabric Reinforcement: 1.3 oz/sq. yd. spunbonded polyester.
        (a) Locations: Typical unless noted otherwise.
    2) Rubber Reinforcement: 60 mil uncured neoprene.
        (a) Locations: Cracks, joints, terminations, and as otherwise recommended by manufacturer.
d. Membrane, 125 mils minimum second pass.

2. Physical Properties:
    a. Capable of resisting 100 maximum water head of 231 feet and preventing moisture migration to interior, tested in accordance with ASTM D5385/D5385M.
    b. Ultimate Elongation: 1000 percent, minimum, measured in accordance with ASTM D412.
    c. Water Vapor Permeance: 0.27 perms, maximum, measured in accordance with ASTM E96/E96M.
    d. Finished Coating Thickness: 215 mil, 0.215 inch, minimum.
    e. Liquid-Applied Flashing: Manufacturer's recommended multicomponent, reinforced, UV stabilized poly methyl-methacrylate (PMMA) resin flashing compatible with waterproofing membrane and suitable for exposed conditions.
3. Products:
    a. American Hydrotech (Sika); Monolithic Membrane 6125: www.hydrotechusa.com/#sle.
    b. Barrett Company, LLC, member of Keene Family of Companies; RamTough 250 - Hot Rubberized Asphalt Waterproof Membrane: www.barrettroofs.com/#sle.
    c. Carlisle Coatings & Waterproofing, Inc; CCW 500: www.carlisleccw.com/#sle.
    d. CETCO, a division of Minerals Technologies Inc; STRATASEAL HR: www.mineralstech.com/#sle.
    e. Henry Company; 790-11: www.henry.com/#sle.
    f. Hydro-Gard; Hydro-Tuff: www.hydro-gard.com/#sle.
    g. Soprema, Inc; COLPHENE H: www.soprema.us/#sle.
    h. Tremco Commercial Sealants & Waterproofing; TREMproof 6100: www.tremcosealants.com/#sle.
    i. W. R. Meadows, Inc; HRM 714: www.wrmeadows.com/#sle.
    j. Substitutions: See Section 01 2500 - Substitution Procedures.

2.05 ACCESSORIES

A. General: Auxiliary materials recommended by waterproofing manufacturer for intended use, compatible with waterproofing membrane, and as necessary to support specified warranty.

B. Sealant for Joints and Cracks in Substrate: Type compatible with waterproofing material and as recommended by waterproofing manufacturer.

C. Flexible Flashings: Type recommended by membrane manufacturer.

D. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
    1. Composition: Dimpled polyethylene, polypropylene, or polystyrene core; polypropylene or polyester filter fabric.
    2. Flow Rate: 9 to 21 gpm per ft., or as otherwise recommended by manufacturer for location and conditions.
    3. Core Compressive Strength: 15,000 psf, minimum, in accordance with ASTM D1621
    4. Product: As recommended by membrane manufacturer.

E. Metal Termination Bars: Manufacturer's standard, pre-drilled stainless steel termination bars; approximately 1 by 1/8 inch thick, with stainless steel anchors.

PART 3 EXECUTION

3.01 EXAMINATION

A. See Section 01 7000 - Execution and Closeout Requirements.

B. Verify existing conditions before starting work.

C. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.

D. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.

E. Verify that items penetrating surfaces to receive waterproofing are securely installed.

F. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.

G. Do not proceed with this work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. See Section 01 7000 - Execution and Closeout Requirements.

B. Protect adjacent surfaces from damage not designated to receive waterproofing.

C. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.

D. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.

E. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.

F. Seal moving cracks with sealant and non-rigid filler, using procedures recommended by sealant and waterproofing manufacturers.

3.03 INSTALLATION

A. Install waterproofing to specified minimum thickness in accordance with manufacturers instructions, NRCA (WM), and approved shop drawings.

B. Do not exceed pot life of material as documented in writing by manufacturer.

C. Apply primer or surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.

D. Seal membrane and flashings to adjoining surfaces.

3.04 INSTALLATION - DRAINAGE PANEL

A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward, and scribe and cut boards around projections, penetrations, and interruptions.

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Owner to engage a qualified testing agency to perform tests and inspections.
   1. Fluid-applied waterproofing will be considered defective if it does not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
   4. Submit field quality control reports to Architect.

C. Tests:
   1. Electronic Leak Detection (ELD) Testing: Test waterproofed areas for leaks using ELD method that locates discontinuities in fluid-applied waterproofing in accordance with ASTM D7877 or ASTM D8231.
      a. Testing agency to create a conductive electronic field over the entire installed membrane and determine locations of discontinuities or leaks, if any. Include abutting or overlapping smaller areas as necessary to cover entire installed membrane.

D. Manufacturer's Representative to provide site monitoring and inspection services as specified in Section 01 4000.
   1. Manufacturer's representative to prepare site review and inspection reports and deliver to Contractor.
   2. Submit field quality control reports to Architect.

3.06 PROTECTION

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements.

B. Provide barrier or other delineation to prevent damage to installed Work from subsequent construction activities.

C. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

SECTION 07 1616
CRYSTALLINE WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Crystalline waterproofing.

1.02 RELATED REQUIREMENTS

A. Section 01 4113.11 - Regulatory Requirements - Global Warming Potential (GWP).

1.03 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.

B. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

C. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

D. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2023.

E. ASTM D4259 - Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application; 2018.

F. ASTM D4260 - Standard Practice for Liquid and Gelled Acid Etching of Concrete; 2023.

G. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.

H. COE CRD-C 48 - Handbook for Concrete and Cement Standard Test Method for Water Permeability of Concrete; 1992.

I. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Global Warming Potential (GWP): Environmental product declaration (EPD) to identify GWP less than or equal to maximum allowable value. See 01 4113.11 - Regulatory Requirements - Global Warming Potential (GWP), for additional information.

C. Product Data: For each item to be installed. Manufacturer's data sheets on each product intended for use, including:
   1. Test data showing hydraulic permeability.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.
   5. Details for waterproofing at joints, intersections, and other special conditions.

D. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.
   2. CAL (CDPH SM) compliance data.

E. Certificates: Products to meet or exceed specified requirements.
F. Test reports.
G. Manufacturer's installation instructions.
H. Manufacturer's qualification statement.
I. Installer's qualification statement.
J. Field Quality Control Reports: As specified in Part 3 of this Section.
K. Warranty.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least 5 years of documented experience and providing technical representative to visit project site.
   2. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience and approved by manufacturer.
B. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.
B. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.
C. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.
D. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.
E. Store products in manufacturer's unopened packaging until ready for installation.
F. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
G. Take necessary precautions to keep cementitious materials dry.

1.07 FIELD CONDITIONS

A. Maintain environmental conditions, such as temperature, humidity, and ventilation, within limits recommended by manufacturer for acceptable results; do not install products under environmental conditions outside manufacturer's indicated limits.

1.08 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of crystalline waterproofing system that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. CDPH: Products to comply with CAL (CDPH SM).

2.02 PERFORMANCE REQUIREMENTS

A. Water Permeability of Applied Concrete: No measurable leakage or water flow at pressure ranging from 175 psi to 200 psi when tested in accordance with COE CRD-C 48, using at least 2-inch thick sample, and with applied surface preparation and installation in accordance with NRCA (WM).

B. Compressive Strength: At least 3,600 psi at test age of 28 days in accordance with ASTM C109/C109M test method.

2.03 REGULATORY REQUIREMENTS

A. See Section 01 4100 - Regulatory Requirements.

B. Concrete: Global Warming Potential (GWP) less than or equal to maximum allowable value. See Section 01 4113.11 - Regulatory Requirements - Global Warming Potential (GWP), for additional information.

2.04 MANUFACTURERS

A. Crystalline Waterproofing:
   1. Koster.
   2. Kryton.
   3. Tremco.
   4. W.R. Meadows.
   5. Xypex.
   6. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 APPLICATIONS

A. Crystalline Waterproofing for Concrete Building Surfaces:
   1. Interior side of elevator pits.

1.03 MATERIALS

A. Crystalline Waterproofing: Portland cement, quartz or silica sand, and other active chemicals applied to surface of concrete to form insoluble crystals in capillary pores, preventing passage of liquids while having no adverse effect on normal properties of concrete.
   1. Products:
      a. Koster; Koster NB 1 Grey.
      b. Kryton; Krystol T1 Waterproofing System.
      c. Tremco; Permaquik 200 Crystalline Waterproofing.
      d. W.R. Meadows; Cem-Kote CW Plus.

e. Xypex; Xypex Concentrate.
f. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 ACCESSORY MATERIALS

A. Plugging Compound: Ready-mixed cementitious compound meeting requirements of project and approved by waterproofing manufacturer; resistant to water but vapor permeable for horizontal, vertical, and overhead surfaces not exposed to vehicular traffic and compatible with substrate.
B. Patching Compound: Ready-mixed cementitious mortar approved by waterproofing manufacturer for patching or filling tie holes, reveals, honeycombs, or other damaged cementitious surfaces and compatible with substrate.
C. Portland Cement: ASTM C150/C150M, Type 1.
D. Sand: ASTM C144.
E. Water: Potable.

PART 3 EXECUTION

2.01 EXAMINATION

A. See Section 01 7000 - Execution and Closeout Requirements.
B. Do not begin installation until substrates are prepared in accordance with manufacturer's instructions.
C. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

2.02 PREPARATION

A. See Section 01 7000 - Execution and Closeout Requirements.
B. Clean surfaces prior to installation.
   1. Remove dust, dirt, mortar, efflorescence, grease, oils, paint, form-release agents, and curing compounds in accordance with ASTM D4258.
C. Prepare surfaces using methods for achieving best result for substrate under project conditions; consider use of sandblasting, water blasting, or acid etching as recommended by manufacturer.
   1. Troweled Finish: Prepare concrete surface by abrasive cleaning in accordance with ASTM D4259 before coating application.
   2. Etched Finish: Prepare concrete surface by acid etching in accordance with ASTM D4260 before coating application.
D. Plug water leaks.
E. Patch holes, construction joints, and cracks; remove defective concrete.
F. Obtain approval of manufacturer's field representative before beginning installation.

2.03 INSTALLATION

A. Install in accordance with manufacturer's written instructions, maintain environmental conditions required and recommended by manufacturer, and keep copy of manufacturer's instructions on-site. Install according to approved shop drawings.

B. Coordinate waterproofing installation with installation of products that must penetrate waterproofed surfaces.

C. Prevent excessive drying of surface.
   1. Cure waterproofing for at least three days or length of time required by manufacturer with water spray and adequate air circulation.
   2. Do not use chemical curing agents unless explicitly approved by waterproofing manufacturer.

D. Do not backfill, fill water- or liquid-holding structures, or apply finish coatings until time period recommended by manufacturer has passed.

E. Do not exceed pot life of material as documented in writing by manufacturer.

2.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Owner to engage a qualified testing agency to perform tests and inspections.
   1. Crystalling waterproofing will be considered defective if it does not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
   4. Submit field quality control reports to Architect.

C. Tests:
   1. Flood test waterproofing application by filling water-holding structures to capacity and allowing to stand for not less than 24 hours.

D. Manufacturer's Representative to provide site monitoring and inspection services as specified in Section 01 4000.
   1. Manufacturer's representative to prepare site review and inspection reports and deliver to Contractor.
   2. Submit field quality control reports to Architect.

2.05 PROTECTION

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements.

B. Protect from damage by weather; do not cover with vapor impermeable sheathing or films unless air circulation is provided.

C. Touch up, repair, or replace damaged waterproofing after Date of Substantial Completion.

END OF SECTION

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SECTION 07 2100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Thermal insulation.

1.02 RELATED REQUIREMENTS

A. Section 01 4113.11 - Regulatory Requirements - Global Warming Potential (GWP).

B. Section 09 8100 - Acoustic Insulation.

1.03 DEFINITIONS

A. Mineral Fiber Material Composition: Insulation referred to as mineral fiber block, board, and blanket insulation is composed of fibers from mineral based substances such as rock, slag, or glass and processed from the molten state into fibrous form.

1. Based on type of insulation substance, the material will be referred to as a mineral fiber when having a rock or slag base, and glass fiber with a glass or silica sand base, also considered a mineral.
2. Insulation blankets are flexible units consisting of felted, bonded, or unbonded fibers formed into rolls or flat cut pieces referred to as batts; rolls are simply longer versions of batts.
3. For additional information about mineral fiber and the various classification types, refer to the following reference standards; ASTM C553, ASTM C612, ASTM C665, and ASTM C726.

1.04 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.

E. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board; 2017.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

G. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: For each item to be installed. Provide data on product characteristics, performance criteria, and product limitations.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Samples for Verification: Submit three samples 6 by 6 inches in size illustrating insulation.

E. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.06 COORDINATION

A. Fire-Rated Assemblies: Confirm insulation products within fire-rated assemblies meet fire-rated assembly requirements.
   1. Substitutions will not be permitted when proprietary products are required to meet fire-rating requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.08 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.09 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Products to be identified with appropriate markings of applicable testing agency.

B. Fire-Test-Response Characteristics: Provide foam plastic continuous insulation assemblies with the following fire-test-response characteristics, as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
   1. Intermediate-Scale Multistory Fire Test: Tested mockup, representative of completed wall assembly of which foam plastic continuous insulation is a part, complies with NFPA 285 for test method and required fire-test-response characteristics of exterior non-load-bearing wall assemblies.

2.03 APPLICATIONS

A. Insulation Over Metal Stud Framed Walls, Continuous: Mineral fiber board.

B. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.

C. Roof Insulation:
   1. See Section 07 5419 - Polyvinyl-Chloride (PVC) Roofing

D. Interior Partition Acoustic Insulation: See Section 09 8100 - Acoustic Insulation.

2.04 MINERAL FIBER BOARD INSULATION MATERIALS

A. Mineral Wool Board Thermal Insulation: Complying with ASTM C612 or ASTM C553.
   1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   2. Thermal Resistance: R-value of 4.2 per inch at 75 degrees F, minimum, when tested in accordance with ASTM C518.

2.05 MINERAL FIBER BLANKET INSULATION MATERIALS

A. Mineral Wool Blanket Thermal Insulation: Flexible or semi-rigid preformed insulation, complying with ASTM C665.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   3. Thermal Resistance: R-value of 4.3 minimum at 1 inch thickness.
   4. Products:
      a. Johns Manville; Mineral Wool TempControl Batts: www.jm.com/#sle.
      b. ROCKWOOL; COMFORTBATT: www.rockwool.com/#sle.
      c. Thermafiber, Inc; SAFB FF: www.thermafiber.com/#sle.
      d. Substitutions: See Section 01 2500 - Substitution Procedures.

2.06 ACCESSORIES

A. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
   1. Application: Sealing of interior circular penetrations, such as pipes or cables.
   2. Width: Are required for application.
   3. Temperature Resistance: Range of minus 40 to 212 degrees F.

B. Protection Board for Below Grade Insulation: Cementitious, 1/4 inch thick.

C. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 BOARD INSTALLATION AT EXTERIOR WALLS

A. Install boards horizontally on walls.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.02 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.03 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 2700
AIR BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air barriers.

1.02 DEFINITIONS

A. See Section 01 4216 - Definitions, for the following technical definitions:
   1. Air barrier material.
   2. Air barrier system.

1.03 REFERENCE STANDARDS

A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.

B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

C. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

F. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

G. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: For each item to be installed. Provide data on material characteristics, performance criteria, and limitations.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Shop Drawings: Provide drawings of special joint conditions.

E. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

F. Certificates: Products to meet or exceed specified requirements.

G. Evaluation Service Reports: From ICC or similar. Show compliance with specified requirements.

H. Manufacturer's qualification statement.

I. Installer's qualification statement.

J. Field Quality Control Reports: As specified in Part 3 of this Section.

K. Warranty.

1.05 COORDINATION

A. UV-Resistance: Confirm UV-resistance of material with manufacturer. Do not leave exposed for longer than allowed duration.

B. Compatibility: Confirm that air barrier is compatible with waterproofing and roofing products.

C. Confirm with manufacturer that products are appropriate to Project scope and conditions.

1.06 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.
   2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture, and use secondary materials manufactured by or approved in writing by primary material manufacturer.

B. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.08 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

1.09 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
   1. ABAA Evaluation: Selected product to be tested and listed on ABAA website as an evaluated air barrier.
   2. Web: https://www.airbarrier.org/technical-information/evaluated-assemblies-2/ .

B. Nail Sealability (ASTM D1970/D1970M): Pass.

C. Comply with NFPA 285 requirements for wall assembly.

D. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.

E. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 90 days of weather exposure.

2.03 AIR BARRIER MATERIALS (AIR IMPERMEABLE AND WATER VAPOR PERMEABLE)

A. Air Barrier Sheet, Self-Adhered:
   1. Water Vapor Permeance: 10 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure A - Desiccant Method, at 73.4 degrees F.
   2. Products:
      a. GCP Applied Technologies; Perm-A-Barrier VPS 30: www.gcpat.com/#sle.
      b. Henry Company; Blueskin VP160: www.henry.com/#sle.
      c. Soprema, Inc; SOPRASEAL Stick VP: www.soprema.us/#sle.
      d. VaproShield, LLC; RevealShield SA - Self-Adhered: www.vaproshield.com/#sle.
      e. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
   1. Air Barrier Coating:
      a. Dry Film Thickness (DFT): As specified in writing by manufacturer, minimum.
      b. Water Vapor Permeance: 11 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method, at 73.4 degrees F.
      c. Elongation: 300 percent, minimum, when tested in accordance with ASTM D412.
      d. Products:
         1) Dow Chemical Company; DOWSIL DefendAir 200C: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
         2) DuPont de Nemours, Inc; Tyvek Fluid Applied WB+ with Tyvek Fluid Applied Flashing and Joint Compound, Sealant for Tyvek Fluid Applied System, and StraightFlash: building.dupont.com/#sle.
         3) GCP Applied Technologies; Perm-A-Barrier VPL 50RS UV Stable: www.gcpat.com/#sle.
         4) Henry Company; Air-Bloc All Weather STPE: www.henry.com/#sle.

5) Pecora Corporation; Pecora XL-Perm Ultra NP with XL-Flash Liquid Flashing and Joint Filler, AVB Silicone Surface Transitions, and XL-Span Transition Membrane: www.pecora.com/#sle.
6) Polyguard; Airlok STPE WRB Spray-N-Roll.
7) PROSOCO, Inc; R-GUARD Cat 5: www.prosoco.com/r-guard/#sle.
8) Substitutions: See Section 01 2500 - Substitution Procedures.

2. Air Barrier Fluid-Applied Membrane:
   a. Dry Film Thickness (DFT): As specified in writing by manufacturer, minimum.
   b. Water Vapor Permeance: 11 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method, at 73.4 degrees F.
   c. Products:
      1) Tremco Commercial Sealants & Waterproofing; ExoAir 230: www.tremcosealants.com/#sle.
      2) W. R. Meadows, Inc; Air-Shield LMP: www.wrmeadows.com/#sle.
      3) Substitutions: See Section 01 2500 - Substitution Procedures.

B. Air Barrier, Glass-Mat Faced Gypsum Panel: Vapor permeable; comply with ASTM C1177/C1177M physical requirements.
   1. Thickness: 5/8 inch.
   2. Width and Height: 48 inches wide by 96 inches high.
   3. Edges: Square.
   4. Water Vapor Permeance: 8 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method, at 73.4 degrees F.
   5. Products:
      a. USG / Tremco Commercial Sealants & Waterproofing; Securock ExoAir 430 Panel: www.tremcosealants.com/#sle.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 ACCESSORIES

A. General: Accessory products by air barrier manufacturer, or approved in writing by air barrier manufacturer.

B. Sealants, Tapes, and Accessories for Sealing Air Barrier and Adjacent Substrates: As indicated or in compliance with air barrier manufacturer's installation instructions.

C. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrate and air barrier materials.

D. Primer: Liquid applied polymer, as recommended by air barrier manufacturer.

E. Foil-Faced Self-Adhering Flashing: Membrane consisting of cross-laminated high-density polyethylene facer laminated to ultraviolet (UV) and weather-resistant exterior aluminum foil facer, using nonasphaltic, butyl-based adhesive to self-adhere to substrate.

F. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement waived if not installed on roof.

G. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.
   1. Width: 3-1/2 inches.
   2. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 30 days of weather exposure.

H. Preformed Transition Membrane: Semirigid silicone or polyester composition, tapered edges, tear resistant.

I. Stainless Steel Flashing: Flexible flashing with 2 mil, 0.002 inch thick Type 304 stainless steel sheet, 8 mil, 0.008 inch of butyl adhesive and siliconized release liner.
   1. Roll Length: 50 feet long.
   2. Width: 6 inches wide.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that surfaces and conditions are ready for work of this section.

B. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.

C. Do not proceed with this work until unsatisfactory conditions have been corrected.

2.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

2.03 INSTALLATION

A. Install materials in accordance with manufacturer's installation instructions.

B. Air Barriers: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.

D. Self-Adhered Sheets:
   1. Prepare substrate in accordance with sheet manufacturer's installation instructions; fill and tape joints in substrate and between dissimilar materials.
   2. Lap sheets shingle fashion to shed water and seal laps airtight.
   3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fishmouths.
   4. Use same material, or other material approved by sheet manufacturer, to seal to adjacent substrates, and as flashing.
   5. At wide joints, provide extra flexible membrane allowing joint movement.

E. Fluid-Applied Coatings or Membranes:
   1. Prepare substrate in accordance with manufacturer's installation instructions; treat joints in substrate and between dissimilar materials as indicated.
   2. Use flashing to seal to adjacent construction and to bridge joints in coating substrate.

F. Openings and Penetrations in Exterior Air Barriers:
   1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto air barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
   2. At openings with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.

3. At openings with nonflanged frames, seal air barrier to each side of framing at opening using flashing at least 9 inches wide, and covering entire depth of framing.
4. At head of openings, install flashing under air barrier extending at least 2 inches beyond face of jambs; seal air barrier to flashing.
5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating item and seal to air barrier surface.

2.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Owner will provide testing services, and Contractor to provide temporary construction and materials for testing.

C. Coordination of ABAA Tests and Inspections:
   1. Provide testing and inspection required by ABAA QAP.
   2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
   3. Cooperate with ABAA testing agency.
   4. Allow access to air barrier work areas and staging.
   5. Do not cover air barrier work until tested, inspected, and accepted.

D. Do not cover installed air barriers until required inspections have been completed.

E. Take digital photographs of each portion of installation prior to covering up air barriers.
   1. See Section 01 3000 - Administrative Requirements for additional information.

2.05 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 4213
METAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal wall panels.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Wall panel substrate.

B. Section 07 2700 - Air Barriers: Air barrier under wall panels.

C. Section 07 9200 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.

C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.

D. Samples: Submit 3 samples of wall panel, 12 inches by 12 inches in size illustrating finish color, sheen, and texture.

E. Test Reports: Submit test report verifying compliance with NFPA 285 for previously-tested exterior wall assembly.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum 5 years of documented experience.

B. Installer Qualifications: Company specializing in installing products specified in this section with minimum three years of documented experience and approved by manufacturer.

1.06 MOCK-UPS

A. Construct mock-up, 4 feet long by 4 feet wide; include panel system, attachments to building frame, associated vapor retarder and air seal materials, weep drainage system, sealants and seals, and related insulation in mock-up.

B. Locate as directed by Architect.

C. Mock-up may remain as part of work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

C. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.

D. Prevent contact with materials that may cause discoloration or staining of products.

1.08 FIELD CONDITIONS

A. Do not install wall panels when air temperature or relative humidity are outside manufacturer's limits.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Finish Warranty: Provide 20-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

C. Special Warranty: Provide 2-year warranty covering water tightness and integrity of seals of metal wall panels. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
   1. AEP Span.
   2. Alcoa.
   3. Architectural Metal Systems.
   4. Berridge.
   5. Centria.
   6. Firestone.
   7. MBCI.
   8. McElroy Metals.
   9. Morin (Kingspan).
   10. Substitutions: See Section 01 2500 - Substitution Procedures.

2.02 METAL WALL PANEL SYSTEM

A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
   1. Basis of Design Product:
      a. See Finish Legend on the Exterior Elevations.
   2. Provide exterior wall panels and subgirt framing assembly.
   3. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
      a. Refer to Structural drawings.
   4. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.
   5. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
   6. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
   7. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
   8. Corners: Factory-fabricated in one continuous piece with minimum 2-inch returns.

B. Subgirt Framing Assembly:

C. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

D. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

E. Anchors: Stainless steel.

2.03 FINISHES

A. Panel Exterior Finish: AAMA 2605-compliant coating. See Finish Legend on the Exterior Elevations.
   1. See Section 05 0513 - Shop-Applied Coatings for Metal for additional information.

B. Panel Backside Finish: Panel manufacturer's standard.

2.04 ACCESSORIES

A. Support for Cladding and Continuous Insulation: Thermal clips.
   1. Thermally-broken clips that provide attachment support for girts, angles, channels, and other cladding support framing.
   2. Fasteners: As recommended by clip manufacturer.
   3. Products:
      a. Cascadia Windows & Doors; Cascadia Clip: www.cascadiawindows.com/#sle.
      b. Northern Facades; ISO Clip: www.northernfacades.com/#sle.
      c. Substitutions: See Section 01 6000 - Product Requirements.

B. Concealed Sealants: Non-curing butyl sealant or tape sealant, see Section 07 9200

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building framing members are ready to receive panels.

B. Verify air barrier, see Section 07 2700, has been installed over wall panel substrate; see Section 05 4000.

3.02 PREPARATION

A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane, and spaced at intervals indicated.

B. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

3.03 INSTALLATION

A. Install panels on walls in accordance with manufacturer's instructions and approved shop drawings.

B. Fasten panels to structural supports; aligned, level, and plumb.

C. Use concealed fasteners unless otherwise indicated by Architect.

D. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

END OF SECTION

SECTION 07 4213.23
ALUMINUM COMPOSITE MATERIAL (ACM) WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum composite material (ACM) wall panel assemblies.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Installation of anchors.
B. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashing components integrated with this wall system.

1.03 DEFINITIONS

A. ACM: Aluminum composite material; cladding material formed by joining two thin aluminum skins to polyethylene or fire-retardant core and bonded under precise temperature and pressure.

1.04 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
D. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.
E. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2023b.
F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
G. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2021).
H. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2023.
I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
J. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
K. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.
L. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene minimum 2 weeks before starting work of this section to verify project requirements, coordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.
   1. See Section Section 01 3000 - Administrative Requirements, for additional requirements.
   2. Require attendance by the installer and relevant sub-contractors.
   3. Include ACM sheet manufacturer’s representative and wall system manufacturer’s representative to review storage and handling procedures.
   4. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
   5. Review procedures for protection of work and other construction.
   6. Review safety precautions.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: For each item to be installed.
   1. Finish manufacturer's data sheet showing physical and performance characteristics.
   2. Storage and handling requirements and recommendations.
   3. Fabrication instructions and recommendations.
   4. Specimen warranty for finish, as specified herein.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Delegated Design Documents: See Section 01 3000 - Administrative Requirements.
   1. Provide design documentation prepared by Contractor's Licensed Professionals.

E. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, support clips, exposed fasteners, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Indicate panel numbering system.
   2. Differentiate between shop and field fabrication.
   3. Indicate substrates and adjacent work with which the wall system must be coordinated.
   4. Include large-scale details of anchorages and connecting elements.
   5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches.
   6. Include design engineer's stamp or seal on shop drawings for attachments and anchors.

F. Selection Samples: For each finish product specified, submit at least three sample color chips representing manufacturer's standard range of available colors and patterns.

G. Verification Samples: For each finish product specified, submit at least three samples, minimum size 12 inch square, and representing actual product in color and texture.

H. Certificate: Certify that the work results of this section meet or exceed specified requirements.

I. Design Data: Submit structural calculations stamped by design engineer, for Architect's information and project record.

J. Evaluation Service Reports: From ICC or similar. Show compliance with specified requirements.

K. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.

L. Test Report: Submit test report verifying compliance with NFPA 285 for previously-tested exterior wall assembly.

M. Manufacturer's Field Reports: Provide within 48 hours of field review. State what was observed and what changes, if any, were requested or required.

N. Designer's qualification statement.

O. Manufacturer's qualification statement.

P. Maintenance Data: Care of finishes and warranty requirements.

1.07 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.

B. Design Engineer's Qualifications: Design structural supports and anchorages under direct supervision of a Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Manufacturer Qualifications: Company specializing in manufacturing wall panel systems specified in this section.
   1. With not less than five years of documented experience.

1.08 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Provide a mock-up for evaluation of fabrication workmanship.

C. Locate where directed by Archite.

D. Mock-up may remain as part of work.

1.09 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

C. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Protect finishes by applying heavy-duty removable plastic film during production.
   2. Package for protection against transportation damage.
   3. Provide markings to identify components consistently with drawings.
   4. Exercise care in unloading, storing, and installing panels to prevent bending, warping, twisting, and surface damage.

D. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
   1. Store in well-ventilated space out of direct sunlight.
   2. Protect from moisture and condensation with tarpaulins or other suitable weathertight covering installed to provide ventilation.
   3. Store at a slope to ensure positive drainage of accumulated water.
   4. Do not store in enclosed space where ambient temperature can exceed 120 degrees F.
   5. Avoid contact with other materials that might cause staining, denting, or other surface damage.

1.10 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal composite material panel systems that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

C. Fabricator’s standard warranty: Fabricator’s standard form in which fabricator agrees to repair or replace components of metal faced assemblies that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

D. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 DELEGATED DESIGN

A. Delegated Design: See Section 01 3000 - Administrative Requirements.

B. Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design metal composite material (ACM) assemblies.

2.02 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.03 MANUFACTURERS

A. Aluminum Composite Material (ACM) Sheet Manufacturers:
   1. 3A Composites.
   2. Alpolic (Mitsubishi Chemical).
   3. ATAS International.
   4. Citadel.
   5. NorthClad.
   6. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Wall Panel System Fabricators:
   1. Americlad.
   2. CEI Materials.
   3. Elward Systems Corporation.
   4. KSC.
   5. Northern Facad
   6. Universe Corporation.
   7. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 WALL PANEL SYSTEM

A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage, or failure.
   1. Provide structural design by or under direct supervision of a Structural Engineer licensed in the State in which the Project is located.
   2. Provide panel jointing and weatherseal using a "wet", sealant-sealed system.
   3. Anchor panels to supporting framing without exposed fasteners.

1.03 PERFORMANCE REQUIREMENTS

A. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F to 180 degrees F without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.

B. Wind Performance: Provide system tested in accordance with ASTM E330/E330M without permanent deformation or failures of structural members under the following conditions:
   1. Design Wind Pressure: As shown on the Structural drawings.
   2. Maximum deflection of perimeter framing member of L/175 normal to plane of the wall; maximum deflection of individual panels of L/60.
   3. Maximum anchor deflection in any direction of 1/16 inch at connection points of framing members to anchors.

C. Fire Performance: Use test method complying with NFPA 285.

1.04 PANELS

A. Products:
   1. ALUCOBOND by 3A Composites USA; ALUCOBOND PLUS: www.alucobondusa.com/#sle.
   2. ALPOLIC Materials; ALPOLIC/fr (Fire Retardant core): www.alpolic-americas.com/#sle.
   3. ATAS International, Inc; SterraCore: www.atas.com/#sle.
   4. Citadel Architectural Products, Inc; Envelope 2000: www.citadelap.com/#sle.
   5. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Panels: 1 inch deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.

C. Reinforce corners with riveted aluminum angles.

1.02 MATERIALS

A. Aluminum Composite Material (ACM) Sheet: Two sheets of aluminum sandwiching a core of extruded thermoplastic material; no foamed insulation material content.
   1. Overall Sheet Thickness: 4 mm, minimum.
   2. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.

3. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
4. Flammability: Self-ignition temperature of 650 degrees F or greater when tested in accordance with ASTM D1929.
    a. Provide panel stiffeners as required.

B. Metal Framing Members: Include sub-girts, zee-clips, base and sill angles and channels, hat-shaped and rigid channels, and furring channels required for complete installation.
1. Provide material strength, dimensions, configuration as required to meet applied loads and in compliance with applicable building code.

1.03 FINISHES

A. Shop-Applied Coating Finish: See Section 05 0513 - Shop-Applied Coatings for Metal, for additional information.
1. Color: See Section 05 0513.

1.04 FABRICATION, GENERAL

A. General: Fabricate and finish metal composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing.
1. Comply with indicated profiles and with dimensional and structural requirements.

B. Shop-fabricate ACM systems and accessories by fabricator's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with requirements of ACM panel manufacturer, of indicated system profiles, and with dimensional and structural requirements.
1. Formed ACM panel lines, breaks, and angles to be sharp and straight, with surfaces free from warp or buckle.
2. Fabricate panels with sharply cut edges and no displacement of face sheet or protrusion of core.

C. Stiffeners: Space panel stiffeners to maintain deflection limitations at design load. Mechanically-fasten stiffeners to the perimeter extrusion and bond to the rear face of the ACM using structural silicone or high strength double-sided bonding tape of sufficient size and strength to maintain panel’s specified deflection under load.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA (ASMM) that apply to design, dimensions, metal, and other characteristics of item indicated.
1. See Section 07 6200 - Sheet Metal Flashing and Trim, for additional information.

1.05 FABRICATED ACM PANEL INSTALLATION SYSTEMS

A. Rout and Return Dry System:
1. Panel system consisting of dry-gasketed interlocking extrusions.
2. Designed system to consist of concealed dry gasketed perimeter extrusions, extruded stiffeners, gaskets, fasteners; and may consist of related flashings, sealant between jamb panels and adjacent construction, and other miscellaneous accessories as required for a complete installation. Assembly shall be water and air-tight without reliance on a weather barrier.
3. Any rout and return dry panel system utilizing a continuous field applied exposed or concealed sealant within the joinery is unacceptable.

1.06 ACCESSORIES

A. Flashing: Sheet aluminum; 0.040 inch thick, minimum; finish and color to match ACM sheet; see Section 07 6200 for additional requirements.

B. Anchors, Clips, and Accessories: Use one of the following:
   1. Stainless steel complying with ASTM A276/A276M, ASTM A480/A480M, or ASTM A666.
   2. Steel complying with ASTM A36/A36M and hot-dip zinc coating to ASTM A153/A153M.
   3. Steel complying with ASTM A36/A36M and hot-dip galvanized to ASTM A123/A123M, with Coating Thickness Grade of 100.

C. Fasteners:
   1. Exposed Fasteners: Stainless steel; permitted only where absolutely unavoidable and subject to prior approval of the Architect.
   2. Screws: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
   3. Bolts: Stainless steel.
   4. Fasteners for Flashing and Trim: Blind fasteners of high-strength aluminum or stainless steel.

D. Provide panel system manufacturer's and installer’s standard corrosion resistant accessories, including fasteners, clips, anchorage devices, and attachments.

PART 3 EXECUTION

2.01 EXAMINATION

A. Examine dimensions, tolerances, and interfaces with other work.

B. Examine substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturer's written instructions.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Notify Architect in writing of conditions detrimental to proper and timely completion of work, and do not proceed with erection until unsatisfactory conditions have been corrected.

2.02 PREPARATION

A. Protect adjacent work areas and finish surfaces from damage during installation.

B. Provide anchorage items to be cast into concrete to appropriate installer(s) together with setting templates.
   1. See Section 03 3000 for additional cast-in-place concrete requirements.

2.03 INSTALLATION

A. Install in accordance with manufacturer's written instructions and approved shop drawings.

B. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.

C. Comply with instructions and recommendations of ACM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.

D. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.

E. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.

F. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with ACM sheet manufacturer's instructions and recommendations for field forming.

G. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.

H. Where joints are designed for field-applied sealant, seal joints completely with specified sealant.

I. Install flashings as indicated on shop drawings. At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.

J. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
   1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
   2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
   3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
   4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.

K. Replace damaged products.

2.04 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.

C. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.

D. Remove temporary coverings and protection of adjacent work areas.

E. Clean installed products in accordance with manufacturer's instructions.

2.05 PROTECTION

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements.

B. Provide barrier or other delineation to prevent damage to installed Work from subsequent construction activities.

END OF SECTION

SECTION 07 4243
HIGH-PRESSURE LAMINATE (HPL) WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High-pressure laminate (HPL) wall panels.

1.02 DEFINITIONS:

A. High-Pressure Laminate (HPL): Multiple layers of kraft paper saturated in phenolic resin, which are fused together by heat and pressure.

1.03 REFERENCE STANDARDS

A. AAMA 509 - Voluntary Test and Classification Method for Drained and Back Ventilated Rainscreen Wall Cladding Systems; 2022.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

D. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2021.

E. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.

F. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; Current Edition.

G. ICC-ES AC92 - Acceptance Criteria for Polymer-Based, Polymer-Modified and High-Pressure Laminate Exterior and Interior Wall Cladding; 2013, with Editorial Revision (2021).

H. ISO 14001 - Environmental Management Systems — Requirements with Guidance for Use; 2015.

I. ISO 9001 - Quality Management Systems — Requirements; 2015.

J. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

K. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's data sheets on each product.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Delegated Design Documents: See Section 01 3000 - Administrative Requirements.

1. Provide design documentation prepared by Contractor's Licensed Professionals.

E. Shop Drawings: Indicate layout, panel locations, and configuration.
   1. Indicate size, spacing, and location of support and attachment components, connections, and types and locations of fasteners.
   2. Indicate necessary provisions for structural and thermal movement between wall panel system and adjacent materials.
   3. Indicate locations and sizes of penetrations through wall panel system for Architect's approval.

F. Samples: Submit samples 12 by 12 inches in size of each style and color of panel showing finish color, sheen, and texture.
   1. Submit 12-inch samples of support framing, trim, and corners.
   2. Submit mounted sample 6 by 6 inches in size showing four-way joint with equally sized panels.

G. Manufacturer's Instructions: Include instructions for storage, handling, preparation, and product installation.

H. Fabricator's qualification statement.

I. Installer's qualification statement.

J. Fabricator's field reports.

K. Maintenance Data: Periodic inspection recommendations and maintenance procedures.

L. Executed warranty.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.

B. Manufacturer Qualifications: Registered and complying with ISO 9001 and ISO 14001.

C. Fabricator Qualifications: Company specializing in performing work of type specified in this section with minimum five years of documented experience and approved by manufacturer.

D. Installer Qualifications: Company specializing in performing work of type specified in this section with minimum five years of documented experience and approved by manufacturer.

E. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.

1.06 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Construct mock-up of each panel type, 4 feet long by 4 feet wide, minimum. Include panel materials, flashings, weep drainage system, attachments, anchors, trim and termination accessories, and perimeter sealant.

C. Locate where directed.

D. Mock-up may remain as part of work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

C. Deliver and store materials with labels intact in manufacturer's unopened packaging until ready for installation.
D. Store products under waterproof cover, well ventilated, and elevated above grade on flat surface.
E. Protect materials from harmful environmental elements, construction dust, direct sunlight, and other potentially detrimental conditions.

1.08 FIELD CONDITIONS

A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Manufacturer Warranty: Provide 10-year manufacturer warranty for panels covering material defects, including spontaneous splitting, splintering, rot, or delamination caused by material or manufacturing flaws. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 DELEGATED DESIGN

A. Delegated Design: See Section 01 3000 - Administrative Requirements.
B. Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design

2.02 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.
B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.03 MANUFACTURERS

A. High-Pressure Laminate (HPL) Panel Manufacturers:
   1. Abet USA.
   2. FunderMax.
   3. Parklex Prodema.
   4. Trespa.
   5. Substitutions: See Section 01 2500 - Substitution Procedures.
B. High-Pressure Laminate (HPL) Fabricators:
   1. CEI Materials.
   2. Elward Systems.
   3. KSC.
   4. Sobotec.
   5. Universe Corporation.
   6. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 GENERAL

A. Type of Wall Panel System: Drained and back-ventilated rain screen, complying with AAMA 509, with concealed fasteners.

B. Provide 3/8 inch to 1 inch clear air space behind panels.

C. Cladding includes exterior wall panels, soffit panels, and subgirt framing assembly.

D. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.

E. Provide continuity of weather-resistant barrier seal at wall panel substrate.

1.03 PERFORMANCE REQUIREMENTS

A. Testing of Drained and Back Ventilated Panel System: Submit results in accordance with AAMA 509 test methods for drained and back ventilated panel system similar to system specified.

B. Design and size components to support assembly dead loads and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.

C. Design Wind Loads: Comply with requirements indicated on drawings.

D. Wind Load Testing, Maximum Allowable Deflection of Panels: L/180 for length (L) of span when tested in accordance with ASTM E330/E330M; no permanent deformation of panel system allowed.

E. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling, dynamic loading and release of loads, and deflection of structural support framing.

F. Surface Burning Index: Maximum flame spread index of 10 and maximum smoke developed index of 70 when tested in accordance with ASTM E84.

G. Fire Propagation of Exterior Wall Assembly: Pass when tested in accordance with NFPA 285 and compliant with engineering judgement acceptable to the authority having jurisdiction.

H. Accelerated Weathering: 2,000 hours without cracking, checking, crazing, or other deterioration that affects performance when tested in accordance with ASTM G155.

I. Freeze-Thaw Resistance: Pass 10 cycles when tested in accordance with ICC-ES AC92.

J. Bond Strength: 10 psi tensile stress, minimum, average of all specimens when tested in accordance with ICC-ES AC92.

K. Average Flexural Strength of Freeze-Thaw Specimens: 60 percent of control, minimum, when tested in accordance with ICC-ES AC92.

L. Average Flexural Strength of Wet Specimens: 60 percent of control, minimum, when tested in accordance with ICC-ES AC92.

M. Salt Spray Resistance: No deleterious effects that affect performance after 300 hours of exposure when tested in accordance with ICC-ES AC92.

N. Water Resistance, 14 Day's Exposure: No deleterious effects that affect performance after 14 days of exposure when tested in accordance with ICC-ES AC92.

O. Fastener Pull-Through: At least 1,442 lbf average load when tested in accordance with ICC-ES AC92.

P. General Emissions Evaluation: Comply with CAL (CDPH SM).

Q. No Added Formaldehyde or Ultra-Low Emitting Formaldehyde: Comply with CARB (ATCM).

1.04 HIGH-PRESSURE LAMINATE (HPL) WALL PANELS

A. Core layer of sheets of kraft paper impregnated with phenolic resins; integral, decorative, melamine finish; manufactured under heat and pressure; NEMA LD 3, Grade CGS.
   1. Products:
      a. Abet USA; MEG.
      b. Trespa; Meteon.
      c. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Thickness: 3/8 inch, nominal.
   3. Dimensions: As indicated on drawings.
   4. Finish: Manufacturer's standard, single-sided, UV-resistant, decorative finish.
   5. Color and Pattern: As selected by Architect from manufacturer's full range.

1.02 FABRICATION

A. Shop-fabricate panels and accessories in accordance with panel manufacturer's written fabrication instructions.

B. Fabricate panel edges to profile indicated, or if not indicated, to profile on approved shop drawings. Raw, as-manufactured panel edges are not permitted.

C. Fabricate true to shape, accurate in size, square, and free from distortion or defects.

1.03 ACCESSORIES

A. Flashing: Manufacturer's standard sheet aluminum; finish and color to match wall panels.

B. Insect Screen: Aluminum mesh, painted where otherwise visible in open panel joints; at least 50 percent open area.

C. Panel to Subframing Fasteners: Stainless steel self-tapping screws, type and style as recommended by panel manufacturer.

PART 3 EXECUTION

2.01 EXAMINATION

A. Examine substrate; clean and repair to eliminate conditions detrimental to proper installation.

B. Verify that weather-resistive barrier is installed and approved.

C. Do not begin installation until unacceptable conditions are corrected.

2.02 PREPARATION

A. Touch up field cut edges before installing.

B. Protect surrounding areas and adjacent surfaces from damage during execution of work.

2.03 INSTALLATION

A. Install cladding in accordance with manufacturer's installation instructions and approved shop drawings.

B. Wall Panels:

1. Do not install wall panels less than 6 inches above surface of ground or closer than 1 inch to surfaces where water may collect.
2. Allow space for thermal movement at ends of wall panels that butt against trim; seal joint between panel and trim.

C. Install control and expansion joints as detailed on drawings.
1. Vertical Joints: Install at locations and with spacings recommended by wall panel manufacturer.
2. Horizontal Compression Joints: Install at locations and with spacings recommended by wall panel manufacturer.
a. Steel Framed Buildings: At walls higher than 45 feet or more than three floors, install compression joint at each floor line and spaced at not more than of 25 feet vertically.

D. Sheet Metal Flashing: Install in accordance with wall panel manufacturer's instructions and as indicated on drawings.

E. After installation, seal joints. Include joints around penetrations and between wall panels and adjacent construction.

2.04 TOLERANCES

A. Installed Tolerance: Not more than 0.072 inch per 3 feet from true line, level, and plumb between fixing points, nonaccumulative.

2.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Fabricator Services: Provide services of fabricator's field representative to review field procedures and to ensure that handling, installation, application, protection, and cleaning complies with manufacturer's instructions. Provide written reports to Architect.

C. Schedule site visits:
1. One visit when substrate work is complete and panel materials have been delivered and stored, but before starting cladding work.
2. One visit when cladding work is approximately 25 percent and one when 60 percent complete.
3. One visit when cladding work, including cleaning, is complete.

2.06 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Remove temporary covers and strippable films before installation of panels. Where film occurs on both sides of panels, remove film from both sides simultaneously.

C. Clean exposed work upon completion of installation; remove grease and oil films, excess joint sealer, handling marks, and debris from installation. Leave work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to finish.

D. Clean accumulations of dirt, sealant, and other obstructions from weep holes and drainage channels.

2.07 PROTECTION

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements.

B. Provide barrier or other delineation to prevent damage to installed Work from subsequent construction activities.

END OF SECTION

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SECTION 07 5419
POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Polyvinyl-chloride (PVC) roofing systems.

1.02 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.
D. ASTM D4434/D4434M - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing; 2021.
E. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; 2016, with Editorial Revision (2022).
F. NRCA (RM) - The NRCA Roofing Manual; 2023.
G. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene minimum 2 weeks before starting work of this section.
    1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide manufacturer's written information listed below.
C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
    1. VOC content restrictions data.
D. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
F. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
G. Field Quality Control Reports: As specified in Part 3 of this Section.
H. Specimen Warranty: For approval.
I. Warranty:

1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
2. Submit installer's certification that installation complies with all warranty conditions for the waterproof membrane.

J. Manufacturer's qualification statement.

K. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section:
1. Approved by membrane manufacturer.

1.06 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Provide mock-up for evaluation of surface preparation, installation methods, and workmanship. mock-up.

C. Locate where directed.

D. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.

C. Protect products in weather protected environment, clear of ground and moisture.

D. Protect foam insulation from direct exposure to sunlight.

E. Comply with requirements from Owner to prevent overloading or disturbance of the structure when loading materials onto the roof.

1.08 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.

B. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Material Warranty: Provide membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within 10 years after installation.

C. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
1. Warranty Term: 20 years.

2. For repair and replacement include costs of both material and labor in warranty.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. Roof Covering External Fire Resistance Classification: Class A when tested per UL 790.

B. Wind Uplift:
   1. Designed to withstand wind uplift forces calculated with ASCE 7.
   2. Design Wind Speed: As indicated on drawings.

C. Drainage: No standing water within 48 hours after precipitation.

2.03 POLYVINYL-CHLORIDE (PVC) ROOFING ASSEMBLIES

A. PVC Roofing System:
   1. Substrate: Refer to Structural drawings and specifications.
   2. Vapor barrier.
   3. Rigid insulation.
   4. Cover board and parapet sheathing.
   5. Conductive primer.
   6. PVC membrane, fully-adhered.
   7. Walkway pads.

2.04 MANUFACTURERS

A. Manufacturers:
   1. Carlisle.
   2. GAF.
   3. Johns Manville.
   4. Sika Sarnafil.
   5. Versico.
   6. Soprema.
   7. Substitutions: See Section 01 2500 - Substitution Procedures.

2.05 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane:
   1. Material: Polyvinyl chloride (PVC) complying with ASTM D4434/D4434M.
   2. Fabric (Fleece) Back: No.
   3. Reinforcing: Internal fabric.
   4. Thickness: 60 mil, 0.060 inch, minimum.
   5. Products:
      a. Carlisle SynTec Systems; SureFlex PVC.
      b. GAF; EverGuard PVC.

c. Johns Manville; JM PVC.
d. Sika Sarnafil; Sarnafil S 327.
e. Versico; VersiFlex PVC.
f. Soprema; Sentinel P150.
g. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Flexible Flashing Material: Same material as membrane.

2.06 DECK SHEATHING AND COVER BOARDS

A. Cover Board: Glass mat faced gypsum panels, ASTM C1177/C1177M, fire resistant type, 1/2 inch thick.

2.07 INSULATION

A. Polyisocyanurate (ISO) Board Insulation: Complies with ASTM C1289, Type II, Class 2 - Faced with dark coated-glass facer on one side and light coated-glass facer on other surface of core foam.
1. Grade and Compressive Strength: Grade 2, 20 psi, minimum.

2.08 ACCESSORIES

A. Prefabricated Flashing Accessories:
1. Corners and Seams: Same material as membrane, in manufacturer's standard thicknesses.
2. Penetrations: Same material as membrane, with manufacturer's standard cut-outs, rigid inserts, clamping rings, and flanges.
3. Walkway Rolls: Sure-Flex Heat Weldable Walkway Rolls; 80 mils (0.080 inch) thick; gray membrane.
4. Contour Rib Profile: Manufacturer's standard extruded PVC; 1-1/4 inch tall, 2-1/8 inch wide, 3/8 inch profile.
5. Miscellaneous Flashing: Non-reinforced PVC membrane; 80 mils (0.080 inch) thick, in manufacturer's standard lengths and widths.

B. Conductive Primer: For electronic leak detection testing.
1. Products:
a. Detec; TruGround Conductive Primer.
b. Substitutions: See Section 01 2500 - Substitution Procedures.

C. Insulation Adhesive: Two component polyurethane, expanding foam.

D. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.

E. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.

F. Membrane Adhesive: As recommended by membrane manufacturer.

G. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

H. Sealants: As recommended by membrane manufacturer.

I. Cleaner: Manufacturer's standard, clear, solvent-based cleaner.

J. Edgings and Terminations: Manufacturer's standard edge and termination accessories.

1. PVC Coated Sheet Metal.
2. Termination Bar.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 PREPARATION, GENERAL

A. Clean substrate thoroughly prior to roof application.

B. Do not begin work until other work that requires foot or equipment traffic on roof is complete.

3.03 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions, NRCA (RM) applicable requirements, and approved shop drawings.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

F. Coordinate the work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

3.04 VAPOR RETARDER INSTALLATION

A. Apply vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
   1. Extend vapor retarder under cant strips and blocking to deck edge.
   2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.

B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.

3.05 INSULATION INSTALLATION

A. Attachment of Insulation:
   1. Mechanically fasten insulation to deck in accordance with roofing manufacturer's instructions.

B. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.

C. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

D. Lay boards with edges in moderate contact without forcing, and gap between boards no greater than 1/4 inch. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

E. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.

F. Do not apply more insulation than can be completely waterproofed in the same day.

3.06 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Fully Adhered Application: Apply adhesive to substrate at rate of ___ gal/sq ft. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.

D. Seam Welding:
   1. Seam Welding: Overlap edges and ends and seal seams by heat welding, minimum 2 inches.
   2. Cover all seams with manufacturer's recommended joint covers.
   3. Probe all seams once welds have thoroughly cooled. (Approximately 30 minutes.)
   4. Repair all deficient seams within the same day.
   5. Seal cut edges of reinforced membrane after seam probe is complete.

E. At intersections with vertical surfaces:
   1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to nailing strips.

F. Coordinate installation of roof drains and sumps and related flashings.

G. Daily Seal: Install daily seal per manufacturers instructions at the end of each work day. Prevent infiltration of water at incomplete flashings, terminations, and at unfinished membrane edges.

3.07 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for general requirements for field quality control and inspection.

B. Owner to engage a qualified testing agency to perform tests and inspections.
   1. PVC roof assemblies will be considered defective if they do not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
   4. Submit field quality control reports to Architect.

C. Tests:
   1. Electronic Leak Detection Testing.
      a. Testing agency to create a conductive electronic field over the entire installed membrane and determine locations of discontinuities or leaks, if any. Include abutting or overlapping smaller areas as necessary to cover entire installed membrane.

D. Manufacturer's Representative to provide site monitoring and inspection services as specified in Section 01 4000.
   1. Manufacturer's representative to prepare site review and inspection reports and deliver to Contractor.
   2. Submit field quality control reports to Architect.

3.08 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Remove wrappings, empty containers, paper, and other debris from the roof daily. Dispose of debris in compliance with local, State, and Federal regulations.

C. Remove bituminous markings from finished surfaces.

D. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

E. Repair or replace defaced or damaged finishes caused by work of this section.

END OF SECTION

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SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sheet metal flashing.

B. Fabricated sheet metal items.

1.02 RELATED REQUIREMENTS

A. Section 07 2700 - Air Barriers: For flexible flashing and fluid-applied flashing.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2022.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

G. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).

H. CDA A4050 - Copper in Architecture - Handbook; current edition.

I. NRCA (RM) - The NRCA Roofing Manual; 2023.

J. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene minimum 2 weeks before starting work of this section.
   1. See Section Section 01 3000 - Administrative Requirements, for additional information.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.
   2. Recycled content data.

C. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
   1. Include identification of material, thickness, weight, and finish for each item.
D. Qualification Statements: For fabricator and installer.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with five years of documented experience.
   1. For fabricated copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested, shop is to be listed as able to fabricate required details as tested and approved.
C. Mockups: See Section Section 01 4000 - Quality Requirements.
   1. Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.
B. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.
C. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
D. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.
B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
C. Recycled Content: Products in this Section to meet minimum recycled content thresholds specified in Section 01 6000.

2.02 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.
B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA (RM) and SMACNA (ASMM).

C. SPRI Wind Design Standard: Design, fabricate, and install copings and roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting design pressures as shown on the Structural drawings.

2.03 SHEET MATERIALS

A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch thick base metal.

B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch thick base metal, shop pre-coated with PVDF coating.
   1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system, per Section 05 0513 - Shop-Applied Coatings for Metal.
      a. Color: See Section 05 0513.

C. Anodized Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper; 20 gauge, 0.032 inch thick; clear anodized finish.

D. Pre-Finished Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper; 18 gauge, 0.040 inch thick; plain finish shop pre-coated with silicone modified polyester coating.
   1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; pretreated metal with two-coat system including primer and color coat with at least 70 percent PVDF coating.
   2. Color: As selected by Architect from manufacturer's full range of colors.

E. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 28 gauge, 0.0156 inch thick; smooth No. 4 - Brushed finish.

2.04 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.

2.05 FABRICATED PARAPET COPING AND ROOF EDGE FLASHING

A. Parapet Copings: Formed metal coping with galvanized steel anchors or support cleats for capping parapet wall; watertight. Butt type joints with concealed splice plates; mechanically fastened. Exposed coping fasteners at backside of parapet only.
   1. Material: 0.04-inch thick, formed aluminum.
   2. Profile: As shown on the Architectural drawings.
   3. Curved Application: Factory fabricated in true radius.

B. Metal Roof Edging and Fascia: Continuous metal edge member serving as termination of roof membrane and retainer for metal fascia; watertight with no exposed fasteners; mounted to roof edge nailer.
   1. Profile: As shown on the Architectural drawings.
   2. Curved Applications: Factory modified.

C. Anchor or Support Cleats: 20-gauge, 0.036-inch thick prepunched galvanized cleat with 12-inch wide stainless steel spring mechanically locked to cleat at 72 inches on center.

D. Special Shaped Components: Provide factory-fabricated pieces necessary for complete installation, including miters, corners, intersections, curves, pier caps, and end caps; minimum 14-inch long legs on corner, intersection, and end pieces.

2.06 FABRICATED PENETRATION FLASHING

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.07 ACCESSORIES

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete flashing and sheet metal installation and recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Stainless steel.

C. Primer Type: Zinc chromate.

D. Sealants: See 07 9200 - Joint Sealants.

E. Concealed Sealants: Non-curing butyl sealant.

F. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

G. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

H. Reglets: Surface-mounted type, galvanized steel; face and ends covered with plastic tape.

2.08 FABRICATION

A. General: Custom fabricate flashing and sheet metal to comply with recommendations in SMACNA (ASMM) "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
   1. Obtain field measurements for accurate fit before shop fabrication.
   2. Form flashing and sheet metal without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
   3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

C. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.

C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION

A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

B. Apply plastic cement compound between metal flashings and felt flashings.

C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

D. Exterior Flashing Receivers: Install in accordance with manufacturer's recommendations, and in proper relationship with adjacent construction, and as follows:
   1. Secure receiver at perimeter of wall opening with adhesives or fasteners.
   2. Place flashing into receiver channel.
   3. Secure flashing with receiver clip.

E. Seal metal joints watertight.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

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SECTION 07 8400
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

1.02 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).

D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.

E. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2020a.

F. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2023b.

G. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2023a.

H. ITS (DIR) - Directory of Listed Products; Current Edition.

I. FM (AG) - FM Approval Guide; Current Edition.

J. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

K. UL (DIR) - Online Certifications Directory; Current Edition.

L. UL (FRD) - Fire Resistance Directory; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on product characteristics, performance ratings, and limitations.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Evaluation Service Reports: From ICC or similar. Show compliance with specified requirements.

E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

G. Manufacturer's qualification statement.

H. Installer's qualification statement.

1.04 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
   2. Installer Qualifications: Company specializing in performing the work of this section and:
      a. Trained by manufacturer.
      b. Verification of minimum five years documented experience installing work of this type.
      c. Licensed by local authorities having jurisdiction (AHJ).
   3. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
      a. Convene minimum 2 weeks before starting work of this Section.

1.02 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Install one firestopping assembly representative of each fire rating design required on project.
   1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
   2. Where firestopping is intended to fill a linear opening, install at least 1 linear foot of firestopping.

C. Obtain approval of authorities having jurisdiction (AHJ) before proceeding.

D. If accepted, mock-up will represent minimum standard for this work.

E. If accepted, mock-up may remain as part of this work. Remove and replace mock-ups not accepted.

1.03 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.04 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

1.05 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
   2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
   3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

2.03 MANUFACTURERS

A. Firestopping Manufacturers:
   1. 3M Fire Protection Products.
   2. A/D Fire Protection Systems.
   3. Hilti.
   4. HoldRite.
   5. RectorSeal.
   6. Specified Technologies Inc. (STI).
   7. Tremco.
   8. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 MATERIALS

A. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

1.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.
   2. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
   3. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
   4. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.

B. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.

C. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.
   2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
   3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
   4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
   1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
   2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
   3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
   4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

2.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

C. Install backing materials to prevent liquid material from leakage.

2.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by Owner's Independent Testing Agency.

C. Do not cover installed firestopping until inspected by authorities having jurisdiction.

D. Install labeling required by code.

2.04 IDENTIFICATION

A. Identify firestopping with preprinted metal or plastic labels, attached with mechanical fasteners or self-adhering type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed.

B. Information: Include the following information on labels:
   1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage".
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Manufacturer's name.
   6. Installer's name.

C. Location: Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping systems.
   1. Exception: If penetration or joint is visible, coordinate alternative locations acceptable to Authority Having Jurisdiction and LPA.

2.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.

C. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

2.06 CLEANING

A. Clean adjacent surfaces of firestopping materials.

2.07 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

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SECTION 07 8700
SMOKE CONTAINMENT BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated elevator door smoke containment transparent curtains.

B. Fixed glass smoke baffle panels.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. FM (AG) - FM Approval Guide; Current Edition.

D. ICC-ES AC77 - Acceptance Criteria for Smoke-Containment Systems Used with Fire-Resistance-Rated Elevator Hoistway Doors and Frames and at the Intersection of Elevator Lobby and Corridor; 2021.

E. ITS (DIR) - Directory of Listed Products; Current Edition.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

H. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.

I. UL (DIR) - Online Certifications Directory; Current Edition.

J. UL 10D - Standard for Safety Fire Tests of Fire Protective Curtain Assemblies; Current Edition, Including All Revisions.

K. UL 864 - Control Units and Accessories for Fire Alarm Systems; Current Edition, Including All Revisions.

L. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's technical literature describing product components, connections, operation details, and required electrical equipment.

C. Shop Drawings: Submit shop drawings that include elevations, sections, details and dimensions, materials, finishes, anchorage methods, and hardware locations for specified smoke containment curtains and baffle panels.

D. Evaluation Service Report: From ICC or similar. Show compliance with specified requirements.

E. Manufacturer's installation instructions.

F. Field Quality Control Submittals: Report of field testing.

G. Operating and Maintenance Manuals: Submit complete set of manuals describing materials, devices, and procedures required in operation and maintenance of specified protective curtain systems.

1.04 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 1-year manufacturer material and labor warranty from Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 SMOKE CONTAINMENT SYSTEMS MANUFACTURERS

A. Manufacturers:
1. CornellCookson.
2. Door Systems, Inc.
3. Smoke Guard.
4. U.S. Smoke & Fire.
5. Substitutions: See Section 01 2500 - Substitution Procedures.

2.02 ELEVATOR DOOR SMOKE CONTAINMENT SYSTEMS

A. Non-Fire-Rated Elevator Door Smoke Containment Transparent Curtain Systems:
1. Smoke Guard; Model 200 Elevator Smoke Curtain and Model 400 Elevator Smoke Curtain.
2. Substitutions: See Section 01 2500 - Substitution Procedures.

2.03 ELEVATOR DOOR SMOKE CURTAIN CONTAINMENT SYSTEMS

A. Elevator Door Smoke Curtain Containment Systems:
1. Smoke and Draft Control: Self-closing or automatic-closing protective curtains in accordance with NFPA 80 and NFPA 105.
2. Maximum Air Leakage: 3 cfm/sq ft of door opening at 0.10 in-wc pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
3. Non-Fire-Rated:
   a. Coated Fabric Curtains: Woven, reinforced, and coated fabric curtain with high visibility see-through panel.
      1) Flame spread index of 25 or less and smoke developed index of 50 or less when tested in accordance with ASTM E84.
      2) Provide pressure sensitive electrical switch located on curtain with word OPEN located on each side of curtain.
   b. Provide positive reseal at entire perimeter of curtain after each opening or egress function.
   c. Edge Retention: Provide curtains mechanically interlocked to guide channel providing complete curtain reseal after each cycle.
   d. Comply with UL 10D. Provide listing label affixed to assembly.
4. Refer to drawings for layout and additional requirements.
5. Elevator Door Egress from Deployed Curtain Containment System: Comply with ICC-ES AC77 requirements.

6. Comply with ADA Standards.

2.04 COMPONENTS

A. Roller Assembly: Horizontal structural support with minimal deflection of protective curtain assembly and sized to incorporate motor drive unit.

B. Hood Assembly: Totally enclosed curtain and roller assembly with approved smoke seals, and removable cover plates to allow access to curtain rollers.
   1. Enclosure: Galvanized steel, with manufacturers standard finish.
   2. Mounting: As indicated on drawings.
   3. Height and Depth: As indicated on drawings.

C. Mounting Brackets: Painted metal plates and brackets as required for supporting hood assembly.
   1. Mounting: As indicated on drawings.
   2. Finished Ceiling Transition: As indicated on drawings.

D. Vertical Guide Assemblies: Guide rails to secure curtain during deployment and operation, with positive mechanical curtain retention.

2.05 OPERATIONAL CONTROLS

A. Operator, Controls, Actuators, and Safeties: Provide products listed by FM (AG), ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
   1. Operable curtain that deploys within 10 seconds upon actuation signal from fire alarm system, local smoke detector, sprinkler alarm system, or loss of electric power to unit with listed releasing device. Comply with UL 864.

B. Electric Motor: Inboard motor including gearbox assembly complying with NFPA 70.
   1. Power Supply: Provide connection to building's 120 VAC power supply for drive-control system.
   2. Mounting: Roller assembly mounted.
   3. Motor Voltage: 24 VDC.
   4. Descent Speed: 6 inches per second, minimum; 24 inches per second, maximum.

C. Test Feature: Provide simple and easily accessible switch feature to test and confirm correct function of curtain.

D. Fail-Safe Release Device:
   1. When release mechanism's power is interrupted by alarm condition, curtain automatically self-closes.
   2. Upon restoration of power and with cleared alarm condition, curtain release mechanism resets to open position.

2.06 FIXED GLASS SMOKE BAFFLE PANELS

A. Fixed Glass Smoke Baffle Panels: Top-supported fully-tempered glass panels at perimeters of vertical openings.
   1. Basis of Design Product:
      a. C.R. Laurence; Custom Aluminum Smoke Baffle Base Shoe with Dark Bronze Cladding for 1/2" Glass.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify areas of installation and conditions, with installer present, comply with requirements for supporting members, blocking, installation tolerances, clearances, and other conditions for proper installation of this work.

B. Correct unsatisfactory conditions before proceeding with installation.

3.02 INSTALLATION

A. Install system in accordance with manufacturer's written installation instructions.

B. Install anchorage devices to securely fasten hood assembly to substrate and building framing without distortion or stress.

C. Install conduit and wiring from disconnect to unit components. Coordinate installation of electrical service; see Division 26 Sections for additional information.

D. Coordinate fire alarm system and smoke detector connection; see Division 28 Sections..

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Provide services of manufacturer's field representative to observe installation, conduct field testing and inspection, and submit report.

C. Provide testing and inspection for the following:
   1. Verify deployment of protective curtain upon signal from fire alarm system or local smoke detectors.
   2. Verify protective curtain deploys properly by gravity upon damage to control panel or loss of power, possibly caused by emergency situation.

3.04 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Remove labels and visible markings from protective curtain components.

3.05 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals for closeout submittals.

B. See Section 01 7900 - Demonstration and Training for additional requirements.

C. Demonstration: Demonstrate proper operation of system to Owner's designated personnel.
   1. Use operating and maintenance manual as reference during demonstration.
   2. Conduct walking tour of project.
   3. Describe function, operation, and maintenance of each component.

3.06 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements relating to maintenance service.

B. Provide a separate maintenance contract for periodic inspection and performance analysis of elevator door smoke-containment protective curtain assemblies in accordance with NFPA 105 and NFPA 80 for one year from Date of Substantial Completion.

C. Indicate services, obligations, conditions, and terms for agreement period and for renewal options.

END OF SECTION

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SECTION 07 9200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Joint sealants.

B. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.

B. Section 08 8000 - Glazing: Sealants installed as part of glazing assemblies.

C. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.03 DEFINITIONS

A. Refer to ASTM C920 for additional information.
   1. Type S: Single-component.
   2. Type M: Multi-component.
   3. Grade P: Pourable or self-leveling, for horizontal applications.
   4. Grade NS: Non-sag or gunnable, for vertical applications.
   5. Class 100/50: Accepts at least 100 percent increase and 50 percent decrease of joint width.
   6. Class 50: Accepts at least 50 percent increase and decrease of joint width.
   7. Class 35: Accepts at least 35 percent increase and decrease of joint width.
   8. Class 25: Accepts at least 25 percent increase and decrease of joint width.
   9. Class 12-1/2: Accepts at least 12-1/2 percent increase and decrease of joint width.
   10. Use T1: Designed for pedestrian and vehicular traffic areas, with a high durometer (hardness).
   11. Use T2: Designed for pedestrian and vehicular traffic areas, with a lower durometer (hardness).
   12. Use NT: Designed for non-traffic areas.
   13. Use I: Designed to be continuously submerged in liquid (immersion service).
   14. Use M: Designed for use with mortar.
   15. Use G: Designed for use with glass. See Section 08 8000 - Glazing.
   16. Use A: Designed for use with aluminum.
   17. Use O: Designed for use on non-standard (other) substrates.

1.04 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).

B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).

C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
H. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2022.
I. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.
J. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
K. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
    1. Physical characteristics, including movement capability, hardness, cure time, and color availability.
    2. List of backing materials approved for use with the specific product.
    3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
    4. Substrates the product should not be used on.
    5. Substrates for which use of primer is required.
    6. Substrates for which laboratory adhesion and/or compatibility testing is required.
C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
    1. VOC content restrictions data.
D. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
E. Sample product warranty.
F. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
G. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
H. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
I. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
J. Installation Plan: Submit at least four weeks prior to start of installation.
K. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

L. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

M. Installation Log: Submit filled-out log for each length or instance of sealant installed.

N. Executed warranty.

1.06 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
   2. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

B. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.

C. Mock-ups: See Section 01 4000 - Quality Requirements.
   1. Build mockups to verify selections made under sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   2. Approved mock-ups may remain as part of the completed Work if undisturbed at time of Substantial Completion.

D. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. See Section Section 01 4000 - Quality Requirements, for additional information.
   2. Adhesion Testing: In accordance with ASTM C794.
   3. Compatibility Testing: In accordance with ASTM C1087.
   4. Stain Testing: In accordance with ASTM C1248; required for stone and masonry substrates.
   5. Allow sufficient time for testing to avoid delaying the work.
   6. Deliver sufficient samples to manufacturer for testing.
   7. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
   8. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

E. Installation Plan: Include schedule of sealed joints, including the following:
   1. Joint width indicated in Contract Documents.
   2. Joint depth indicated in Contract Documents; to face of backing material at centerline of joint.
   3. Approximate date of installation, for evaluation of thermal movement influence.
   4. Installation Log Form: Include the following data fields, with known information filled out.
      a. Location on project.
      b. Substrates.
      c. Sealant used.
      d. Stated movement capability of sealant.
      e. Primer to be used, or indicate no primer is used.
      f. Size and actual backing material used.
      g. Date of installation.
      h. Name of installer.
      i. Actual joint width; provide space to indicate maximum and minimum width.
      j. Actual joint depth to face of backing material at centerline of joint.

k. Air temperature.

F. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
1. Identification of testing agency.
2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
a. Test date.
b. Copy of test method documents.
c. Age of sealant upon date of testing.
d. Test results, modeled after the sample form in the test method document.
e. Indicate use of photographic record of test.

G. Field Adhesion Test Procedures:
1. Allow sealants to fully cure as recommended by manufacturer before testing.
2. Have a copy of the test method document available during tests.
3. Take photographs or make video records of each test, with joint identification provided in the photos/videos; for example, provide small erasable whiteboard positioned next to joint.
4. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
5. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.08 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer, or are below 40 degrees F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 JOINT SEALANTS - GENERAL

A. Color of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

B. Source Limitations: Obtain each type of joint sealant from single source from single manufacturer.

2.03 NONSAG JOINT SEALANTS

A. Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus 100 percent and minus 50 percent, minimum.
   2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
   3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
   5. Products:
      a. Dow; DOWSIL 790 Silicone Building Sealant: www.dow.com/#sle.
      b. Dow; DOWSIL 791 Silicone Weatherproofing Sealant: www.dow.com/#sle.
      c. Dow; DOWSIL 795 Silicone Building Sealant: www.dow.com/#sle.
      d. Momentive Performance Materials, Inc/GE Silicones; SCS9000 SilPruf NB - Non-Staining Silicone Weatherproofing Sealant: www.siliconeforbuilding.com/#sle.
      e. Pecora Corporation; Pecora 890 NST (Non-Staining Technology): www.pecora.com/#sle.
      f. Tremco Commercial Sealants & Waterproofing; Spectrem 1: www.tremcosealants.com/#sle.
      g. Substitutions: See Section 01 2500 - Substitution Procedures.
   6. Locations:
      a. Joints in cast-in-place concrete.
      b. Control and expansion joints in unit masonry.
      c. Joints in dimension stone cladding.
      d. Joints in exterior insulation and finish systems.
      e. Joints between metal panels.

f. Joints between different materials listed above.
g. Permiter joints between materials listed above and frames of doors, windows, aluminum storefront and curtain wall, and louvers.

B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant, acid-curing; not expected to withstand continuous water immersion or traffic.
1. Color: White.
2. Products:
a. Dowsil; 786 Mildew Resistant.
b. GE Advanced Materials - Silicones; Sanitary SCS1700.
c. Pecora Corporation; Pecora 898 NST (Non-Staining Technology): www.pecora.com/#sle.
d. Sika Corporation; Sikasil GP: www.usa.sika.com/#sle.
e. Tremco; Tremsil 200 Sanitary.
f. Substitutions: See Section 01 2500 - Substitution Procedures.
3. Locations:
a. Interior sealant joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Interior sealant joints subject to moisture.

C. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
1. Grade: ASTM C834; Grade 0 Degrees F (Minus 18 Degrees C).
2. Products:
a. Bostik; Siliconized Acrylic Caulk.
b. Pecora Corporation; AC-20 +Silicone: www.pecora.com/#sle.
c. Sherwin-Williams Company; 850A Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
d. Tremco Commercial Sealants & Waterproofing; Tremflex 834: www.tremcosealants.com/#sle.
e. Substitutions: See Section 01 2500 - Substitution Procedures.

D. Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag; not expected to withstand continuous water immersion or traffic.
1. Hardness Range: 10 to 30, Shore A, when tested in accordance with ASTM C661.
2. Service Temperature Range: Minus 13 to 180 degrees F.
3. Products:
a. Pecora Corporation; Pecora BC-158 Butyl Rubber Sealant: www.pecora.com/#sle.
b. Sherwin-Williams Company; Storm Blaster All Season Sealant: www.sherwin-williams.com/#sle.
c. Substitutions: See Section 01 2500 - Substitution Procedures.
4. Locations:
a. Roof panel rib sealant.
b. Termination bars.

E. Noncuring Butyl Sealant: Solvent-based, single component, nonsag, nonskinning, nonhardening, nonbleeding; nonvapor permeable; intended for fully concealed applications.
1. Products:
a. Pecora Corporation; Pecora BA-98 Non-Skinning Butyl Sealant: www.pecora.com/#sle.
b. Tremco Commercial Sealants & Waterproofing; Acoustical/Curtainwall Sealant: www.tremcosealants.com/#sle.
c. Substitutions: See Section 01 2500 - Substitution Procedures.

2.04 SELF-LEVELING JOINT SEALANTS

A. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion.
   1. Movement Capability: Plus and minus 25 percent, minimum.
   2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
   3. Service Temperature Range: Minus 40 to 180 degrees F.
   4. Products:
      a. Master Builders Solutions; MasterSeal SL 2.
      b. Sherwin-Williams Company; Stampede 2SL Polyurethane Sealant: www.sherwin-williams.com/#sle.
      c. Sika Corporation; Sikaflex-2c SL: www.usa.sika.com/#sle.
      d. Substitutions: See Section 01 2500 - Substitution Procedures.
   5. Locations:
      a. Control and expansion joints in brick pavers.
      b. Isolation and control joints in cast-in-place concrete slabs.
      c. Joints in stone paving units.
      d. Tile control and expansion joints.
      e. Joints between materials listed above.

B. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single component; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
   1. Movement Capability: Plus and minus 25 percent, minimum.
   2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
   3. Service Temperature Range: Minus 40 to 180 degrees F.
   4. Products:
      a. Sika Corporation; Sikaflex-2c SL: www.usa.sika.com/#sle.
      b. W. R. Meadows, Inc; POURTHANE SL: www.wrmeadows.com/#sle.
      c. Substitutions: See Section 01 2500 - Substitution Procedures.

C. Semi-Rigid Self-Leveling Polyurea Joint Filler: Two-component, 100 percent solids, UV-resistant; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
   1. Durometer Hardness, Type A: 85, minimum, after seven days when tested in accordance with ASTM D2240.
   2. Joint Depth: Provide product suitable for joints from 1/8 inch to 1 inch in depth excluding space for backer rod.
   3. Products:
      a. ARDEX Engineered Cements; ARDEX ARDISEAL RAPID PLUS: www.ardexamericas.com/#sle.
      b. Euclid Chemical Company; EUCO QWIKjoint UVR: www.euclidchemical.com/#sle.
      c. Metzger McGuire; Edge-Pro.
      d. SASE; FlexJoint 85.
      e. VersaFlex; SL/85.
      f. Substitutions: See Section 01 2500 - Substitution Procedures.
   4. Locations:
      a. Exposed sawcuts and non-moving control joints in concrete slabs subject to heavy loads.

2.05 GLAZING SEALANTS

A. See Section 08 8000 - Glazing.

2.06 ACOUSTICAL JOINT SEALANTS

A. See Section 09 2116 - Gypsum Board Assemblies.

2.07 ACCESSORIES

A. Sealant Backing, General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
   1. Sealant Backing Manufacturers:
      a. Adfast.
      b. Alcot Plastics.
      c. Nomaco.
      d. W.R. Meadows.
      e. Substitutions: See Section 01 2500 - Substitution Procedures

B. Sealant Backing Rod, Closed-Cell Type:
   1. Cylindrical flexible sealant backings complying with ASTM C1330 Type C.
   2. Size: 25 to 50 percent larger in diameter than joint width.

C. Preformed Extruded Silicone Joint Seal: Pre-cured low-modulus silicone extrusion, in sizes to fit applications indicated on drawings, combined with a neutral-curing liquid silicone sealant for bonding joint seal to substrates.
   1. Size: As recommended by manufacturer for Project conditions.
   2. Thickness: 0.78 inch, with ridges along outside bottom edges for bonding area.
   3. Color: As selected by Architect.
   4. Products:
      a. Tremco Commercial Sealants & Waterproofing; Spectrem Simple Seal: www.tremcosealants.com/#sle.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.

D. Preformed Extruded Polyurethane Joint Seal: Medium-modulus, preformed polyurethane extrusion used to bridge joints under elastomeric wall coatings, in sizes to fit applications indicated on drawings, combined with polyurethane sealant for bonding joint seal to substrates.
   1. Size: As recommended by manufacturer for Project conditions.
   2. Thickness: 0.051 inch, with ridges along outside bottom edges for bonding area.
   3. Color: As selected by Architect.
   4. Products:
      a. Dayton Superior.
      b. Emseal (Sika).
      c. Willseal.
      d. Substitutions: See Section 01 2500 - Substitution Procedures.

E. Backing (Bond-Breaker) Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
   1. Manufacturers:
      a. 3M.
      b. Berry Plastics Corporation.

c. C.R. Laurence.
d. Scapa Tapes North America.
e. Valley Industrial Products.

F. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

G. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.

H. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Do not exceed pot life of material as documented in writing by manufacturer.

C. Provide joint sealant installations complying with ASTM C1193.

D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer.

E. Install bond breaker backing tape where backer rod cannot be used.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Owner to engage a qualified testing agency to perform tests and inspections.
   1. Joint sealants will be considered defective if they do not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
   4. Submit field quality control reports to Architect.

C. Tests:
   1. Field Adhesion Testing: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
      a. Perform 10 tests for the first 1,000 linear feet of joint, for each kind of sealant and joint substrate.
      b. Perform 1 test for each 1,000 linear feet of joint thereafter, or one test per each floor per elevation.

D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

E. Repair destructive test location damage immediately after evaluation and recording of results.

1.02 PROTECTION

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements.

B. Protect joint sealants during and after curing period from contact with contaminating substances or damage from subsequent construction activities.

END OF SECTION

SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hollow metal doors and frames.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware.
B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.
C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2024.
D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
J. ITS (DIR) - Directory of Listed Products; Current Edition.
K. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.
L. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
M. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
N. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
O. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
P. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.
Q. UL (DIR) - Online Certifications Directory; Current Edition.

R. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

S. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

D. Samples: Submit two samples of metal, 2 by 2 inches in size, showing factory finishes, colors, and surface texture.

E. Manufacturer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
1. Ceco Door (Assa A
2. Curries (Assa Abloy).
3. DCI Hollow Metal Frames.
4. Deansteel.
5. DKS Doors.
6. Krieger Specialty Products.
7. Republic Doors and Frames (Allegion).
8. Steelcraft (Allegion).
9. Stiles Custom Metal.
10. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
   4. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

1.03 HOLLOW METAL DOORS

A. Door Finish: Factory-primed and shop-finished.

B. Exterior Doors: Thermally insulated.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 4 - Maximum-duty.
      b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 14 gauge, 0.067 inch, minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
   3. Door Thickness: 1-3/4 inches, nominal.
   4. Door Face Sheets: Flush.
   5. Weatherstripping: Refer to Section 08 7100 - Door Hardware.

C. Interior Doors, Non-Fire-Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 3 - Extra Heavy-duty.
      b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.
   2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
   3. Door Thickness: 1-3/4 inches, nominal.
   4. Door Face Sheets: Flush.

D. Fire-Rated Interior Doors:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 3 - Extra Heavy-duty.
      b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.

c. Model 1 - Full Flush.
d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.

2. Fire Rating: As indicated on drawings, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
   a. Attach fire rating label to each fire rated unit.
4. Smoke and Draft Control Doors (Indicated with letter "S" on Drawings and/or Door Schedule): Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;
   a. Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
   b. Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
   c. Label: Include the "S" label on fire-rating label of door.
5. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
6. Door Thickness: 1-3/4 inches, nominal.
7. Door Face Sheets: Flush.

1.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and shop finished.

C. Exterior Door Frames: Face welded type.
   1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
   2. Frame Metal Thickness: 14 gauge, 0.067 inch, minimum.
   3. Weatherstripping: Separate, see Section 08 7100.

D. Interior Door Frames, Non-Fire Rated: Knock-down type.
   1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.

E. Door Frames, Fire-Rated: Face welded type.
   1. Fire Rating: Same as door, labeled.
   2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.

F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

G. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high or as otherwise necessary to fill opening without cutting masonry units.

H. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

1.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Exterior Doors Paint Finish: See Section 09 9113 - Exterior Painting.

C. Interior Doors Paint Finish: See Section 09 9123 - Interior Painting.

1.06 ACCESSORIES

A. Louvers: Roll formed steel with overlapping frame; finish same as door components ; factory-installed.
   1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.
   2. Style: Standard straight slat blade.

B. Door Window Frames: Door window frames with glazing securely fastened within door opening.
   1. Frame Material: 18 gauge, 0.0478 inch, galvanized steel.

C. Glazing: As specified in Section 08 8000, shop-installed.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

2.02 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Install door hardware as specified in Section 08 7100.
   1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.

E. Comply with glazing installation requirements of Section 08 8000.

F. Touch up damaged factory finishes.

2.03 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

2.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

B. Adjust sound control doors so that seals are fully engaged when door is closed.

C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

END OF SECTION

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SECTION 08 1416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors.

1.02 RELATED REQUIREMENTS

A. Section 08 1113 - Hollow Metal Doors and Frames.
B. Section 08 8000 - Glazing.
C. Section 10 2310 - Glazed Interior Wall and Door Assemblies.

1.03 REFERENCE STANDARDS

A. AWI (QCP) - Quality Certification Program; Current Edition.
B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
E. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
F. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
G. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
H. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
I. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.
J. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2021, with Errata (2022).
K. WI (CCP) - Certified Compliance Program (CCP); Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
    1. VOC content restrictions data.
D. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
    1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

E. Samples: Submit two samples of door veneer, 4 by 4 inches in size illustrating wood grain, stain color, and sheen.

F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

G. Manufacturer's Installation Instructions: Indicate special installation instructions.

H. Installer's qualification statement.

I. Field Quality Control Reports: As specified in Part 3 of this Section.

J. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.

1. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than five years of documented experience.
    a. Company with at least one project within past five years with value of woodwork within at least 20 percent of cost of woodwork for this project.
    b. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
2. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

1.06 FIELD CONDITIONS

A. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Package, deliver and store doors in accordance with specified quality standard.

C. Accept doors on site in manufacturer's packaging, and inspect for damage.

D. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Owner's name and register with manufacturer.

1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. Woodwork Quality Assurance Program:
   1. Comply with AWI (QCP) or WI (CCP) woodwork association quality assurance service / program in accordance with requirements for work specified in this section.
   2. Provide labels indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   3. Provide designated labels on shop drawings as required by quality assurance program.
   4. Provide designated labels on installed products as required by quality assurance program.
   5. Submit documentation upon completion of installation that verifies this work is in compliance with specified requirements.

B. Fire-Rated Wood Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.
   1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
   2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

C. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.03 MANUFACTURERS

A. Flush Wood Doors:
   1. Eggers Industries.
   2. Haley Brothers.
   3. Masonite Architectural.
   4. Oregon Door.
   5. Vancouver Door Company.
   6. VT Industries.
   7. Substitutions: See Section 01 2500 - Substitution Procedures.

2.04 DOORS AND PANELS

A. Doors: See drawings for locations and additional requirements.

1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with WDMA I.S. 1A, except as follows:
   a. Extra Heavy Duty Performance:
      1) Classrooms.
      2) Public bathrooms.
      3) Janitor's closets.
      4) Assembly spaces.
      5) Exits.
2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
1. Provide solid core doors at each location.
2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
3. Smoke and Draft Control Doors (Indicated as "S" on Drawings): In addition to required fire rating, provide flush wood door assemblies in compliance with WDMA I.S. 1A requirements for "S" label; no additional gasketing or edge sealing allowed.

2.05 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.06 DOOR FACINGS

A. Veneer Facing for Transparent Finish: White oak, veneer grade in accordance with quality standard indicated, rift cut, with random match (mismatched) between leaves of veneer, center balance match of spliced veneer leaves assembled on door or panel face.
1. Vertical Edges: Same species as face veneer.

B. Veneer Facing for Opaque Finish: Medium density overlay (MDO), in compliance with indicated quality standard, or any closed-grain hardwood of mill option.

2.07 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:
1. Provide solid blocks at lock edge for hardware reinforcement.
2. Provide solid blocking for other throughbolted hardware.

C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
1. Exception: Doors to be field finished.

E. Provide edge clearances in accordance with the quality standard specified.

2.08 FINISH - WOOD VENEER DOORS

A. Quality Standard Grade: Match door construction.
B. Stain: Match Architect's sample.
C. Finish System:
   1. System 11: Catelyzed polyurethane.
D. Sheen: Satin.

2.09 FINISH - OPAQUE DOORS

A. Quality Standard Grade: Match door construction.
B. Paint Finish for Interior Wood Doors: See 09 9123 - Interior Painting.

2.10 ACCESSORIES

A. Hollow Metal Door Frames: See Section 08 1113.
B. Metal Louvers:
   1. Material and Finish: Roll formed steel; pre-painted finish to color as selected.
C. Door Window Frames: Door window frames with glazing securely fastened within door opening.
   1. Frame Material: 18 gauge, 0.0478 inch, galvanized steel.
D. Glazing: See Section 08 8000 - Glazing.
E. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that opening sizes and tolerances are acceptable.
C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.
   2. Install smoke and draft control doors in accordance with NFPA 105 requirements.
B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
C. Use machine tools to cut or drill for hardware.
D. Coordinate installation of doors with installation of frames and hardware.
E. Coordinate installation of glazing.
F. Install door louvers plumb and level.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Owner to engage a qualified testing agency to perform tests and inspections.
   1. Flush wood doors will be considered defective if they do not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
   4. Submit field quality control reports to Architect.

C. Inspections:
   1. Provide inspection of installed Work through AWI's Quality Certification Program or WI's Certified Compliance Program, certifying that wood doors and frames, including installation, comply with requirements of AWI/AWMAC/WI (AWS) for the specified grade.
   2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
   3. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

3.05 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION

SECTION 08 1700
INTEGRATED DOOR OPENING ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Factory-assembled and factory-finished hollow metal doors and frames, including hardware for door opening assemblies.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware: Hardware to be installed on doors in this Section.

1.03 REFERENCE STANDARDS

A. ABA Standards - ABA Accessibility Standards; 2004, with Amendments (2015).
B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
C. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2019.
D. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2024.
E. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
F. BHMA A156.32 - American National Standard for Integrated Swinging Door Opening Assemblies; 2023.
G. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
H. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
I. ITS (DIR) - Directory of Listed Products; Current Edition.
J. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
K. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
L. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
M. UL (DIR) - Online Certifications Directory; Current Edition.
N. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
O. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
P. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

1. VOC content restrictions data.

D. Shop Drawings: Indicate details of each opening showing elevations, glazing, frame profiles, hardware, and different finish locations, if any.

E. Test reports.

F. Samples: Submit two samples of exposed door finish materials, in manufacturer's standard sizes, showing factory finishes and colors as selected.

G. Certificate: Certify that products of this section meet or exceed specified requirements.
1. Include certification of compliance with BHMA A156.32.

H. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

I. Manufacturer's qualification statement.

J. Installer's qualification statement.

1.05 COORDINATION

A. Confirm with manufacturer that products are appropriate to Project scope and conditions.

1.06 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience and certified by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Deliver units preassembled and prefinished, with door hardware mounted and functioning, and packaged to protect contents from damage.

D. Store in a clean, dry, and ventilated space having controlled temperature and relative humidity between 30 and 60 percent and in accordance with manufacturer's written instructions.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide five-year manufacturer warranty for entire door opening assembly. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. Comply with requirements of local building code and authorities having jurisdiction, and the following:
   1. Fire-Rated Doors: Comply with NFPA 80 and NFPA 252.
      a. Hourly Fire-Rating: As indicated on drawings.
   2. Door Assemblies in Corridors and Smoke Barriers: Test fire door assemblies required to have a minimum fire protection rating of 20 minutes and located in corridor walls or smoke barrier walls in accordance with NFPA 252 or UL 10C without the hose stream test.
   3. Door Assemblies in Other Fire Partitions: Test fire door assemblies required to have a minimum fire protection rating of 20 minutes and located in other fire partitions having a fire-resistance rating of 30 minutes in accordance with NFPA 252, UL 10B, or UL 10C with the hose stream test.
   4. Smoke and Draft Control Doors (Indicated with letter "S" on Drawings and/or Door Schedule): Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated same or greater than fire-rated doors, and the following;
      a. Maximum Air Leakage: 3.0 cfm per sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
      b. Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
      c. Label: Include the "S" label on fire-rating label of door in compliance with NFPA 80.
   5. Temperature Rise Across Fire Doors in Interior Exit Stairways, Ramps, and Exit Passageways: Maximum of 250 degrees F above ambient at end of 30 minutes standard fire test exposure.
   6. Provide fire-rated units listed and labeled by UL (DIR) or ITS (DIR).
      a. Attach fire rating label to each fire-rated unit in compliance with NFPA 80.

2.03 REGULATORY REQUIREMENTS

A. Accessibility: Comply with applicable provisions in the ADA Standards, ABA Standards, and ICC A117.1.
   1. Force to Open Interior Swinging Egress Doors, Non-Fire Doors: Not more than 5 lb.
   2. Force to Release Latch for Other Swinging Doors: Not more than 15 lb to release latch, not more than 30 lb to set door in motion, and not more than 15 lb to swing door to full open position.

2.04 MANUFACTURERS

A. Manufacturers:
   1. Rite Door (Assa Abloy).
   2. Steelcraft (Allegion).
   3. Syntegra.

4. Total Door Systems.
5. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 ASSEMBLIES

A. Door, Frame, and Hardware Assemblies: Provide fully functional, factory-assembled and factory-finished door opening units, complete with door, frame, and hardware; complying with BHMA A156.32 and specified requirements.
   1. Products:
      a. Rite Door (Assa Abloy); Rite Door.
      b. Steelcraft (Allegion); Inpact Door System.
      c. Syntegra; Integrated Doors.
      d. Total Door Systems; Total Door.
      e. Substitutions: See Section 01 2500 - Substitution Procedures

1.02 COMPONENTS

A. Hollow Metal Doors: Doors complying with ANSI/SDI A250.8 construction requirements meeting Level 3 and Physical Performance Level A, Model 1 - Full Flush; electrogalvanized prior to finishing; manufacturer's standard core and reinforcements.
   1. Door Thickness: 1-3/4 inches.
   2. Level 3 Fire-Rated Doors: 20-gauge, 0.032-inch thick faces and edges.
   3. Core: Manufacturer's standard.
   4. Fire Door Core: As required to provide fire protection and temperature-rise ratings indicated.
   5. Provide sealed filler channel at top edge of exterior doors.
   6. Provide full height formed steel plate at hinge and lock stiles of doors.

B. Hollow Metal Door Frames: Formed steel cased opening complying with ANSI/SDI A250.8 construction requirements meeting Level 3 and Physical Performance Level A; electrogalvanized prior to finishing.
   1. Type: Full profile welded, 16 gauge, 0.053 inch, primed for field finishing.
   2. Provide frame anchors for secure installation and to comply with opening performance requirements.
   3. Hardware Reinforcement: ANSI/SDI A250.6.

1.03 DOOR HARDWARE

A. Manufacturers: Door hardware manufacturers are as determined by manufacturer of Integrated Door Opening Assemblies in compliance with BHMA A156.32 requirements for applications indicated.

B. See Section 08 7100 for door hardware requirements.

1.04 FINISHES

A. Doors and Frames:
   1. Door Factory Finish: Complying with ANSI/SDI A250.3, door manufacturer's standard coating.
      a. Color: As selected by Architect from manufacturer's full range.

B. Fabrication

1. Hollow-Metal Frames: Fabricate in one piece, except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
    a. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
    b. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
        1) Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
        2) Double-Door Frames: Drill stop in head jamb to receive two door silencers.
    c. Terminated Stops: Terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
2. Hardware Preparation: Prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, door hardware schedule, and templates.
    a. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
    b. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify existing conditions before starting this Work.

B. Verify that opening sizes and tolerances are acceptable.

2.02 INSTALLATION

A. Install doors in accordance with manufacturer's requirements, specified performance requirements, and approved shop drawings.

B. Install fire rated units in accordance with NFPA 80.

C. Install smoke and draft control doors in accordance with NFPA 105.

D. Coordinate frame anchor placement with wall construction.

E. Coordinate installation of electrical connections to electrical hardware items.

F. Touch up damaged factory finishes.

2.03 TOLERANCES

A. Clearances Between Door and Frame: As specified in ANSI/SDI A250.8.

B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

2.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

END OF SECTION

SECTION 08 3100
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Access doors and frames for walls and ceilings.

1.02 DEFINITIONS:

A. See Section 05 0511 - Surface Preparation and Finishing of Metals, for the following definitions:
   1. Metallic-coated.

1.03 REFERENCE STANDARDS

A. ANSI A326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials; 2021.

B. ANSI H35.2 - American National Standard Dimensional Tolerances for Aluminum Mill Products; 2017.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

H. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2015 (Reapproved 2021).

I. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface; 2022.

J. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

K. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

L. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

M. ASTM B632/B632M - Standard Specification for Aluminum-Alloy Rolled Tread Plate; 2018.

N. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2022.

O. ASTM F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners; 2015.
P. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
R. NFPA 288 - Standard Methods of Fire Tests of Horizontal Fire Door Assemblies Installed in Horizontal Fire Resistance-Rated Assemblies; 2022.
S. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal requirements.
B. Product Data: For each item to be installed.
C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
    1. VOC content restrictions data.
D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
E. Samples: For each door face material
F. Manufacturer's installation instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.
B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.
C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.
D. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.06 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.
B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 tested according to the following test method:
   1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
   2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.03 MANUFACTURERS

A. Manufacturers:
   1. Acudor.
   2. Babcock-Davis.
   3. Bauco.
   4. Best Access Doors.
   5. Cendrex.
   6. Elmdor / Stoneman.
   7. J.L. Industries (Activar).
   8. Larsen's Manufacturing.
   9. Nystrom.
   10. Substitutions: Section 01 2500 - Substitution Procedures.

B. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

1.02 ACCESS DOORS AND PANELS, GENERAL

A. Access Door and Panel Size: As shown on the Architectural drawings or as required for access. Confirm each size with Architect.

1.03 ACCESS DOORS FOR WALLS AND CEILINGS

A. Flush Access Doors with Exposed Flanges: Face of door flush with frame, with exposed flange and concealed hinge.
   1. Products:
      a. Bauco; Softline.
      b. Elmdor / Stoneman; DW Series Drywall Access Doors.
      c. Nystrom; Architectural Access Door.
      d. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Physical Properties:
      a. Uncoated steel sheet, nominal 0.060 inch, 16 gage.
         1) Finish: Factory prime.
      b. Metallic-coated steel sheet, nominal 0.064 inch, 16 gage.
         1) Finish: Factory prime.
      c. Stainless steel, nominal 0.062 inch, 16 gage.
         1) Finish: No. 4.
      d. Frame Material: Same material, thickness, and finish of door.
      e. Hinges: Manufacturer's standard.
      f. Hardware: Latch.

B. Flush Access Doors with Concealed Flanges: Face of door flush with frame; with concealed flange for gypsum board and plaster installation, with concealed hinge.
   1. Products:

a. Gypsum:
1) Elmdor / Stoneman; DWB Series Drywall Bead Access Door.
b. Plaster:
1) Elmdor / Stoneman; ML Series Metal Lath Access Door.
2. Physical Properties:
a. Uncoated steel sheet, nominal 0.060 inch, 16 gage.
1) Finish: Factory prime.
b. Metallic-coated steel sheet, nominal 0.064 inch, 16 gage.
1) Finish: Factory prime.
c. Stainless steel, nominal 0.062 inch, 16 gage.
1) Finish: No. 4.
d. Frame Material: Same material, thickness, and finish of door.
e. Hinges: Manufacturer's standard.
f. Hardware: Latch.

B. Recessed Access Doors: Door face recessed for gypsum board, plaster, and acoustical tile infill; with concealed flange installation, and with concealed hinge.
1. Products:
a. Gypsum Board:
1) Bauco; Bauco Plus II.
2) Elmdor / Stoneman; ADW Series Drywall Aluminum Access Door.
3) Nystrom; Recessed Access Door.
b. Plaster:
1) Elmdor / Stoneman; AP Series Acoustical Plaster Access Door.
c. Acoustical Tile:
1) Elmdor / Stoneman; AT Series Acoustical Tile Access Door.
2. Physical Properties:
a. Uncoated steel sheet, nominal 0.060 inch, 16 gage.
1) Finish: Factory prime.
b. Metallic-coated steel sheet, nominal 0.064 inch, 16 gage.
1) Finish: Factory prime.
c. Stainless steel, nominal 0.062 inch, 16 gage.
1) Finish: No. 4.
d. Frame Material: Same material, thickness, and finish of door.
e. Hinges: Manufacturer's standard.
f. Hardware: Latch.

B. Fire-Rated, Flush Access Doors with Exposed Flanges: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal, with exposed flange, self-closing door, and concealed hinge.
1. Products:
a. Elmdor / Stoneman; FR / FRC Series.
b. Nystrom; Fire-Rated Access Door.
2. Physical Properties:
a. Fire-Resistance Rating: Not less than that of adjacent construction.
b. Temperature-Rise Rating: 450 degrees F at the end of 30 minutes.
c. Uncoated steel sheet, nominal 0.060 inch, 16 gage.
1) Finish: Factory prime.
d. Metallic-coated steel sheet, nominal 0.064 inch, 16 gage.
1) Finish: Factory prime.
e. Stainless steel, nominal 0.062 inch, 16 gage.

1) Finish: No. 4.

f. Frame Material: Same material, thickness, and finish of door.

g. Hinges: Manufacturer's standard.

h. Hardware: Latch.

3. Location:

1.02 HARDWARE

A. Hinges: Heavy-duty, with stainless steel pins.

B. Latch: Stainless-steel slam latch.

C. Lock: Keyed deadbolt lock.

1. Lock Preparation: Prepare door panel to accept cylinder specified in 087100 - Door Hardware.

D. Hardware Material: Manufacturer's standard.

E. Insulation: Manufacturer's standard.

F. Safety Accessories: Safety chain.

1.03 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

E. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 304. Remove tool and die marks and stretch lines or blend into finish.

F. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.

G. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

H. Aluminum Sheet: ASTM B209/B209M, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15; with minimum sheet thickness according to ANSI H35.2.

I. Frame Anchors: Same type as door face.

J. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

1.04 FINISHES

A. Stainless Steel Finish: See 05 0511 - Surface Preparation and Finishing of Metals.

B. Exterior Paint Finish: See Section 09 9113 - Exterior Painting.

C. Interior Paint Finish: See Section 09 9123 - Interior Painting.

1.05 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.

E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
   1. For cylinder locks, furnish two keys per lock and key all locks alike.
   2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

F. Extruded Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

PART 3 EXECUTION - NOT USED

2.01 INSTALLATION

A. Install in accordance with manufacturer's written instructions and approved shop drawings.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

2.02 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08 3473
SOUND CONTROL DOOR ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sound control door assemblies.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware.
B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.

1.03 REFERENCE STANDARDS

A. ABA Standards - ABA Accessibility Standards; 2004, with Amendments (2015).
B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.
D. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2024.
E. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
F. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
H. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
J. ASTM E336 - Standard Test Method for Measurement of Airborne Sound Attenuation Between Rooms in Buildings; 2023.
K. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
L. ASTM E413 - Classification for Rating Sound Insulation; 2022.
M. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
N. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
O. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.
P. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers; 2017.

Q. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
R. ITS (DIR) - Directory of Listed Products; Current Edition.
S. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.
T. NAAMM HMMA 865 - Guide Specifications for Sound Control Hollow Metal Door and Frame Assemblies; 2013.
U. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
V. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
W. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
X. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.
Y. SDI 128 - Guidelines for Acoustical Performance of Standard Steel Doors and Frames; 2019.
Z. UL (DIR) - Online Certifications Directory; Current Edition.
AA. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
BB. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.
CC. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2021, with Errata (2022).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: For each item to be installed. Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
    1. VOC content restrictions data.
    2. CAL (CDPH SM) compliance data.
    3. Life cycle data.
    4. Sustainable wood data.
    5. Recycled content data.
D. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
E. Samples: Submit two samples, 4 inch by 4 inch in size showing factory finishes, colors, and surface texture.
F. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
G. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
H. Test reports.
I. Manufacturer's Qualification Statement.
J. Installer's Qualification Statement.
K. Field Quality Control Reports: As specified in Part 3 of this Section.
L. Warranty.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.
   2. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

B. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.
   2. Review procedures for coordinating frame and anchor installation with wall construction.
   3. Review required field quality-control procedures.

C. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Avoid the use of nonvented plastic.
   1. Provide additional protection to prevent damage to factory-finished units.

C. Store doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

D. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

E. Protect metal doors in compliance with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) and specified requirements.

F. See Section 01 7419 - Construction Waste Management and Disposal

1.07 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Special Warranty: Manufacturer agrees to repair or replace components of sound control door assemblies that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure to meet sound rating requirements.
      b. Faulty operation of sound seals.
      c. Deterioration of metals, finishes, and other materials beyond normal use or weathering.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. CDPH: Products to comply with CAL (CDPH SM) .

D. Life Cycle: Products in this section to have LCA as specified in Section 01 6000.

E. Sustainable Wood: Products in this Section to meet sustainable wood requirements specified in Section 01 6000.

F. Recycled Content: Products in this Section to meet minimum recycled content thresholds specified in Section 01 6000.

2.02 PERFORMANCE REQUIREMENTS

A. Sound Rating: Provide sound control door assemblies identical to those of assemblies tested as sound-retardant units by an acoustical testing agency, and rated as specified in articles below.

B. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
   1. Smoke- and Draft Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.03 REGULATORY REQUIREMENTS

A. Accessibility: Comply with applicable provisions in the ADA Standards, ABA Standards, and ICC A117.1.
   1. Opening Force of Sound Control Doors, Non-Fire Rated: 5 lbs, maximum.

2.04 MANUFACTURERS

A. Sound Control Door Assemblies:
   1. Ambico.
   2. IAC Acoustics.
   3. Krieger Specialty Products.
   4. Noise Barriers.
   5. Overly Door Company.
   6. Premier Steel Doors and Frames.
   7. Stiles (Assa Abloy).
   8. Substitutions: See Section 01 6000 - Product Requirements.

B. Source Limitations: Obtain pre-hung, pre-swung sound control door assemblies, including doors, frames, sound control seals, hinges, thresholds, and other items essential for sound control, from single source from single manufacturer.

1.02 METAL SOUND CONTROL DOOR ASSEMBLIES

A. Metal Sound Control Door Assemblies:
   1. Products:
      a. Krieger Specialty Doors; Sound 52 Door, Model NC3-STC52.
      b. Noise Barriers; QuietSwing, STC-52.
      c. Substitutions: See Section 01 2500 - Substitution Procedures.

2. Metal Doors: Refer to drawings for locations and additional requirements.
    a. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
        1) Level 3 - Extra Heavy-duty.
        2) Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
        3) Model 1 - Full Flush.
        4) Comply with guidelines of SDI 128 for acoustic performance of metal doors and frames.
        5) Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.
    b. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
        1) Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
            (a) Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) where necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
3. Sound Transmission Class (STC) Rating of Sound Control Door Assembly: STC of 52, minimum, calculated in accordance with ASTM E413, and tested in accordance with ASTM E90.
4. Door Thickness: Comply with sound control requirements as indicated on the drawings.
5. Door Face Sheets: Flush.
6. Finish:
    a. Wood Veneer Finish: Factory-applied wood veneer.
        1) Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), AWMAC/WI (NAAWS) or WDMA I.S. 1A.
        2) Species: As selected by Architect from manufacturer's full range.
2. Sound Seals: As required by manufacturer to meet indicated sound control ratings.
3. Interior Doors, Non-Fire Rated:
    a. Door Core Material: As required by manufacturer to meet indicated sound control ratings.
4. Fire-Rated Doors:
    a. Fire Rating: As indicated on Door Schedule, complying with NFPA 80 and tested in accordance with UL 10C and NFPA 252 as positive pressure fire tests.
    b. Temperature-Rise Rating (TRR) Across Door Thickness: Comply with requirements of local building code and authorities having jurisdiction (AHJ).
    c. Provide units listed and labeled by UL (DIR) or ITS (DIR).
        1) Attach fire rating label to each fire rated unit.
    d. Smoke and Draft Control Doors (Indicated as "S" on Drawings): In addition to required fire rating, provide sound control door assemblies tested in accordance with UL 1784 and maximum air leakage of 3.0 cfm per sq ft of door opening at 0.10 inch wg pressure at both ambient and elevated temperatures for 'S' label.
    e. Door Core Material: As required by manufacturer to meet indicated fire and sound control ratings.

1.02 SOUND CONTROL DOOR FRAMES

A. Comply with standards and custom guidelines, as apply, for corresponding door in accordance with applicable door frame requirements.

B. Metal Sound Control Interior Door Frames: Continuously welded type. Fabricate according to NAAMM HMMA 865.
   1. Frame Finish: Factory prime painted for shop finishing.
   2. Interior Door Frames, Non-Fire Rated:
      a. Frame Metal Thickness: 14 gauge, 0.067 inch, minimum.
   3. Fire-Rated Door Frames:
      a. Fire Rating: Same as door, and labeled.
      b. Frame Metal Thickness: 14 gauge, 0.067 inch, minimum.

1.03 DOOR HARDWARE

A. See Section 08 7100 - Door Hardware, for additional information..

B. Hinges: Cam lift type by door manufacturer; see Section 08 7100.

C. Threshold: Provide sound control/acoustic seal for sill of door in closed position by door manufacturer.

D. Sound Control Seals: Provide sound control /acoustic seals for jambs and head of door in closed position by door manufacturer.

1.04 FINISHES

A. Primer, Metal Doors and Frames: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Wood Door Finish: Complying with WDMA I.S. 1A, premium grade, manufacturer's standard coating.

C. Paint Finish: See Section 09 9123 - Interior Painting.

1.05 ACCESSORIES

A. Glazing: See Section 08 8000, factory installed, and tested to comply with specified sound control and fire ratings as indicated.

B. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

2.02 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions, approved shop drawings, and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 865.

2.03 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 865.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

2.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Owner to engage a qualified testing agency to perform tests and inspections.
   1. Sound control door assemblies will be considered defective if they do not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
   4. Submit field quality control reports to Architect.

C. Tests:
   1. Provide field testing of installed sound control doors in accordance with ASTM E336 test methods, with results calculated in accordance with ASTM E413 and having acceptable field noise isolation class (NIC) values within 5 dB of laboratory STC rating values.

D. Manufacturer's Representative to provide inspection services as specified in Section 01 4000.
   1. Manufacturer's representative to prepare site inspection reports and deliver to Contractor.
   2. Submit field quality control reports to Architect.

2.05 ADJUSTING

A. Adjust for smooth and balanced sound control door movement.

B. Adjust sound control doors so that seals are fully engaged when door is closed.

C. Adjust sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

END OF SECTION

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SECTION 08 4229
AUTOMATIC ENTRANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sliding type packaged power-operated door assemblies.

B. Controllers, actuators and safety devices.

1.02 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. ABA Standards - ABA Accessibility Standards; 2004, with Amendments (2015).

C. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

E. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2023.

F. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2023.

G. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

H. BHMA A156.10 - Power Operated Pedestrian Doors; 2024.

I. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.

J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Delegated Design Documents: See Section 01 3000 - Administrative Requirements.
   1. Provide design documentation prepared by Contractor's Licensed Professionals.

C. Global Warming Potential (GWP): Environmental product declaration (EPD) to identify GWP less than or equal to maximum allowable value. See 01 4113.11 - Regulatory Requirements - Global Warming Potential (GWP), for additional information.

D. Shop Drawings:

1. Indicate layout and dimensions; head, jamb, and sill conditions; elevations; components, anchorage, recesses, materials, and finishes, electrical characteristics and connection requirements.
2. Identify installation tolerances required, assembly conditions, routing of service lines and conduit, and locations of operating components and boxes.

E. Product Data: For each item to be installed. Include system components, sizes, features, and finishes.

F. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
1. VOC content restrictions data.
2. CAL (CDPH SM) compliance data.
3. Life cycle data.
4. Recycled content data.

G. Samples for Initial Selection: For units with factory-applied finishes.

H. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

I. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and manufacturer's hardware and component templates.

J. Manufacturer's qualification statement.

K. Installer's qualification statement.

L. Field Quality Control Reports: As specified in Part 3 of this Section.

M. Maintenance Contract.

N. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

O. Maintenance Data: Include manufacturer's parts list and maintenance instructions for each type of hardware and operating component.

P. Sample Warranties: For manufacturer's special warranties.

Q. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 7000 - Execution and Closeout Requirements for additional provisions.
2. Wrenches and other tools required for maintenance of equipment.

1.05 COORDINATION

A. Coordinate sizes and locations of recesses in concrete floors for recessed sliding tracks and recessed control mats that control automatic entrances. Concrete, reinforcement, and formwork requirements are specified elsewhere.

B. Templates: Distribute for doors, frames, and other work specified to be factory prepared for installing automatic entrances.

C. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of Project.

D. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies and access-control system.

E. System Integration: Integrate sliding automatic entrances with other systems as required for a complete working installation.
1. Provide electrical interface control capability for activation of sliding automatic entrances by security access system on doors with electric locking.

2. Provide electrical interface to deactivate door operators on activation of fire alarm system.
3. Provide electrical interface to allow for remote monitoring of automatic entrance door panel status.

1.06 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years of documented experience, and a member of AAADM.
   2. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience and approved by manufacturer.
   3. Certified by AAADM.
   4. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
      a. Convene minimum 2 weeks before starting work of this Section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.08 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 6000 - Product Requirements for additional warranty requirements.

B. Special Warranty: Manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Faulty operation of operators, controls, and hardware.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
   2. Warranty Period: Two years from date of Substantial Completion.

C. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested in accordance with ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 DELEGATED DESIGN

A. Delegated Design: See Section 01 3000 - Administrative Requirements.

B. Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design automatic entrances.

2.02 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. CDPH: Products to comply with CAL (CDPH SM).

D. Life Cycle: Products in this section to have LCA as specified in Section 01 6000.

E. Recycled Content: Products in this Section to meet minimum recycled content thresholds specified in Section 01 6000.

2.03 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Structural Performance: Automatic entrances to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated in accordance with ASCE 7.
   1. Seismic Loads: As shown on the Structural drawings.
   2. Wind Loads: As shown on the Structural drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 degrees F ambient, 180 degrees F material surfaces.

D. Operating Temperature Range: Automatic entrances to operate within minus 20 to 122 degrees F.

E. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sq. ft. of fixed entrance-system area when tested according to ASTM E283/E283M at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..

F. Opening Force:
   1. Power-Operated Doors: Not more than 50 lbf required to manually set door in motion if power fails, and not more than 15 lbf required to open door to minimum required width.
   2. Breakaway Device for Power-Operated Doors: Not more than 50 lbf required for a breakaway door or panel to open.

G. Entrapment-Prevention Force:
   1. Power-Operated Sliding Doors: Not more than 30 lbf required to prevent stopped door from closing.

2.04 REGULATORY REQUIREMENTS

A. Automatic and power-assisted doors and gates to comply with CBC Seection 11B-404.3.

B. Structural Steel and Flat Glass: Global Warming Potential (GWP) less than or equal to maximum allowable value. See Section 01 4113.11 - Regulatory Requirements - Global Warming Potential (GWP), for additional information.

C. Accessibility: Comply with applicable provisions in the ADA Standards, ABA Standards, and ICC A117.1.

2.05 MANUFACTURERS

A. Sliding Automatic Entrance Door Assemblies:
   1. Assa Abloy.
   2. Horton Automatics.
   3. Stanley.
   4. Substitutions: See Section 01 2500 - Substitution Procedures.

2.06 AUTOMATIC ENTRANCE DOOR ASSEMBLIES, GENERAL

A. General: Provide manufacturer's standard automatic entrances, including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, controls, and accessories required for a complete installation.
   1. Configuration: As shown on the Architectural drawings.

B. Framing and Transom Members: Provide manufacturer's standard extruded aluminum framing, reinforced as required to support imposed loads.
   1. Nominal Sizes:
   2. Transoms: Provide flush glazed transom with framing that is integral with automatic entrance framing system.

C. Door and Sidelight Construction: Heavy duty interlocked extruded aluminum tubular stile and rail sections, through-rod bolted construction with steel corner support at hinge stile of carrier-suspended swinging panels or mechanically fastened corners with welded reinforcing brackets to reduce sag in sliding or breakout mode.
   1. Door Thickness: 1-3/4 inch, nominal.
   2. Glazing Stops: Manufacturer's standard snap-on extruded aluminum square stops with preformed resilient glazing gaskets.
   3. Glazing Stop Width: Manufacturers standard.

2.07 SLIDING AUTOMATIC DOOR ASSEMBLIES

A. Sliding Automatic Door: BHMA A156.10, Bi-parting double leaf track-mounted, electric operation, extruded aluminum glazed door, with frame, and operator concealed overhead.
   1. Basis of Design Product:
      a. Stanley; Dura-Glide 2000 Series.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Exterior-Side Actuator/Safety: Motion sensor.
   3. Interior-Side Actuator/Safety: Motion sensor.
   4. Sliding-Door Carrier Assemblies and Overhead Roller Tracks: Carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered, ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly
      a. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.

5. Sliding-Door Threshold: Threshold members and bottom-guide-track system with stainless steel, ball-bearing-center roller wheels.
   a. Configuration: As shown on the Architectural drawings.
6. Glazing: GL-.
   a. See Section 08 8000 - Glazing, for additional information.
7. Finish:
   a. AAMA 2605-compliant superior coating.
   b. Color: As selected by Architect from manufacturer's full range.

1.02 CONTROLLERS, ACTUATORS, AND SAFETIES

A. Controller: Provide microprocessor operated controller for each door.

B. Comply with BHMA A156.10 for actuator and safety types and zones.

C. Proximity Detector Actuator/Safety: Microwave or passive infrared; distance of control sensitivity adjustable.

D. Photo-Electric Actuator/Safety: Horizontal single ray device, with aluminum housing for light source and relay units.

1.03 FINISHES

A. Shop-Applied Coating Finish: See Section 05 0513 - Shop-Applied Coatings for Metal, for additional information.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.

B. Verify that electric power is available, at the correct location, and is of the correct characteristics.

2.02 INSTALLATION

A. Install equipment in accordance with manufacturer's written instructions and approved shop drawings.

B. Install entrances securely anchored in place, plumb, level, and true to location, in alignment with established lines and grades, without warp, bow, or racking of members.

C. Where frames are assembled in field, fit frame joints hairline tight without burrs or distortion; rigidly secure nonmoving joints and seal watertight.

D. Coordinate installation of components with related and adjacent work; level and plumb.

2.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Owner to engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.
   1. Automatic entrances will be considered defective if they do not pass tests and inspections.

2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
4. Submit field quality control reports to Architect.

C. Tests and Inspections: Perform the following with the assistance of a factory-authorized service representative:
1. Test and inspect each automatic entrance, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

2.04 ADJUSTING

A. Adjust entrances for correct function and smooth operation, without binding or scraping and without excessive noise; lubricate operating hardware and other moving parts.

2.05 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
B. Remove temporary protection; clean exposed surfaces.

2.06 CLOSEOUT ACTIVITIES

A. See Section 01 7900 - Demonstration and Training for additional requirements.
B. Demonstrate operation, operating components, adjustment features, and lubrication requirements.

2.07 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
B. Provide service and maintenance of operating equipment for one year from Date of Substantial Completion, at no extra charge to Owner.

END OF SECTION

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SECTION 08 4313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront.

B. Aluminum entrance doors and frames.

1.02 RELATED REQUIREMENTS

A. Section 08 8000 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

B. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.

C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

I. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

J. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

K. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

L. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

M. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).

N. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting minimum 2 weeks before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
   1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.

E. Delegated Design Documents: See Section 01 3000 - Administrative Requirements.
   1. Provide design documentation prepared by Contractor's Licensed Professionals.

F. Manufacturer's installation instructions.

G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

H. Designer's qualification statement.

I. Manufacturer's qualification statement.

J. Installer's qualification statement.

1.06 COORDINATION

A. Register project with aluminum-framed storefront manufacturer.

1.07 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.

B. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

C. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
      a. Insulating Glass Certification Council (IGCC).
      b. Safety Glazing Certification Council (SGCC).

D. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.08 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Build mockups to verify selections made under sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

C. Locate where directed by Architect.

D. Mock-up may remain as part of work.

1.09 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Handle products of this section in accordance with AAMA CW-10.

E. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

F. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.10 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.11 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide 10 year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide 20 year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 DELEGATED DESIGN

A. Delegated Design: See Section 01 3000 - Administrative Requirements.

B. Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design aluminum-framed storefront assemblies.

C. Design aluminum-framed systems, including comprehensive engineering analysis by a professional engineer registered in the State of California, using performance requirements and design criteria indicated.

2.02 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.03 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed storefront systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   1. Aluminum-framed entrance and storefront systems to withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   2. Failure also includes the following:
      a. Thermal stresses transferring to building structure.
      b. Glass breakage.
      c. Noise or vibration created by wind and thermal and structural movements.
      d. Loosening or weakening of fasteners, attachments, and other components.
      e. Failure of operating units.

B. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   1. Design Wind Loads: As shown on the Structural drawings. Comply with requirements of ASCE 7.
   2. Member Deflection: Limit member deflection to 1/175 in any direction, with full recovery of glazing materials.
   3. Seismic Loads: As indicated on Drawings, in accordance with the CBC.

C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 10 psf.

D. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.

2.04 MANUFACTURERS

A. Aluminum-Framed Storefronts:
   1. Arcadia.
   2. Commercial Architectural Products.
   3. C.R. Laurence.
   4. Efco.
   5. Kawneer.
   6. Manko Window Systems.
   7. Oldcastle BuildingEnvelope.
   8. Trulite.
   9. YKK AP.
   10. Substitutions: See Section 01 2500 - Substitution Procedures.

2.05 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Basis of Design Product:

a. Arcadia, TC670 Thermal.
b. Substitutions: See Section 01 2500 - Substitution Procedures.
2. Construction: Thermally broken.
3. System: Either stick or unitized system.
4. Glazing: Refer to Architectural drawings for type.
a. See Section 08 8000 - Glazing, for additional information.
5. Glazing Position: Centered (front to back).
6. Finish: Superior performing organic coatings compliant with AAMA 2605.
a. See Section 05 0513 - Shop-Applied Coatings for Metal, additional information.
b. Factory finish all surfaces that will be exposed in completed assemblies.
c. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
7. Finish Color: See Section 05 0513 - Shop-Applied Coatings for Metal.
8. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
9. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
10. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
11. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
12. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
13. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel, and heel bead of glazing compound.

2.06 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Glazing Stops: Flush.
B. Swing Doors: Glazed aluminum.
1. Manufacturer: Same as aluminum framing system.
2. Construction: Thermally broken.
3. Thickness: 1-3/4 inches.
4. Top Rail: 4 inches wide.
5. Vertical Stiles: Narrow stile.
6. Bottom Rail: 10 inches wide.
7. Glazing Stops: Square.
8. Finish: Same as storefront.

2.07 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
   1. Shop prime with products in 05 1200 - Structural Steel Framing.
C. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.
D. Structural Supporting Anchors Attached to Reinforced Concrete Members: Design for welded attachment to weld plates embedded in concrete.
E. Fasteners: Stainless steel.
F. Metal Flashing: See 07 6200 - Sheet Metal Flashing and Trim.
G. Sealant for Setting Thresholds: Non-curing butyl type.
H. Glazing Accessories: See Section 08 8000.
I. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.08 FINISHES

A. Shop-Applied Coating Finish: See Section 05 0513 - Shop-Applied Coatings for Metal, for additional information.

2.09 HARDWARE

A. See Section 087100 - Door Hardware.

2.10 FABRICATION

A. Form or extrude aluminum shapes before finishing.
B. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Physical and thermal isolation of glazing from framing members.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing from interior.
   6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
C. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
D. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
E. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Install hardware using templates provided.

J. Install glass and infill panels using glazing method required to achieve performance criteria; see Section 08 8000.

K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Owner to engage a qualified testing agency to perform tests and inspections.
   1. Aluminum-framed storefront assemblies will be considered defective if they do not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
   4. Submit field quality control reports to Architect.

C. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.

D. Tests:
   1. Provide field testing of installed storefront system in accordance with AAMA 503 during construction process and before installation of interior finishes.
      a. Perform a minimum of two tests in each designated area as indicated on drawings.
      b. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
   2. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf.
      a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
   3. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 1.57 psf.

3.04 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.05 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.06 PROTECTION

A. Provide barrier or other delineation to prevent damage to installed Work from subsequent construction activities.

END OF SECTION

SECTION 08 4413
GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed curtain wall.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping: Firestop at system junction with structure.
B. Section 08 8000 - Glazing.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
B. AAMA 501.1 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2017.
C. AAMA 501.4 - Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift; 2018.
D. AAMA 501.5 - Test Method for Serviceability of Exterior Fenestration After Thermal Cycling; 2023.
E. AAMA 501.7 - Recommended Static Test Method for Evaluating Windows, Window Wall, Curtain Wall and Storefront Systems Subjected to Vertical Inter-Story Movements; 2017.
F. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.
G. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
H. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
I. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
J. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
K. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
L. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
M. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
N. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
O. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.

P. ASTM C1135 - Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants; 2019.

Q. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

R. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

S. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

T. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

U. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).

V. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting minimum 2 weeks before starting work of this section; require attendance by all affected installers.
   1. See Section Section 01 3000 - Administrative Requirements, for additional information.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Delegated Design Documents: See Section 01 3000 - Administrative Requirements.
   1. Provide design documentation prepared by Contractor's Licensed Professionals.

E. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.

F. Manufacturer's installation instructions.

G. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

H. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.

I. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

J. Designer's Qualification Statement.

K. Manufacturer's Qualification Statement.

L. Installer's Qualification Statement.

M. Flashing Transition Certification: Provide written approval by the aluminum component manufacturer for the location of the engineered transition flashings. Provide written confirmation by the engineered transition flashing that the sequence of installation has been reviewed to ensure that the proper weather barrier connections can be made effectively.

N. California Compliance Labeling and Certifications: Provide labeling and certifications complying with the California Energy Code section 116.

O. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 COORDINATION

A. Register Project with glazed aluminum curtain wall manufacturer.

1.07 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.

B. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than five years of documented documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
      a. Insulating Glass Certification Council (IGCC).

D. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.08 PRECONSTRUCTION TESTING

A. Preconstruction Testing: See Section 01 4000 - Quality Requirements.

B. Owner to engage a qualified testing agency to perform tests and inspections.
   1. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
      a. Do not install product on the Project until passing test is achieved.
   3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
   4. Submit preconstruction testing reports to Architect.

C. Tests:
   1. Preconstruction Laboratory Mockup Testing: Test preconstruction laboratory mockups according to requirements in "Performance Requirements" Article. Perform the following tests in the following order:
      a. Structural, 50 percent: ASTM E330/E330M at 50 percent of positive test load.
      b. Air Leakage: ASTM E283/E283M.
      c. Water Penetration under Static Pressure: ASTM E331.
      d. Water Penetration under Dynamic Pressure: AAMA 501.1.
      e. Structural, 100 percent: ASTM E330/E330M at 100 percent of positive and negative test loads. Repeat the following:
         1) Air Leakage: ASTM E283/E283M.
         2) Water Penetration under Static Pressure: ASTM E331.

f. Interstory Drift: AAMA 501.4 at 100 percent of design displacement. Repeat the following:
   1) Air Leakage: ASTM E283/E283M.
   2) Water Penetration under Static Pressure: ASTM E331.
g. Vertical Interstory Movement: AAMA 501.7. Repeat the following:
   1) Air Leakage: ASTM E283/E283M.
   2) Water Penetration under Static Pressure: ASTM E331.
h. Thermal Cycling: In accordance with AAMA 501.5. Repeat the following:
   1) Air Leakage: ASTM E283/E283M.
   2) Water Penetration under Static Pressure: ASTM E331.
i. Structural, 100 and 150 percent: ASTM E330/E330M at 100 and 150 percent of positive and negative test loads. Repeat the following:
   1) Air Leakage: ASTM E283/E283M,
   2) Water Penetration under Static Pressure: ASTM E331.

2. Preconstruction Adhesion and Compatibility Testing: Submit to structural glazing sealant manufacturer, for testing indicated below, Samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that is in close proximity to or is touching the structural or nonstructural sealants of a structural glazed system.
   a. Compatibility: Test materials or components using ASTM C1087.
   b. Adhesion: Test for adhesion or lack of adhesion of a structural sealant to the surface of another material or component using ASTM C1135.
   c. Submit no fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
   d. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
   e. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
   f. Testing will not be required if data based on previous testing of current sealant products match those submitted.

1.09 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Construct mock-up indicating each component being used on the project. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.

C. Locate where directed by Architect.

D. Mock-up may remain as part of work.

1.10 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Handle products of this section in accordance with AAMA CW-10.

E. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

F. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.11 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.12 WARRANTY

A. See Sections 01 6000 - Product Requirements and 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 5-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units. Complete forms in Owner's name and register with installer.

C. Finish Warranty: Provide 20 manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 DELEGATED DESIGN

A. Delegated Design: See Section 01 3000 - Administrative Requirements.

B. Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design aluminum-framed curtain wall assemblies.

C. Delegated Design: Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, registered in the State of California, using performance requirements and design criteria indicated.

2.02 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.03 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain wall systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   1. Glazed aluminum curtain wall systems to withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   2. Failure also includes the following:
      a. Thermal stresses transferring to building structure.
      b. Glass breakage.

c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
1. Design Wind Loads: Comply with the following:
a. Wind Loads: As indicated on Structural drawings.
b. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
c. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
d. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.
2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement in accordance with requirements of ASCE 7.
3. Seismic Loads: As indicated on the drawings.
4. Blast Loads: As indicated on the Drawings.
5. Interstory Differential Lateral Movement: Meeting pass/fail criteria of AAMA 501.4 for Use Group I, Standard Occupancy, when tested at design displacement of 0.010 times greater adjacent story height, maximum, and 1.5 times design displacement, through three complete cycles.
6. Movement: Accommodate the following movement without damage to components or deterioration of seals:
a. Expansion and contraction caused by 180 degrees F surface temperature.
b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
c. Movement of curtain wall relative to perimeter framing.
d. Deflection of structural support framing, under permanent and dynamic loads.

C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
1. Test Pressure Differential: 10 psf.

D. Air Leakage: 0.06 cfm/sq ft maximum leakage of wall area when tested in accordance with ASTM E283/E283M at 6.24 psf pressure difference across assembly.

E. Thermal Performance Requirements:
1. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.
2. Energy Performance: Certified and labeled energy performance ratings in accordance with the California Energy Code (CEC) and NFRC. Provide labeling and certifications complying with CEC section 116.
3. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 as determined according to NFRC 200.

2.04 MANUFACTURERS

A. Glazed Aluminum Curtain Walls Manufacturers:
1. Arcadia.
2. Commercial Architectural Products.

3. C.R. Laurence.
4. Efco.
5. Kawneer.
6. Manko Window Systems.
7. Oldcastle BuildingEnvelope.
8. Trulite.
9. Wausau.
10. YKK AP.
11. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Basis of Design Products:
      a. CW-1: Arcadia; OPG3000.
      b. CW-2: Arcadia; OPG6000.
      c. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Construction: Thermally broken.
   3. Glazing: Refer to Architectural drawings for types.
      a. See Section 08 8000 - Glazing, for additional information.
   4. Outside glazed, with pressure plate and mullion cover.
   5. Fabrication Method: Shop/factory unitized system.
   6. Glazing Method: Shop/factory glazed system.
   7. Finish: Superior performing organic coatings, compliant with AAMA 2605.
      a. See Section 05 0513 - Shop-Applied Coatings for Metal, for additional information.
      b. Color: See Section 05 0513.
      c. Factory finish surfaces that will be exposed in completed assemblies.
      d. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
      e. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
   8. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   9. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   10. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   11. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
   12. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

1.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.

B. Swing Doors: Glazed aluminum.

1. Manufacturer: Same as aluminum framing system.
2. Construction: Thermally broken.
3. Thickness: 1-3/4 inches.
4. Top Rail: 4 inches wide.
5. Vertical Stiles: Wide stile.
6. Bottom Rail: 10 inches wide.
7. Glazing Stops: Square.
8. Finish: Same as storefront.

C. Glazing: See Section 08 8000.

1.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
   1. Shop prime with products in 05 1200 - Structural Steel Framing.

C. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.

D. Structural Supporting Anchors Attached to Reinforced Concrete Members: Design for welded attachment to weld plates embedded in concrete.

E. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.

F. Metal Flashing: See 07 6200 - Sheet Metal Flashing and Trim.

G. Firestopping: See Section 07 8400.

H. Glazing Sealants: See Section 08 8000 - Glazing for the following:
   1. Weatherseal sealant.
   2. Sill sealant.
   3. Structural sealant.

I. Engineered Transition Flashing Assemblies (ETA): Pre-fabricated flashing transition assemblies for bridging continuously between openings and the adjacent air and vapor weather barrier materials. The ETA shall be designed to absorb thermal movement and wind-loading stresses. Components of the ETA may be shop-applied; the system shall be completed in the field.

J. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

K. Glazing Accessories: See Section 08 8000.

L. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

1.05 FINISHES

A. Shop-Applied Coating Finish: See Section 05 0513 - Shop-Applied Coatings for Metal, for additional information.

1.06 HARDWARE

A. See Section 087100 - Door Hardware.

1.07 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Physical and thermal isolation of glazing from framing members.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing from interior.
   6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

C. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

D. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

E. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.

B. Verify that curtain wall openings and adjoining water-resistive and air barrier seal materials are ready to receive work of this section.

C. Verify that anchorage devices have been properly installed and located.

2.02 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Install firestopping at each floor slab edge.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Pressure Plate Framing: Install glazing and infill panels using exterior dry glazing method; see Section 08 8000.

J. Structural Sealant Glazing (SSG) Adhesive: Install structural sealant glazing adhesive and weatherseal sealant in accordance with manufacturer's instructions.

K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

2.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Owner to engage a qualified testing agency to perform tests and inspections.
   1. Glazed aluminum curtain wall assemblies will be considered defective if they do not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
   4. Submit field quality control reports to Architect.

C. Provide services of curtain wall manufacturer's field representative to observe for proper installation of system and submit report.

D. Tests:
   1. Provide field testing of installed curtain wall system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
   2. Perform a minimum of two tests in each designated area as indicated on drawings.
      a. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
   3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf.
      a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
   4. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 1.57 psf.

2.04 ADJUSTING

A. Adjust operating sash for smooth operation.

2.05 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Remove protective material from pre-finished aluminum surfaces.

C. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.

D. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

2.06 PROTECTION

A. Provide barrier or other delineation to prevent damage to installed Work from subsequent construction activities.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Mechanical door hardware for:
   a. Swinging doors.
   b. Gates.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:
1. Windows
2. Cabinets (casework), including locks in cabinets.
3. Signage
4. Toilet accessories
5. Overhead doors
6. Installation.
7. Rough hardware.
8. Conduit, junction boxes & wiring.
9. Folding partitions, except cylinders where detailed.
10. Sliding aluminum doors, except cylinders where detailed.
11. Access doors and panels, except cylinders where detailed.

C. Related Sections:
1. Division 01 Section “Alternates” for alternates affecting this section.
2. Division 07 Section “Joint Sealants” for sealant requirements applicable to threshold installation specified in this section.
3. Division 09 sections for touchup finishing or refinishing of existing openings modified by this section.
4. Division 13 Section “Radiation Protection” for requirements for lead-lining for door hardware at openings indicated to receive radiation protection. Division 26 sections for connections to electrical power system and for low-voltage wiring.
5. Division 28 sections for coordination with other components of electronic access control system.

1.3 REFERENCES

A. UL - Underwriters Laboratories
1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. ANSI - American National Standards Institute
1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

C. California Code of Regulations
1. Title 24: California Building Standards Code

1.4 SUBMITTALS

A. General:
1. Submit in accordance with Conditions of Contract and Division 01 requirements.

B. Action Submittals:
1. Product Data: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
   a. Wiring Diagrams: For power, signal, and control wiring and including:
      1) Details of interface of electrified door hardware and building safety and security systems.
      2) Schematic diagram of systems that interface with electrified door hardware.
      3) Point-to-point wiring.
      4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
   a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
   a. Door Index; include door number, heading number, and Architects hardware set number.
   b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
   c. Type, style, function, size, and finish of each hardware item.
   d. Name and manufacturer of each item.
   e. Fastenings and other pertinent information.
   f. Location of each hardware set cross-referenced to indications on Drawings.
   g. Explanation of all abbreviations, symbols, and codes contained in schedule.
   h. Mounting locations for hardware.
   i. Door and frame sizes and materials.
   j. Name and phone number for local manufacturer's representative for each product.
   k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
      1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

5. Key Schedule:
   a. Initiate and conduct meeting(s) with Owner representatives and hardware supplier to determine system keyway(s), keybow styles, structure, stamping, degree of physical security and degree of geographic exclusivity. Furnish Owner's written approval of the system; do not order keys or cylinders without written confirmation of actual requirements from the Owner.
   b. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used, and door numbers controlled.
   c. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
   d. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.

e. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
f. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
1) Forward bitting list, key cuts, and key system schematic directly to Owner, by means as directed by Owner.

6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.

C. Informational Submittals:
1. Qualification Data: For Supplier and Installer.
2. Product Certificates for electrified door hardware, signed by manufacturer:
a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
3. Certificates of Compliance:
a. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in “QUALITY ASSURANCE” article, herein.
4. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:
1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Name, address, and phone number of local representative for each manufacturer.
d. Final approved hardware schedule, edited to reflect conditions as installed.
e. Final keying schedule
f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
g. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.5 QUALITY ASSURANCE
A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.
1. Where specific manufacturer’s product is named and accompanied by “Owner Standard,” including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)
a. Where no additional products or manufacturers are listed in product category, requirements for “Owner Standard” govern product selection.
2. Where products indicate “acceptable manufacturers” or “acceptable manufacturers and products”, provide product from specified manufacturers, subject to compliance with specified requirements and “Single Source Responsibility” requirements stated herein.
B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project.
1. Scheduling Responsibility: Preparation of door hardware and keying schedules.
2. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.
D. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.

E. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

F. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
   1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

G. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

H. Means of Egress Doors: Latches do not require more than 5 lbs. (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.

I. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in “REFERENCES” article, herein.
   1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbs. (22.2 N).
   2. Maximum opening-force requirements:
      a. Interior, Non-Fire-Rated Hinged Doors: 5 lbs. (22.2 N) applied perpendicular to door.
      b. Sliding or Folding Doors: 5 lbs. (22.2 N) applied parallel to door at latch.
      c. Fire Doors: The minimum opening force allowable by the appropriate administrative authority, not to exceed 15 lbs. (66.7N).
   3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
   4. Adjust closer so that the time required to move the door from the 90-degree position to 12 degrees from the latch is 5 seconds minimum.

J. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01.
   1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Inspect and discuss preparatory work performed by other trades.
   3. Inspect and discuss electrical roughing-in for electrified door hardware.
   4. Review sequence of operation for each type of electrified door hardware.
   5. Review required testing, inspecting, and certifying procedures.

K. Coordination Conferences:
   1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
      a. Attendees: Door hardware supplier, door hardware installer, Contractor.
      b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.
   2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
      a. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, Owner’s security consultant, Architect and Contractor.
      b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
   1. Deliver each article of hardware in manufacturer's original packaging.
C. Project Conditions:
   1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
   2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
D. Protection and Damage:
   1. Promptly replace products damaged during shipping.
   2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace, or repair products damaged during Work.
   3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
E. Owner to verify how and where permanent cores and keys are to be delivered.

1.7 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
E. Existing Openings:
   1. Prior to submittal, carefully inspect existing conditions to verify finish hardware required to complete Work, including sizes, quantities, existing hardware scheduled for re-use, and sill condition material. If conflict between the specified/scheduled hardware and existing conditions, submit request for direction from Architect. Include date of jobsite visit in the submittal.
   2. Submittals prepared without thorough jobsite visit by qualified hardware expert will be rejected as non-compliant.
F. Direct shipments not permitted, unless approved by Contractor.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
      a. Closers:
         1) Mechanical: 10 years.
      b. Automatic Operator: 2 Years.
      c. Exit Devices:
         1) Mechanical: 3 years.
         2) Electrified: 1 year.
      d. Locksets:
         1) Mechanical: 10 years.
         2) Electrified: 1 year.
      e. Continuous Hinges: Lifetime warranty

f. Key Blanks: Lifetime
2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.9 MAINTENANCE
A. Maintenance Tools:
1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PART 2 - PRODUCTS
2.1 MANUFACTURERS
A. Where “Owner Standard” is noted, submittals and substitution requests for other products will not be considered.
B. Approval of manufacturers and/or products other than those listed as “Scheduled Manufacturer” or “Acceptable Manufacturer” in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
C. Approval of products from manufacturers indicated in “Acceptable Manufacturers” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.
D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
E. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 MATERIALS
A. Fasteners
1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
4. Install hardware with fasteners provided by hardware manufacturer.
B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.3 HINGES
A. Manufacturers and Products:
1. Scheduled Manufacturer and Product: Ives 5BB series
2. Acceptable Manufacturers and Products: Hager BB series, Stanley FBB series.
B. Requirements:

1. Provide five-knuckle ball bearing hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high
4. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins
8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
9. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.
10. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
11. Provide mortar guard for each electrified hinge specified.
12. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

2.4 CONTINUOUS HINGES

A. Aluminum Geared
   1. Manufacturers:
      a. Scheduled Manufacturer: Ives.
      b. Acceptable Manufacturers: Markar, Stanley.
   2. Requirements:
      a. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
      b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum, with 0.25-inch (6 mm) diameter Teflon coated stainless steel hinge pin.
      c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
      d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
      e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
      f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
      g. Install hinges with fasteners supplied by manufacturer.

h. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.5 PIVOT SETS

A. Manufacturers:
   1. Scheduled Manufacturer: Ives
   2. Acceptable Manufacturers: Dorma, Rixson
B. Requirements:
   1. Provide pivot sets complete with oil-impregnated top pivot, unless indicated otherwise.
   2. Where offset pivots are specified, Provide one intermediate pivot for doors less than 91 inches (2311 mm) high and one additional intermediate pivot per leaf for each additional 30 inches (762 mm) in height or fraction thereof. Intermediate pivots spaced equally not less than 25 inches (635 mm) or not more than 35 inches (889 mm) on center, for doors over 121 inches (3073 mm) high.
   3. Provide appropriate model where pivot sets are scheduled at fire rated openings.
   4. Provide lead-lined model where pivot sets are specified at lead-lined doors.
   5. Provide pivots with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electrified pivot nearest to electrified locking component. If manufacturer of electrified locking component requires another device for power transfer, then provide recommended power transfer device and appropriate quantity of pivots.
   6. Provide mortar guard for each electric pivot specified, unless specified in hollow metal frame specification.

2.6 ELECTRIC POWER TRANSFER

A. Manufacturers:
   a. Scheduled Manufacturer: Von Duprin EPT-10
   b. Acceptable Manufacturers: ABH PT1000, Securitron CEPT-10
B. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires sufficient to accommodate electric function of specified hardware.
C. Locate electric power transfer per manufacturer’s template and UL requirements, unless interference with operation of door or other hardware items.

2.7 MORTISE LOCKS

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Schlage L9000 series
   2. Acceptable Manufacturers and Products: Best 45H series, Sargent 8200 series
B. Requirements:
   1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.
   2. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
   3. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
   4. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide a request to exit (RX) switch that is actuated with rotation of inside lever.
      a. UL Listed – 3-hour fire door.
   5. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
      a. Lever Design: As scheduled.

2.8 ALUMINUM DOOR LOCKS

A. Manufacturer and Product:
   1. Scheduled Manufacturer and Product: Adams Rite MS1850 series
   2. Acceptable Manufacturers and Products: Owner Standard.

B. Requirements:
   1. Provide narrow style aluminum door locks as specified. Cylinders: Refer to “KEYING” article, herein.
   2. Provide locks with backset as required for door detail with full 5/8-inch (16 mm) throw latchbolt.
   3. Provide manufacturer’s standard strikes unless extended lip strikes are necessary to protect trim.

2.9 FLUSH BOLTS

A. Manufacturers:
   1. Scheduled Manufacturer: Ives
   2. Acceptable Manufacturers: DonJo, Trimco

B. Requirements:
   1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.10 COORDINATORS

A. Manufacturers:
   1. Scheduled Manufacturer: Ives
   2. Acceptable Manufacturers: Rockwood, Trimco

B. Requirements:
   1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
   2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers and surface vertical rod exit device strikes. Factory-prep coordinators for vertical rod devices if required.

2.11 MORTISE LOCKS

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Schlage L9000 series
   2. Acceptable Manufacturers and Products: Best 45H series, Sargent 8200 series

B. Requirements:
   1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.
   2. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
   3. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
      a. UL Listed – 3-hour fire door.
   4. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
      a. Lever Design: As scheduled.

2.12 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Schlage ND Series
   2. Acceptable Manufacturers and Products: Sargent 11-Line, Best 9K Series.

B. Requirements:
   1. Provide cylindrical locks conforming to the following standards and requirements:
      a. ANSI/BHMA A156.2 Series 4000, Grade 1.
      b. UL 10C for 4’-0” x 10’-0” 3-hour fire door.
   2. Cylinders: Refer to “KEYING” article, herein.
   3. Provide cylindrical locksets exceeding the ANSI/BHMA A156.2 Grade 1 performance standards for strength, security, and durability in the categories below:
      a. Abusive Locked Lever Torque Test – minimum 3,100 inch-pounds without gaining access
      b. Cycle life - tested to minimum 10 million cycles per ANSI/BHMA A156.2 Cycle Test with no visible lever sag or use of performance aids such as set screws or spacers.
   4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
   5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
   6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
   7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
   8. Provide electrified options as scheduled in the hardware sets.
   9. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
      a. Lever Design: As scheduled.
      b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.13 EXIT DEVICES

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Von Duprin 98/35 series
   2. Acceptable Manufacturers and Products: Sargent 8000 Series, Precision Apex series

B. Requirements:
   1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to “KEYING” article, herein.
   2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
   3. Touchpad: Extend minimum of one half of door width. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. No plastic inserts are allowed in touchpads.
   4. Provide exit devices with dead-latching feature for security and for future addition of alarm kits and/or other electrified requirements.
   5. Provide flush end caps for exit devices.
   6. Provide exit devices with manufacturer’s approved strikes.
   7. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
   8. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
   9. Provide cylinder dogging at non-fire-rated exit devices.
   10. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
   11. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
      a. Lever Style: Match lever style of locksets.

12. Accessibility: Maximum 5lbs force to retract latch bolt per CBC Chapter 11B.
    "AX" feature: touchpad directly retracts the latchbolt with 5 lbs. or less of force. Provide testing lab certification confirming that the mechanical device is independent third-party tested to meet this 5 lbs. requirement.
13. Provide UL labeled fire exit hardware for fire rated openings.
14. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and were noted in hardware sets.
15. Provide electrified options as scheduled.

2.14 POWER SUPPLIES

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Schlage or Von Duprin PS900 series
   2. Acceptable Manufacturers and Products: Precision ELR series, Sargent 3500 series, Securitron BPS series.
B. Requirements:
   1. Provide power supplies, recommended and approved by manufacturer of electrified locking component, for operation of electrified locks, electrified exit devices, magnetic locks, electric strikes, and other components requiring power supply.
   2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
   3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
   4. Options:
      a. Provide power supply, where specified, with internal capability of charging sealed backup batteries 24 VDC, in addition to operating DC load.
      b. Provide sealed batteries for battery back-up at each power supply where specified.
      c. Provide keyed power supply cabinet.
   5. Provide power supply in an enclosure, complete, and requiring 120VAC to fused input.
   6. Provide power supply with emergency release terminals, where specified, that allow release of all devices upon activation of fire alarm system complete with fire alarm input for initiating "no delay" exiting mode.

2.15 CYLINDERS

A. Manufacturers:
   1. Scheduled Manufacturer: Schlage and as per Owner.
   2. Acceptable Manufacturers: TBD by Owner, to match existing.
B. Requirements:
   1. cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.
   2. Replaceable Construction Cores:
      a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
         1) 3 construction control keys
         2) 12 construction change (day) keys.
      b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2.16 KEYING

A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Provide cylinders/cores keyed into Owner's existing factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
C. Requirements:
   1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      a. Master Keying system as directed by the Owner.
   2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.
   3. Provide keys with the following features:
      a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
      b. Identification stamping provisions must be approved by the Architect and Owner.
   4. Identification:
      a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Blind code marks shall not include actual key cuts.
      b. Identification stamping provisions must be approved by the Architect and Owner.
      c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
      d. Failure to comply with stamping requirements shall be cause for replacement of keys involved at no additional cost to Owner.
      e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
   5. Quantity: Furnish in the following quantities.
      a. Change (Day) Keys: 3 per cylinder/core.
      b. SFIC Permanent Control Keys: 3.
      c. Master Keys: 6.

2.17 KEY CONTROL SYSTEM

A. Manufacturers:
   1. Scheduled Manufacturer: Telkee
   2. Acceptable Manufacturers: HPC, Lund
B. Requirements:
   1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
      a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
      b. Provide hinged-panel type cabinet for wall mounting.

2.18 DOOR CLOSERS

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: LCN 4040XP series.
   2. Acceptable Manufacturers and Products: Sargent 281 series.
B. Requirements:
   1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certifies closers. Stamp units with date of manufacture code.
   2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.

3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117 or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.19 ELECTRO-MECHANICAL AUTOMATIC OPERATORS

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: LCN Senior Swing 9500 Series
   2. Acceptable Manufacturers and Products: Besam SW200i, Horton 4000LE series
B. Requirements:
   1. Provide low energy automatic operator units that are electro-mechanical design complying with ANSI/BHMA A156.19.
      a. Opening: Powered by DC motor working through reduction gears.
      b. Closing: Spring force.
      c. Manual, hydraulic, or chain drive closers: Not permitted.
      d. Operation: Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Provide variable adjustments, including opening and closing speed adjustment.
      e. Cover: Aluminum.
   2. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 2 to 30 seconds, and logic terminal to interface with accessories, mats, and sensors.
   3. Provide drop plates, brackets, or adapters for arms as required to suit details.
   4. Provide hard-wired motion sensors and/or actuator switches for operation as specified. Provide weather-resistant actuators at exterior applications.
   5. Provide key switches, with LED’s, recommended and approved by manufacturer of automatic operator as required for function as described in operation description of hardware sets. Cylinders: Refer to “KEYING” article, herein.
   6. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.
   7. Provide units with inputs for smoke evacuation doors, where specified, which allow doors to power open upon fire alarm activation and hold open indefinitely or until fire alarm is reset, presence detector input, which prevents closed door from opening or door that is fully opened from closing, hold open toggle input, which allows remote activation for indefinite hold open and close second time input is activated, vestibule inputs, which allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.20 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Hager, Trimco.

B. Requirements:

1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back-to-back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.21 PROTECTION PLATES

A. Manufacturers:
1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Hager, Trimco

B. Requirements:
1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs.
b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs.
c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.22 DOOR STOPS AND HOLDERS

A. Manufacturers:
1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Hager, Trimco

B. Provide door stops at each door leaf:
1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.23 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: Zero International
2. Acceptable Manufacturers: National Guard, Trimco.

B. Requirements:
1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Size of thresholds:
a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width.
b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.24 SILENCERS

A. Manufacturers:
1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

B. Requirements:
1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.25 MAGNETIC HOLDERS

A. Manufacturers:
1. Scheduled Manufacturer: LCN
2. Acceptable Manufacturers: Rixson, Sargent

B. Requirements:
1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordinate projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Connect magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.26 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match, 689.
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Where on-site modification of doors and frames is required:
    1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
    2. Field modifies and prepare existing door and frame for new hardware being installed.
    3. When modifications are exposed to view, use concealed fasteners, when possible.
    4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
        a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
        b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
        c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
    1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
    2. Custom Steel Doors and Frames: HMMA 831.
    3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
B. Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.
C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
    1. Replace construction cores with permanent cores as indicated in keying section.

J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.
L. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
M. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
   1. Coordination: Coordinate provision with the security systems provider to mitigate excessive or redundant purchase.
   2. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
N. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
O. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard. Locate no more than 4 inches from walls.
P. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
Q. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
R. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
   1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
   2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
   3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.
B. Clean operating items as necessary to restore proper function and finish.
C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.7 DOOR HARDWARE SCHEDULE

A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type, and function. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

B. Do not order material until submittal has been reviewed, stamped, and signed by hardware consultant.
C. Hardware Sets: See Hardware sets below.

120722
Version

Legend:
Link to

Opening

01

For use

100A

Abbreviation	Name
ADA	Adams Rite Manufacturing Co
B/O	By Others
GLY	Glynn-Johnson Corp
IVE	H.B. Ives
KEE	Keedex Inc
LCN	LCN Commercial Division
LOX	Locinox
SCE	Schlage Electronic Security
SCH	Schlage Lock Company
TBD	Manufacturer To Be Determined
VON	Von Duprin
ZER	Zero International Inc

OPT0392674
4

catalog cut sheet
Electrified

Hardware Group No.

on Door #(s):

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	PANIC HARDWARE	CDSI-9849-EO		626	VON
1	EA	PANIC HARDWARE	CDSI-9849-L-NL-06		626	VON
2	EA	SFIC MORTISE CYLINDER	80-132 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
3	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	SURF. AUTO OPERATOR	9550 SERIES AS REQ'D (120/240 VAC)	✓	ANCLR	LCN
2	EA	ACTUATOR KIT	8310-3836T EXTERIOR		689	LCN
1	EA	RAIN DRIP	142A (OMIT IF SHELTERED)		AA	ZER
1	SET	MEETING STILE	326AA-S		AA	ZER
1	SET	GASKETING	429AA-S		AA	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED)		A	ZER
1	EA	WIRED ALARM	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR	✓		B/O

*INSTALL DOOR SEAL BEFORE CLOSERS AND PANIC STRIKE.
*ALARM BY SECURITY CONTRACTOR.
*COORDINATION ITEMS: POWER/CONDUIT/WIRING/ALARM/ ACCESS CONTROL SYSTEM.

Hardware Group No. 02

For use on Door #(s):
213A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5			652	IVE
2	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	ELEC PANIC HARDWARE	RX-AX-9850WDC-EO-LBL-CON-SNB			626	VON
1	EA	ELEC PANIC HARDWARE	RX-AX-9850WDC-L-M996-17-FSE-LBL-CON-SNB			626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT			626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY			626	TBD
2	EA	SURFACE CLOSER	4040XP HEDA WMS			689	LCN
2	EA	FLUSH CEILNG MTG PLATE	4040XP-18G WMS (AS REQ'D)			689	LCN
2	EA	BLADE STOP SPACER	4040XP-61 WMS (AS REQ'D)			689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS			630	IVE
2	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)			630	IVE
1	SET	MEETING STILE	326AA-S			AA	ZER
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE			TBD	B/O
2	EA	WIRE HARNESS (DOOR)	CON XX-XX				VON
2	EA	WIRE HARNESS (FRAME)	CON-6W				VON
2	EA	DOOR CONTACT	679-05			BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC COORDINATE W/ SECURITY CONTRACTOR				VON
1	EA	CARD/ CREDENTIAL READER	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR				B/O

*COORDINATION ITEMS: POWER/ CONDUIT/ WIRING/ ELECTRONIC SECURITY SYSTEM.
*ALL ACCESS CONTROL EQUIPMENT, DIAGRAMS, DOOR CONTACT, WIRING DOOR AND FRAME CONNECTOR BY SECURITY CONTRACTOR.
*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.

OPERATION DESCRIPTION:
DOOR IS NORMALLY CLOSED AND LOCKED.
DOOR ACCESS THROUGH VALID CREDENTIALS/ KEY, OR SCHEDULED HOURS. UPON POWER INTERRUPTION, THE DOOR IS CLOSED AND LOCKED.
DOOR ALWAYS FREE FOR IMMEDIATE EGRESS.

Hardware Group No. 03

For use on Door #(s):
108

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1HW 5 X 4.5 NRP		630	IVE
2	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC PANIC HARDWARE	RX-9849-EO-CON		626	VON
1	EA	ELEC PANIC HARDWARE	RX-9849-L-M996-17-FSE-CON		626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
2	EA	SURFACE CLOSER	4040XP SCUSH PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES (AS REQ'D).		689	LCN
2	EA	ARMOR PLATE	8400 34" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142A (OMIT IF SHELTERED)		AA	ZER
1	SET	MEETING STILE	326AA-S		AA	ZER
1	SET	GASKETING	429AA-S		AA	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED)		A	ZER
2	EA	WIRE HARNESS (DOOR)	CON XX-XX			VON
2	EA	WIRE HARNESS (FRAME)	CON-6W			VON
2	EA	DOOR CONTACT	679-05		BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC COORDINATE W/ SECURITY CONTRACTOR			VON
1	EA	CARD/ CREDENTIAL READER	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR			B/O

*COORDINATION ITEMS: POWER/ CONDUIT/ WIRING/ ELECTRONIC SECURITY SYSTEM.
*ACCESS CONTROL EQUIPMENT, DIAGRAMS, DOOR CONTACT, WIRING DOOR AND FRAME CONNECTOR BY SECURITY CONTRACTOR.
*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.
*INSTALL DOOR SEAL BEFORE CLOSER AND PANIC DEVICE STRIKE.

OPERATION DESCRIPTION:
DOOR IS NORMALLY CLOSED AND LOCKED.
DOOR ACCESS THROUGH VALID CREDENTIALS/ KEY, OR SCHEDULED HOURS. UPON POWER INTERRUPTION, THE DOOR IS CLOSED AND LOCKED.
DOOR ALWAYS FREE FOR IMMEDIATE EGRESS.

Hardware Group No. 04

For use on Door #(s):
201

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1HW 5 X 4.5		652	IVE
1	EA	FIRE EXIT HARDWARE	AX-9447-EO-F		626	VON
1	EA	FIRE EXIT HARDWARE	AX-9447-L-F-17		626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
2	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)		689	LCN
2	EA	FIRE/LIFE WALL MAG	SEM 7800 SERIES	✓	689	LCN
1	EA	GASKETING	188SGY PSA		Gy	ZER
1	SET	MEETING STILE	326AA-S		AA	ZER
2	EA	DOOR BOTTOM	355AA		AA	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED) (AS REQ'D)		A	ZER

*WIRE MAGNETIC-HOLDER INTO THE SMOKE/FIRE ALARM SYSTEM FOR IMMEDIATE RELEASE UPON ACTIVATION.
*VERIFY HARDWARE COMPATITABILITY WITH DOOR MFG./ SUPPLIER.

Hardware Group No. 05

For use on Door #(s):
407.12

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5			652	IVE
2	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	ELEC PANIC HARDWARE	RX-AX-9849-EO-LBL-CON			626	VON
1	EA	ELEC PANIC HARDWARE	RX-AX-9849-L-M996-17-FSE-LBL-CON-			626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT			626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY			626	TBD
1	EA	SURFACE CLOSER	4040XP SCUSH PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES (AS REQ'D).			689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS			630	IVE
1	EA	GASKETING	188SGY PSA			Gy	ZER
1	SET	MEETING STILE	326AA-S			AA	ZER
2	EA	WIRE HARNESS (DOOR)	CON XX-XX				VON
2	EA	WIRE HARNESS (FRAME)	CON-6W				VON
2	EA	DOOR CONTACT	679-05			BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC COORDINATE W/ SECURITY CONTRACTOR				VON
1	EA	CARD/ CREDENTIAL READER	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR				B/O

*COORDINATION ITEMS: POWER/ CONDUIT/ WIRING/ ELECTRONIC SECURITY SYSTEM.
*ACCESS CONTROL EQUIPMENT, DIAGRAMS, DOOR CONTACT, WIRING DOOR AND FRAME CONNECTOR BY SECURITY CONTRACTOR.
*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.

OPERATION DESCRIPTION:
DOOR IS NORMALLY CLOSED AND LOCKED.
DOOR ACCESS THROUGH VALID CREDENTIALS/ KEY, OR SCHEDULED HOURS. UPON POWER INTERRUPTION, THE DOOR IS CLOSED AND LOCKED.
DOOR ALWAYS FREE FOR IMMEDIATE EGRESS.

Hardware Group No. 06

For use on Door #(s):
101B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP			630	IVE
1	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	ELEC PANIC HARDWARE	RX-AX-98-L-M996-17-FSE-CON			626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT			626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY			626	TBD
1	EA	SURFACE CLOSER	4040XP SCUSH PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES (AS REQ'D).			689	LCN
1	EA	RAIN DRIP	142A (OMIT IF SHELTERED)			AA	ZER
1	SET	GASKETING	429AA-S			AA	ZER
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED)			A	ZER
1	EA	WIRE HARNESS (DOOR)	CON XX-XX				VON
1	EA	WIRE HARNESS (FRAME)	CON-6W				VON
1	EA	DOOR CONTACT	679-05			BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC COORDINATE W/ SECURITY CONTRACTOR				VON
1	EA	CARD/ CREDENTIAL READER	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR				B/O

*COORDINATION ITEMS: POWER/ CONDUIT/ WIRING/ ELECTRONIC SECURITY SYSTEM.
*ACCESS CONTROL EQUIPMENT, DIAGRAMS, DOOR CONTACT, WIRING DOOR AND FRAME CONNECTOR BY SECURITY CONTRACTOR.
*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.
*INSTALL DOOR SEAL BEFORE CLOSER.

OPERATION DESCRIPTION:
DOOR IS NORMALLY CLOSED AND LOCKED.
DOOR ACCESS THROUGH VALID CREDENTIALS/ KEY, OR SCHEDULED HOURS. UPON POWER INTERRUPTION, THE DOOR IS CLOSED AND LOCKED.
DOOR ALWAYS FREE FOR IMMEDIATE EGRESS.

Hardware Group No. 07

For use on Door #(s):
141

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP			630	IVE
1	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-AX-98-L-F-M996-17-FSE-CON			626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT			626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY			626	TBD
1	EA	SURFACE CLOSER	4040XP SCUSH PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES (AS REQ'D).			689	LCN
1	EA	RAIN DRIP	142A (OMIT IF SHELTERED)			AA	ZER
1	SET	GASKETING	429AA-S			AA	ZER
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED)			A	ZER
1	EA	WIRE HARNESS (DOOR)	CON XX-XX				VON
1	EA	WIRE HARNESS (FRAME)	CON-6W				VON
1	EA	DOOR CONTACT	679-05			BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC COORDINATE W/ SECURITY CONTRACTOR				VON
1	EA	CARD/ CREDENTIAL READER	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR				B/O

*COORDINATION ITEMS: POWER/ CONDUIT/ WIRING/ ELECTRONIC SECURITY SYSTEM.
*ACCESS CONTROL EQUIPMENT, DIAGRAMS, DOOR CONTACT, WIRING DOOR AND FRAME CONNECTOR BY SECURITY CONTRACTOR.
*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.
*INSTALL DOOR SEAL BEFORE CLOSER.

OPERATION DESCRIPTION:
DOOR IS NORMALLY CLOSED AND LOCKED.
DOOR ACCESS THROUGH VALID CREDENTIALS/ KEY, OR SCHEDULED HOURS. UPON POWER INTERRUPTION, THE DOOR IS CLOSED AND LOCKED.
DOOR ALWAYS FREE FOR IMMEDIATE EGRESS.

Hardware Group No. 08

For use on Door #(s):
241 341 441 541

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PANIC HARDWARE	AX-98-L-17		626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)		689	LCN
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	EA	RAIN DRIP	142A (OMIT IF SHELTERED)		AA	ZER
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED)		A	ZER

*INSTALL FRAME SEAL BEFORE CLOSER.

Hardware Group No. 09

For use on Door #(s):
407.13

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5			652	IVE
1	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	ELEC PANIC HARDWARE	RX-AX-98-L-M996-17-FSE-CON			626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT			626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY			626	TBD
1	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)			689	LCN
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)			630	IVE
1	EA	GASKETING	188SGY PSA			Gy	ZER
1	EA	WIRE HARNESS (DOOR)	CON XX-XX				VON
1	EA	WIRE HARNESS (FRAME)	CON-6W				VON
1	EA	DOOR CONTACT	679-05			BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC COORDINATE W/ SECURITY CONTRACTOR				VON
1	EA	CARD/ CREDENTIAL READER	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR				B/O

*COORDINATION ITEMS: POWER/ CONDUIT/ WIRING/ ELECTRONIC SECURITY SYSTEM.
*ACCESS CONTROL EQUIPMENT, DIAGRAMS, DOOR CONTACT, WIRING DOOR AND FRAME CONNECTOR BY SECURITY CONTRACTOR.
*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.
*INSTALL DOOR SEAL BEFORE CLOSER.

OPERATION DESCRIPTION:
DOOR IS NORMALLY CLOSED AND LOCKED.
DOOR ACCESS THROUGH VALID CREDENTIALS/ KEY, OR SCHEDULED HOURS. UPON POWER INTERRUPTION, THE DOOR IS CLOSED AND LOCKED.
DOOR ALWAYS FREE FOR IMMEDIATE EGRESS.

Hardware Group No. 10

For use on Door #(s):
100B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC PANIC HARDWARE	RX-AX-98-L-M996-17-FSE-CON		626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	SURFACE CLOSER	4040XP SCUSH PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES (AS REQ'D).		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	188SGY PSA		Gy	ZER
1	EA	WIRE HARNESS (DOOR)	CON XX-XX			VON
1	EA	WIRE HARNESS (FRAME)	CON-6W			VON
1	EA	DOOR CONTACT	679-05		BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC COORDINATE W/ SECURITY CONTRACTOR			VON
1	EA	CARD/ CREDENTIAL READER	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR			B/O

*COORDINATION ITEMS: POWER/ CONDUIT/ WIRING/ ELECTRONIC SECURITY SYSTEM.
*ACCESS CONTROL EQUIPMENT, DIAGRAMS, DOOR CONTACT, WIRING DOOR AND FRAME CONNECTOR BY SECURITY CONTRACTOR.
*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.
*INSTALL DOOR SEAL BEFORE CLOSER.

OPERATION DESCRIPTION:
DOOR IS NORMALLY CLOSED AND LOCKED.
DOOR ACCESS THROUGH VALID CREDENTIALS/ KEY, OR SCHEDULED HOURS. UPON POWER INTERRUPTION, THE DOOR IS CLOSED AND LOCKED.
DOOR ALWAYS FREE FOR IMMEDIATE EGRESS.

Hardware Group No. 11

For use on Door #(s):
202B 207.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PANIC HARDWARE	AX-98-L-17		626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 WMS (AS REQ'D)		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE		TBD	B/O

Hardware Group No. 11A

For use on Door #(s):
207.5

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PANIC HARDWARE	AX-98-L-17		626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 WMS (AS REQ'D)		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE		TBD	B/O
1	EA	FINGER GUARD	51A-90 48" (1219MM)		A	ZER
1	EA	FINGER GUARD	951A 36"		A	ZER

Hardware Group No. 12

For use on Door #(s):
107B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-AX-98-L-F-M996-17-FS-CON		626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)		689	LCN
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	EA	GASKETING	188SGY PSA		Gy	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED)		A	ZER
1	EA	WIRE HARNESS (DOOR)	CON XX-XX			VON
1	EA	WIRE HARNESS (FRAME)	CON-6W			VON
1	EA	DOOR CONTACT	679-05		BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC COORDINATE W/ SECURITY CONTRACTOR			VON
1	EA	CARD/ CREDENTIAL READER	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR			B/O

*COORDINATION ITEMS: POWER/ CONDUIT/ WIRING/ ELECTRONIC SECURITY SYSTEM.
*ACCESS CONTROL EQUIPMENT, DIAGRAMS, DOOR CONTACT, WIRING DOOR AND FRAME CONNECTOR BY SECURITY CONTRACTOR.
*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.

OPERATION DESCRIPTION:
DOOR IS NORMALLY CLOSED AND LOCKED.
DOOR ACCESS THROUGH VALID CREDENTIALS/ KEY, OR SCHEDULED HOURS. UPON POWER INTERRUPTION, THE DOOR IS CLOSED AND LATCHED.
DOOR ALWAYS FREE FOR IMMEDIATE EGRESS.

Hardware Group No. 13

For use on Door #(s):

106.2	232.1	232.2	232	336.1	336
436.1	436				

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	FIRE EXIT HARDWARE	AX-98-L-NL-F-17-		626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	SURFACE CLOSER	4040XP PA WMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	EA	GASKETING	188SGY PSA		Gy	ZER

Hardware Group No. 14

For use on Door #(s):

501

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP		630	IVE
1	EA	FIRE EXIT HARDWARE	AX-98-L-NL-F-17-		626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	SURFACE CLOSER	4040XP SCUSH PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES (AS REQ'D).		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142A (OMIT IF SHELTERED)		AA	ZER
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED)		A	ZER

*INSTALL FRAME SEAL BEFORE CLOSER.

Hardware Group No. 15

For use on Door #(s):
342 442

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	FIRE EXIT HARDWARE	AX-98-L-BE-F-17-		626	VON
1	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)		689	LCN
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	EA	GASKETING	188SGY PSA		Gy	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED)		A	ZER

Hardware Group No. 16

For use on Door #(s):
106A 106B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	CONST LATCHING BOLT SET	FB51P 24"		630	IVE
1	EA	DUST PROOF STRIKE	DP1/ DP2 (AS REQ'D)		626	IVE
1	EA	STOREROOM LOCK	L9080HD 17A VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	COORDINATOR	COR X FL X MB/MBF		628	IVE
2	EA	SURFACE CLOSER	4040XP HEDA WMS		689	LCN
4	EA	ARMOR PLATE	8400 34" X 1" LDW B-CS EGRESS SIDE		630	IVE
2	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	EA	ASTRAGAL	44STST		STST	ZER
2	EA	SILENCER	SR64		GRY	IVE

*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.

Hardware Group No. 17

For use on Door #(s):
213D

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CONST LATCHING BOLT SET	FB51P 24"		630	IVE
1	EA	DUST PROOF STRIKE	DP1/ DP2 (AS REQ'D)		626	IVE
1	EA	STOREROOM LOCK	L9080HD 17A VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	COORDINATOR	COR X FL X MB/MBF		628	IVE
2	EA	OH STOP	90S		630	GLY
2	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)		689	LCN
4	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	ASTRAGAL	44STST		STST	ZER
2	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 18

For use on Door #(s):

106.1	106.4	106.5	107A	212C	212D
334	407.11	434			

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080HD 17A VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	EA	GASKETING	188SGY PSA (OR BY FRAME MFG.)		Gy	ZER

Hardware Group No. 18A

For use on Door #(s):
110

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	L9070HD 17A VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	EA	GASKETING	188SGY PSA (OR BY FRAME MFG.)		Gy	ZER

Hardware Group No. 18B

For use on Door #(s):
213.4

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	L9070HD 17A VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	EA	GASKETING	188SGY PSA (OR BY FRAME MFG.)		Gy	ZER
1	EA	DOOR BOTTOM	360AA (AS REQ'D)		AA	ZER

Hardware Group No. 20

For use on Door #(s):
105

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080HD 17A VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	SURFACE CLOSER	4040XP SCUSH PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES (AS REQ'D).		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 21

For use on Door #(s):
111

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080HD 17A VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)		689	LCN
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	EA	RAIN DRIP	142A (OMIT IF SHELTERED)		AA	ZER
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED)		A	ZER

*FOR ELECTRICAL ROOMS: IF CONTAINED EQUIPMENT LOAD EXCEEDS 600V/ 800 AMPS, DOOR SHALL RECIEVE EXIT DEVICE TO MEET NFPA 70 REQUIRMENTS.
*INSTALL FRAME SEAL BEFORE CLOSER.

Hardware Group No. 22

For use on Door #(s):

205	206	304.2	304.3	304.4	406.1
406.2	406.3	406.4	407.2	407.5	407.6
407.7	407.8	407.10			

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50HD SPA VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE		TBD	B/O

Hardware Group No. 23

For use on Door #(s):

407.1	407.3

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	SET	HINGES/ CAM LIFT HINGES/ PIVOTS	BY SPECIALITY DOOR MFG./ SUPPLIER X (QTY AS REQ'D)		TBD	B/O
1	EA	CONST LATCHING BOLT SET	FB51P 24"		630	IVE
2	EA	DUST PROOF STRIKE	DP1/ DP2 (AS REQ'D)		626	IVE
1	EA	CLASSROOM LOCK W/ OUTSIDE INDICATOR	L9070HD 17A OS-LOC VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	COORDINATOR	COR X FL X MB/MBF		628	IVE
1	EA	OH STOP	90S		630	GLY
2	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-NH-A		630	IVE
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	EA	DOOR BOTTOM	BY SPECIALTY DOOR MFG./SUPPLIER		AA	B/O
1	EA	GASKETING AND SEAL (FRAME HEADER AND JAMBS)	BY SPECIALTY DOOR MFG./SUPPLIER FINISH TO MATCH DOOR HARDWARE			B/O
1	SET	ASTRAGAL	BY SPECIALTY DOOR MFG./SUPPLIER		TBD	B/O
1	EA	THRESHOLD	BY SPECIALTY DOOR MFG./SUPPLIER		TBD	B/O

*PLEASE CONFIRM COMPATIBILITY OF SPECIFIED HARDWARE WITH SPECIALTY STC DOOR MFG./ SUPPLIER TO ACHEIVE REQUIRED STC RATING.
*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.

Hardware Group No. 24

For use on Door #(s):
201.5 304.1 335 406 435

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5			652	IVE
1	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	EU MORTISE LOCK	L9092HDEU 17A RX CON 12/24 VDC VERIFY KEY SYSTEM FORMAT			626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY			626	TBD
1	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)			689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS			630	IVE
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)			630	IVE
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE			TBD	B/O
1	EA	WIRE HARNESS (DOOR)	CON XX-XX				VON
1	EA	WIRE HARNESS (FRAME)	CON-6W				VON
1	EA	DOOR CONTACT	679-05			BLK	SCE
1	EA	CARD/ CREDENTIAL READER	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR				B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR				B/O

*COORDINATION ITEMS: POWER/ CONDUIT/ WIRING/ ELECTRONIC SECURITY SYSTEM.
*ACCESS CONTROL EQUIPMENT, DIAGRAMS, DOOR CONTACT, WIRING DOOR AND FRAME CONNECTOR BY SECURITY CONTRACTOR.
*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.

OPERATION DESCRIPTION:
DOOR IS NORMALLY CLOSED AND LOCKED.
DOOR ACCESS THROUGH VALID CREDENTIALS/ KEY, OR SCHEDULED HOURS. UPON POWER INTERRUPTION, THE DOOR IS CLOSED AND LOCKED.
DOOR ALWAYS FREE FOR IMMEDIATE EGRESS.

Hardware Group No. 25

For use on Door #(s):
106C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080HD 17A VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	SURFACE CLOSER	4040XP SCUSH PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES (AS REQ'D).		689	LCN
1	EA	ARMOR PLATE	8400 34" X 2" LDW B-CS EGRESS SIDE		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.

Hardware Group No. 26

For use on Door #(s):

102	103	104	207.6	207.7	207.8
207.9	213.2	213.3	330	331	335.1
407.9	430	431	435.1		

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		630	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR W/ INSIDE INDICATOR	L9040 17A L583-363 OS-OCC IS-LOC		626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS		630	IVE
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	EA	GASKETING	188SGY PSA (OR BY FRAME MFG./ SUPPLIER)		Gy	ZER
1	EA	COAT AND HAT HOOK	571 (ADD 1 @ 42" FOR ADA REQ'D)		626	IVE

Hardware Group No. 27

For use on Door #(s):
109 407.4

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	L9010 17A		626	SCH
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 28

For use on Door #(s):
101.1 101.2 230 231 332 333
432 433

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5		630	IVE
1	EA	PUSH PLATE	8200 4" X 16"		630	IVE
1	EA	PULL PLATE	8302 10" 4" X 16"		630	IVE
1	EA	SURFACE CLOSER	4040XP REG OR PA (AS REQ'D)		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS		630	IVE
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	EA	GASKETING	188SGY PSA		Gy	ZER

Hardware Group No. AL-01

For use on Door #(s):
213B 213C

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	PIVOT SET	7215 SET (TOP AND BOTTOM)		626	IVE
4	EA	INTERMEDIATE PIVOT	7215 INT (QTY AS REQUIRED)		626	IVE
1	EA	PANIC HARDWARE	3549A-EO		626	VON
1	EA	PANIC HARDWARE	3549A-T-360T		626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
2	EA	90 DEG OFFSET PULL	8190EZHD 12"		630-316	IVE
1	EA	SURFACE CLOSER	4040XP PA WMS FOR WALL ADJACENT LEAF		689	LCN
1	EA	SURFACE CLOSER	4040XP SCUSH PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES (AS REQ'D).		689	LCN
2	EA	FLUSH CEILNG MTG PLATE	4040XP-18G WMS (AS REQ'D)		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 WMS (AS REQ'D)		689	LCN
2	EA	BLADE STOP SPACER	4040XP-61 WMS (AS REQ'D)		689	LCN
1	EA	FLOOR STOP	FS18S/FS18L		BLK	IVE
1	EA	RAIN DRIP	142A (OMIT IF SHELTERED)		AA	ZER
1	SET	MEETING STILE	326AA-S (OR BY DOOR MFG./ SUPPLIER)		AA	ZER
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE		TBD	B/O
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED)		A	ZER

*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.
*INSTALL FRAME SEAL BEFORE CLOSER AND PANIC STRIKE.
*DOORS TO OUTSWING FROM COMMUNITY ROOM TO OUTDOOR CIRCULATION.
*COORDINATE REQUIRED DOOR CONTACTS, SUPPLIED BY SECURITY CONTRACTOR.

Hardware Group No. AL-02

For use on Door #(s):
101A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	PIVOT SET	7215 SET (TOP AND BOTTOM)		626	IVE
4	EA	INTERMEDIATE PIVOT	7215 INT (QTY AS REQUIRED)		626	IVE
1	EA	PANIC HARDWARE	AX-3549A-EO-LBL		626	VON
1	EA	PANIC HARDWARE	AX-3549A-T-360T-LBL		626	VON
1	EA	SFIC MORTISE CYLINDER	80-132 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
2	EA	90 DEG OFFSET PULL	8190EZHD 12"		630-316	IVE
2	EA	SURFACE CLOSER	4040XP SHCUSH WMS PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES (AS REQ'D).		689	LCN
2	EA	FLUSH CEILNG MTG PLATE	4040XP-18G WMS (AS REQ'D)		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 WMS (AS REQ'D)		689	LCN
2	EA	BLADE STOP SPACER	4040XP-61 WMS (AS REQ'D)		689	LCN
1	SET	MEETING STILE	326AA-S (OR BY DOOR MFG./ SUPPLIER)		AA	ZER
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE		TBD	B/O

*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.
*TEMPLATE DOOR CLOSER TO 110 DEGREES (AS REQ’D).

Hardware Group No. AL-03

For use on Door #(s):
201.3

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	PIVOT SET	7215 SET (TOP AND BOTTOM)		626	IVE
1	EA	INTERMEDIATE PIVOT	7215 INT (QTY AS REQUIRED)		626	IVE
1	EA	POWER TRANSFER	EPT10 CON	✓	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-AX-35A-NL-OP-388-CON	✓	626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	90 DEG OFFSET PULL	8190EZHD 12"		630-316	IVE
1	EA	SURFACE CLOSER	4040XP PA WMS		689	LCN
1	EA	FLUSH CEILNG MTG PLATE	4040XP-18G WMS (AS REQ'D)		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 WMS (AS REQ'D)		689	LCN
1	EA	FLOOR STOP	FS18S/FS18L		BLK	IVE
1	EA	RAIN DRIP	142A (OMIT IF SHELTERED)		AA	ZER
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE		TBD	B/O
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED)		A	ZER
1	EA	WIRE HARNESS (DOOR)	CON XX-XX			VON
1	EA	WIRE HARNESS (FRAME)	CON-6W			VON
1	EA	DOOR CONTACT	7764	✓	628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC COORDINATE W/ SECURITY CONTRACTOR	✓		VON
1	EA	CARD/ CREDENTIAL READER	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR	✓		B/O

*COORDINATION ITEMS: POWER/ CONDUIT/ WIRING/ ELECTRONIC SECURITY SYSTEM.
*ACCESS CONTROL EQUIPMENT, DIAGRAMS, DOOR CONTACT, WIRING DOOR AND FRAME CONNECTOR BY SECURITY CONTRACTOR.
*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.

OPERATION DESCRIPTION:
DOOR IS NORMALLY CLOSED AND LOCKED.
DOOR ACCESS THROUGH VALID CREDENTIALS/ KEY, OR SCHEDULED HOURS. UPON POWER INTERRUPTION, THE DOOR IS CLOSED AND LOCKED.
DOOR ALWAYS FREE FOR IMMEDIATE EGRESS.

Hardware Group No. AL-04

For use on Door #(s):
202A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	PIVOT SET	7215 SET (TOP AND BOTTOM)		626	IVE
4	EA	INTERMEDIATE PIVOT	7215 INT (QTY AS REQUIRED)		626	IVE
2	EA	PUSH/PULL BAR	9103EZHD-12"		630-316	IVE
2	EA	SURFACE CLOSER	4040XP SHCUSH WMS PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES (AS REQ'D).		689	LCN
2	EA	FLUSH CEILNG MTG PLATE	4040XP-18G WMS (AS REQ'D)		689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30 WMS (AS REQ'D)		689	LCN
2	EA	BLADE STOP SPACER	4040XP-61 WMS (AS REQ'D)		689	LCN
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE		TBD	B/O
1	SET	MEETING STILE	BY DOOR MFG./SUPPLIER		TBD	B/O

*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.

Hardware Group No. AL-05

For use on Door #(s):
207.3 300 404

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	EA	PIVOT SET	7215 SET (TOP AND BOTTOM)			626	IVE
1	EA	INTERMEDIATE PIVOT	7215 INT (QTY AS REQUIRED)			626	IVE
1	EA	PANIC HARDWARE	AX-35A-NL-OP-388			626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT			626	SCH
1	EA	90 DEG OFFSET PULL	8190EZHD 12"			630-316	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES (AS REQ'D).			689	LCN
1	EA	FLUSH CEILNG MTG PLATE	4040XP-18G WMS (AS REQ'D)			689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 WMS (AS REQ'D)			689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 WMS (AS REQ'D)			689	LCN
1	EA	RAIN DRIP	142A (OMIT IF SHELTERED)			AA	ZER
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE			TBD	B/O
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED)			A	ZER
1	EA	DOOR CONTACT	7764		✓	628	SCE
1	EA	WIRED ALARM	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR		✓		B/O

*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.

Hardware Group No. AL-06

For use on Door #(s):
208A 212A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		628	IVE
1	EA	PANIC HARDWARE	CDSI-AX-35A-NL-OP-388		626	VON
1	EA	SFIC MORTISE CYLINDER	80-132 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
2	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	90 DEG OFFSET PULL	8190EZHD 12"		630-316	IVE
1	EA	SURFACE CLOSER	4040XP SHCUSH WMS PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES (AS REQ'D).		689	LCN
1	EA	FLUSH CEILNG MTG PLATE	4040XP-18G WMS (AS REQ'D)		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 WMS (AS REQ'D)		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 WMS (AS REQ'D)		689	LCN
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE		TBD	B/O
1	EA	FINGER GUARD	51A-180 48" (1219MM)		A	ZER

*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.

Hardware Group No. AL-07

For use on Door #(s):

204	209	210	211	302A	302B
303	307	308	309	310	311
312	313	314	315	316	317
318	319				

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50HD SPA VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE		TBD	B/O

Hardware Group No. AL-08

For use on Door #(s):
212B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	PIVOT SET	7215 SET (TOP AND BOTTOM)		626	IVE
1	EA	INTERMEDIATE PIVOT	7215 INT (QTY AS REQUIRED)		626	IVE
1	EA	STOREFRONT DEADBOLT, HEADER AND THRESHOLD	MS1850S X 4016 X 4015		628	ADA
1	EA	MORTISE x THUMBTURN CYLINDER	4036 x 4066 VERIFY KEY SYSTEM FORMAT		626	ADA
1	EA	EXIT INDICATOR	4089		130	ADA
1	EA	Header Sign Exit Indicator	20-0256-IP "THIS DOOR TO REMAIN UNLOCKED WHEN THE BUILDING IS OCCUPIED"		TBD	B/O
1	EA	90 DEG OFFSET PULL	8190EZHD 12"		630-316	IVE
1	EA	SURFACE CLOSER	4040XP SHCUSH WMS PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES (AS REQ'D).		689	LCN
1	EA	FLUSH CEILNG MTG PLATE	4040XP-18G WMS (AS REQ'D)		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 WMS (AS REQ'D)		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 WMS (AS REQ'D)		689	LCN
1	EA	RAIN DRIP	142A (OMIT IF SHELTERED)		AA	ZER
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE		TBD	B/O
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED)		A	ZER

*FOR DOOR CLOSER: PROVIDE MTG. PLATES, SPACERS AND ACCESSORIES (AS REQ'D)

Hardware Group No. AL-09

For use on Door #(s):
201.4

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	PIVOT SET	7215 SET (TOP AND BOTTOM)		626	IVE
1	EA	INTERMEDIATE PIVOT	7215 INT (QTY AS REQUIRED)		626	IVE
1	EA	PANIC HARDWARE	AX-35A-NL-OP-388		626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY		626	TBD
1	EA	90 DEG OFFSET PULL	8190EZHD 12"		630-316	IVE
1	EA	SURFACE CLOSER	4040XP PA WMS		689	LCN
1	EA	FLUSH CEILNG MTG PLATE	4040XP-18G WMS (AS REQ'D)		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 WMS (AS REQ'D)		689	LCN
1	EA	FLOOR STOP	FS18S/FS18L		BLK	IVE
1	EA	RAIN DRIP	142A (OMIT IF SHELTERED)		AA	ZER
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE		TBD	B/O
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	545 (OR AS DETAILED)		A	ZER

*FOR DOOR CLOSER: PROVIDE MOUNTING BRACKETS, SPACERS AND PLATES AS REQUIRED.

Hardware Group No. AL-10

For use on Door #(s):
305A 305B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	PIVOT SET	7215 SET (TOP AND BOTTOM)		626	IVE
1	EA	INTERMEDIATE PIVOT	7215 INT (QTY AS REQUIRED)		626	IVE
1	EA	PANIC HARDWARE	AX-35A-NL-OP-388		626	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT		626	SCH
1	EA	90 DEG OFFSET PULL	8190EZHD 12"		630-316	IVE
1	EA	SURFACE CLOSER	4040XP PA WMS		689	LCN
1	EA	FLUSH CEILNG MTG PLATE	4040XP-18G WMS (AS REQ'D)		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 WMS (AS REQ'D)		689	LCN
1	EA	WALL/ FLOOR STOP	WS406/407CVX / FS436 (AS REQ'D)		630	IVE
1	SET	GASKETING AND SEAL	BY STOREFRONT MFG./SUPPLIER. TO MATCH DOOR HARDWARE		TBD	B/O
1	EA	DOOR BOTTOM	355AA		AA	ZER
1	EA	THRESHOLD	164A (OR AS DETAILED)		A	ZER

*FOR DOOR CLOSER: PROVIDE MTG. PLATES, SPACERS AND ACCESSORIES (AS REQ'D)

Hardware Group No. GATE-01

For use on Door #(s):
S1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	SET	SELF CLOSING HINGES/ PIVOTS	BY GATE MFG./ SUPPLIER			626	B/O
1	SET	HYDRAULIC 180° GATE CLOSER AND HINGE	MAMMOTH-180-ZILV			626	LOX
1	EA	PANIC HARDWARE	XP98-L-NL-17-WH-SNB			630	VON
1	EA	SFIC RIM CYLINDER	80-159 VERIFY KEY SYSTEM FORMAT			626	SCH
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY			626	TBD
1	EA	ELECTRIC STRIKE	6300 FSE 12/24 VAC/VDC		✓	630	VON
1	EA	WELDABLE GATE BOX	K-BXED-V990NL-2			TBD	KEE
1	EA	FLOOR STOP	FS18S/FS18L			BLK	IVE
1	SET	BALANCE OF GATE HARDWARE	BY GATE DOOR MFG./ SUPPLIER			TBD	B/O
1	EA	CARD/ CREDENTIAL READER	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR		✓		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR COORDINATE W/ SECURITY CONTRACTOR		✓		B/O

*CONFIRM HARDWARE COMPATIBILITY WITH GATE MFG./ SUPPLIER PRIOR ORDERING.
*PIVOTS, WELDABLE GATE BOX FOR LOCK, BALANCE OF HARDWARE BY GATE MFG./ SUPPLIER.
*ENSURE FLOOR STOP HEIGHT TO MEET DOOR.
*GATE CANNOT SWING PAST THE SUPPLIED STRIKE.
*COORDINATION ITEMS: POWER/ CONDUIT/ WIRING/ ELECTRONIC SECURITY SYSTEM.
*ACCESS CONTROL EQUIPMENT, DIAGRAMS, DOOR CONTACT, WIRING DOOR AND FRAME CONNECTOR BY SECURITY CONTRACTOR.

Hardware Group No. GATE-02

For use on Door #(s):
S2

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	SET	SELF CLOSING HINGES/ PIVOTS	BY GATE MFG./ SUPPLIER	626	B/O
2	EA	CANE BOLT	BY GATE MFG./ SUPPLIER	626	B/O
1	EA	MANUAL PADLOCK	BY GATE MFG./ SUPPLIER	626	TBD
1	EA	PERM. CORE	TO MATCH EXISTANT/ VERIFY KEYWAY	626	TBD
2	EA	FLOOR STOP	FS18S/FS18L	BLK	IVE
1	SET	BALANCE OF GATE HARDWARE	BY GATE DOOR MFG./ SUPPLIER	TBD	B/O

*PIVOTS, WELDABLE GATE BOX FOR LOCK, BALANCE OF HARDWARE BY GATE MFG./ SUPPLIER.
*ENSURE FLOOR STOP HEIGHT TO MEET DOOR.
*CONFIRM HARDWARE COMPATIBILITY WITH GATE MFG./ SUPPLIER PRIOR ORDERING.
*JAMB POSTS TO HAVE STEEL POSITIONED TO SERVE AS A POSITIVE STOP;
*GATE CANNOT SWING PAST THE SUPPLIED STRIKE.

Hardware Group No. SL-01

For use on Door #(s):
200

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	SET	SLIDING DOOR AND HARDWARE	BY STANLEY DOORS	TBD	B/O

*DOOR AND HARDWARE BY STANLEY IN A SEPARATE SPECIFICATION PACKAGE.

END OF SECTION

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SECTION 08 8000
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.
B. Glazing units.
C. Plastic films.
D. Glazing compounds.

1.02 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).
E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
F. ASTM C1036 - Standard Specification for Flat Glass; 2021.
G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
H. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
I. ASTM C1184 - Standard Specification for Structural Silicone Sealants; 2023.
J. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
K. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
L. ASTM D1003 - Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics; 2021.
M. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
N. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
O. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.
P. GANA (SM) - GANA Sealant Manual; 2008.
Q. IGMA TB-3001 - Guidelines for Sloped Glazing; 2001.
R. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
S. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

T. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting minimum 2 weeks before starting work of this section; require attendance by each of the affected installers.
   1. See Section Section 01 3000 - Administrative Requirements, for additional

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: For each item to be installed.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. CAL (CDPH SM) compliance data.
   2. Recycled content data.
   3. VOC content restrictions data.

D. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

E. Samples: Submit two samples 6 by 6 inch in size, or manufacturer's standard sample size, of glass units.

F. Samples: Submit 6 inch long bead of glazing sealant, color as selected.

G. Certificate: Certify that products of this section meet or exceed specified requirements.

H. Manufacturer's qualification statement.

I. Installer's qualification statement.

J. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
      a. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
      b. Insulating Glass Certification Council (IGCC).
      c. Safety Glazing Certification Council (SGCC).
   2. Installer Qualifications: Company specializing in performing work of the type specified and with at least _____ years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.07 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

C. Laminated Glass: Provide a ten (10) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

D. Heat Soaked Tempered Glass: Provide a ten (10) year manufacturer warranty to include coverage for spontaneous breakage of fully tempered glass caused by nickel sulfide (NiS) inclusions.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. CDPH: Products to comply with CAL (CDPH SM) .

D. Recycled Content: Products in this Section to meet minimum recycled content thresholds specified in Section 01 6000.

2.02 MANUFACTURERS

A. Glass Manufacturers:
   1. Cardinal Glass Industries.
   2. Gardner Glass.
   3. Guardian Glass.
   4. Ornilux.
   5. Pilkington North America.
   6. Saint Gobain.
   7. Schott.
   8. Vitro Architectural Glass.
   9. Walker Glass.
   10. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Glass Fabricators:
   1. General Glass International (GGI).
   2. Glaspro.
   3. Standard Bent Glass.
   4. Tecnoglass.
   5. Thompson Innovative Glass.
   6. Trulite Glass & Aluminum Solutions.
   7. Viracon.
   8. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Wind Pressures: As shown on the Structural drawings.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Seismic Loads: Design and size glazing components to withstand seismic loads and sway displacement in accordance with the requirements of ASCE 7
   4. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   5. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
   1. In conjunction with weather barrier related materials described in other sections, as follows:

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

1.03 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
   3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   5. Heat-Soak Testing (HST): Provide HST of fully tempered glass used on canopy, point-supported, spider wall, high-risk, sloping overhead, horizontal overhead, free-standing glass protective barrier, or other demanding applications of project, to reduce risks of spontaneous breakage due to nickel sulfide (NiS) induced fractures in accordance with industry established testing requirements.

6. Impact Resistant Safety Glass: Complies with ANSI Z97.1 - Class B, or 16 CFR 1201 - Category I criteria.
7. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.
2. Interlayers: Refer to Laminated Glass Interlayers article below.

1.04 INSULATING GLASS UNITS

A. Manufacturers:
1. Cardinal Glass.
2. Guardian Glass.
3. Pilkington North America.
4. Viracon.
5. Vitro Architectural Glass.
6. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Insulating Glass Units: Types as indicated.
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
3. Warm-Edge Spacer: Fabricator's standard.
4. Spacer Color: Black.
5. Edge Seal:
   a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
   b. Color: Black.
6. Purge interpane space with dry air, hermetically sealed.

C. Type GL-1 - Insulating Glass Units: Vision glass, double glazed.
1. Product: Match existing.
2. Applications: Exterior glazing unless otherwise indicated.
3. Space between lites filled with argon.
4. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
   a. Tint: _____.
   b. Coating: Low-E (passive type), on #2 surface.
5. Warm-edge spacer.
6. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
   a. Tint: Clear.
7. Total Thickness: 1 inch.
8. Thermal Transmittance (U-Value): 0.41, nominal.
9. Solar Heat Gain Coefficient (SHGC): 0.31, nominal.

D. Type GL-2 - Insulating Glass Units: Vision glass, laminated. Match GL-1, except:
1. Applications: Pedestrian level exterior glazing.
2. Laminated Outboard Lite, Outer Pane: Annealed float glass, 1/4 inch thick, minimum.
   a. Tint: Match existing.
3. Interlayer: Polyvinyl butyral (PVB); structural type, thickness as required.

4. Laminated Outboard Lite, Inner Pane: Annealed float glass, 1/4 inch thick, minimum.
   a. Tint: Clear.
   b. Coating: Low-E (passive type), on #4 surface.
5. Total Thickness: 1-5/16 inches.
6. Thermal Transmittance (U-Value): 0.41, nominal.
7. Solar Heat Gain Coefficient (SHGC): 0.31, nominal.
8. Glazing Method: Dry glazing method, gasket glazing.

1.02 GLAZING UNITS

A. Monolithic Interior Vision Glazing:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Annealed float glass.
   3. Tint: Clear.
   4. Types: Refer to Architectural drawings for locations.
      a. GL-3: 1/4 inch, nominal.
      b. GL-4: 1/2 inch, nominal.

1.02 GLAZING SURFACE FILMS

A. Glazing Surface Films Manufacturers:
   1. 3M.
   2. Avery Dennison.
   3. Decorative Films.
   4. Johnson Window Films.
   5. Eastman Chemical.
   6. Madico.
   7. Saint-Gobain.
   8. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Glass Surface Protection Film: Self-adhesive, replaceable polyester anti-graffiti film.
   1. Application: Locations as indicated on drawings.
   2. Functionality: Protection of glass substrate against scratches, acid etching, and gouging.
   3. Film Color: Clear.
   4. Thickness: 0.004 inch.
   5. Abrasion Resistance: Less than 5 percent increase in haze when measured in accordance with ASTM D1003.
   6. Film Visible Light Transmittance (VLT): 88 percent, minimum.
   7. Products:
      a. 3M; Anti-Graffiti Film.
      b. Avery Dennison; AG Clear ix.
      c. Johnson Window Films; Defendor.
      d. LLumar; Anti-Graffiti.
      e. Madico; Graffiti-Free.
      f. Saint Gobain; Solar Gard Anti-Graffiti.
      g. XPEL, Inc; ANTI-GRAFFITI: www.xpel.com/#sle.
      h. Substitutions: See Section 01 2500 - Substitution Procedures.

1.03 LAMINATED GLASS INTERLAYERS

A. Manufacturers:

1. DuPont.
2. Eastment Chemical.
3. Kuraray.
4. Sekisui.
5. Viracon.
6. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Polyvinyl Butyral (PVB) Interlayer for Laminated Glazing:
   1. Basis of Design Products:
      a. Clear Structural Interlayer: Kuraray; SentryGlas.
   2. Thickness: As required for indicated performance of laminated glass application.

1.04 GLAZING COMPOUNDS

A. Definitions: See Section 07 9200 - Joint Sealants.

B. Color, General: As selected by Architect from manufacturer's full range.

C. Manufacturers:
   1. Bostik.
   2. Dow Corning / Dowsil.
   3. GE Silicones.
   4. Momentive Performance Materials.
   5. Pecora.
   6. Tremco.
   7. Substitutions: See Section 01 2500 - Substitution Procedures.

D. Butyl Sealant: Single component; ASTM C920 Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.

E. Polysulfide Sealant: Two component; chemical curing, nonsagging type; ASTM C920 Type M, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

F. Silicone Sealant: Neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining, ASTM C920 Type S, Grade NS, Class 50, Use NT.
   1. Products:
      a. Dowsil; 795 Silicone Building Sealant.
      b. GE Silicones; SCS2000 SilPruf.
      c. Pecora; 895NST Silicone.
      d. Tremco; Spectrum 2.
   2. Locations:
      a. Typical use.
      b. Perimeter at smooth substrates, including glass, metals, and coated metals.
      c. Wet sealing of glass components within frames.
      d. Non-structural internal components of window system, including end dams and internal seals.

G. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining, ASTM C920 Type S or M, Grade NS, Class 25, Use NT.
   1. Products:
      a. Dowsil; 983 Structural Glazing Sealant Base and Curing Agent.
      b. GE Silicones; SSG4000 UltraGlaze.
      c. Pecora; AVB Silicone.
      d. Tremco; Tremsil 600.

2. Locations:
    a. Non-structural internal components of window system, including end dams and internal seals.

H. Structural Glazing Sealants: ASTM C1184, high-modulus, neutral-cure silicone formulation that is specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in opening system indicated, for 2-and 4-sided structural glazing. Product to be compatible with system components with which it comes in contact.
    1. Shop-Applied Products:
        a. Dowsil; 983 Structural Glazing Sealant.
        b. GE Silicones; SSG4650
        c. Pecora; 985 Silicone.
        d. Tremco; Proglaze II.
        e. Substitutions: See Section 01 2500 - Substitution Procedures.
    2. Field-Applied Products:
        a. Dowsil; 795 Silicone Building Sealant, 995 Silicone Structural Sealant.
        b. GE Silicones; SSG4000AC UltraGlaze.
        c. Pecora; 895 NST Silicone.
        d. Tremco; Proglaze SSG.
        e. Substitutions: See Section 01 2500 - Substitution Procedures.

1.05 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.

D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

PART 3 EXECUTION

2.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

2.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry immediately before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

2.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

2.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

2.05 INSTALLATION - WET GLAZING METHOD (SEALANT AND SEALANT)

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.

B. Place setting blocks at 1/4 points and install glazing pane or unit.

C. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch intervals, 1/4 inch below sight line.

D. Fill gaps between glazing and stops with _____ type sealant to depth of bite on glazing, but not more than 3/8 inch below sight line to ensure full contact with glazing and continue the air and vapor seal.

E. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

2.06 INSTALLATION - WET/DRY GLAZING METHOD (PREFORMED TAPE AND SEALANT)

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.

B. Cut glazing tape to length and set against permanent stops, 3/16 inch below sight line. Seal corners by butting tape and dabbing with butyl sealant.

C. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.

D. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

E. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.

F. Install removable stops, with spacer strips inserted between glazing and applied stops 1/4 inch below sight lines.
   1. Place glazing tape on glazing pane of unit with tape flush with sight line.
G. Fill gap between glazing and stop with _____ type sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch below sight line.
H. Apply cap bead of _____ type sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

2.07 INSTALLATION - WET/DRY GLAZING METHOD (TAPE AND SEALANT)

A. Application - Interior Glazed: Set glazing infills from the interior of the building.
B. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.
C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
D. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
E. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
F. Fill gaps between pane and applied stop with _____ type sealant to depth equal to bite on glazing, to uniform and level line.
G. Carefully trim protruding tape with knife.

2.08 INSTALLATION - BUTT JOINT GLAZING METHOD (SEALANT ONLY)

A. Application - Exterior Glazed: Set glazing infills from exterior side of building.
B. Temporarily brace glass in position for duration of glazing process; mask edges of glass at adjoining glass edges and between glass edges and framing members.
C. Temporarily secure a small diameter nonadhering foamed rod on back side of joint.
D. Apply sealant to open side of joint in continuous operation; thoroughly fill joint without displacing foam rod, and then tool sealant surface smooth to concave profile.
E. Permit sealant to cure then remove foam backer rod, and then apply sealant to opposite side, tool smooth to concave profile.
F. Remove masking tape.

2.09 INSTALLATION - PLASTIC FILM

A. Install plastic film with adhesive, applied in accordance with film manufacturer's instructions.
B. Place without air bubbles, creases or visible distortion.
C. Install film tight to perimeter of glass and carefully trim film with razor sharp knife. Provide 1/16 inch to 1/8 inch gap at perimeter of glazed panel unless otherwise required. Do not score the glass.

2.10 FIELD QUALITY CONTROL

A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
B. Monitor and report installation procedures and unacceptable conditions.

2.11 CLEANING

A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

B. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

C. Remove nonpermanent labels immediately after glazing installation is complete.

D. Clean glass and adjacent surfaces after sealants are fully cured.

E. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

2.12 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

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SECTION 08 8300
MIRRORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass mirrors.
   1. Tempered safety glass.

1.02 REFERENCE STANDARDS

A. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
B. GANA (GM) - GANA Glazing Manual; 2022.
C. GANA (SM) - GANA Sealant Manual; 2008.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: For each item to be installed.
C. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment to other work.
D. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.
E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.
B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with recommendations of GANA (TIPS).

1.05 FIELD CONDITIONS

A. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Safety Glazing Products: For film backed mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials and complying with CBC requirements.

2.02 MANUFACTURERS

A. Mirrors:
   1. Guardner Glass.
   2. Guardian Industries.
   3. Lenoir Mirror.
   4. Trulite Glass and Aluminum Solutions.
   5. Substitutions: See Section 01 2500 - Substitution Procedures.

2.03 MATERIALS

A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

B. Mirror Glass: Clear, tempered safety glass; ASTM C1048, with copper and silver coatings, and protective overcoating.
   1. Thickness: 1/4 inch.
   2. Edges: Square and lapped.
   3. Size: As noted on drawings.

2.04 ACCESSORIES

A. Edge Sealer: Approved by mirror manufacturer.

B. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness.

C. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness.

D. Glazing Tape: Preformed butyl compound; 10 to 15 Shore A durometer hardness; on release paper.

E. Mirror Attachment Accessories: Stainless steel J-profile channels.

F. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.
   1. Application Temperature: Minus 35 to 140 degrees F at contact surfaces.

G. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings for mirrored glazing are correctly sized and within tolerance.

B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Install mirrors in accordance with GANA (TIPS) and manufacturers recommendations.

B. Set mirrors plumb and level, and free of optical distortion.

C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

D. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

E. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.

3.04 CLEANING

A. Remove wet glazing materials from finish surfaces.

B. Remove labels after work is complete.

C. Clean mirrors and adjacent surfaces.

END OF SECTION

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SECTION 09 0561
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Resilient tile and sheet.
   2. Broadloom carpet.
   3. Carpet tile.
   4. Thin-set ceramic tile and stone tile.

B. Patching compound.

C. Remedial floor coatings.

1.02 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

C. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
   1. Manufacturer's qualification statement.
   2. Certificate: Manufacturer's certification of compatibility with types of flooring applied over remedial product.
   3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
   4. Manufacturer's installation instructions.
   5. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

D. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.

2. Summary of conditions encountered.
3. Copies of specified test methods.
4. Recommendations for remediation of unsatisfactory surfaces.
5. Product data for recommended remedial coating.
6. Submit report directly to Owner.
7. Submit report not more than two business days after conclusion of testing.

E. Adhesive Bond and Compatibility Test Report.

1.05 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing will be performed by an independent testing agency employed and paid by Owner.

B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

C. Contractor's Responsibility Relating to Independent Agency Testing:
1. Provide access for and cooperate with testing agency.
2. Confirm date of start of testing at least 10 days prior to actual start.
3. Allow at least 4 business days on site for testing agency activities.
4. Achieve and maintain specified ambient conditions.
5. Notify Owner when specified ambient conditions have been achieved and when testing will start.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer’s instructions and recommendations.

B. Deliver materials in manufacturer’s packaging; include installation instructions.

C. Keep materials from freezing.

1.07 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.

2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.

B. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
   1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
   2. Use product recommended by testing agency.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Follow recommendations of testing agency.

B. Perform following operations in the order indicated:
   1. Preliminary cleaning.
   2. Specified remediation, if required.
   3. Patching, smoothing, and leveling, as required.
   4. Other preparation specified.
   5. Adhesive bond and compatibility test.
   6. Protection.

3.02 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

3.03 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with recommendations of testing agency.

C. Comply with requirements and recommendations of floor covering manufacturer.

D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

E. Do not fill expansion joints, isolation joints, or other moving joints.

3.04 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.05 APPLICATION OF REMEDIAL FLOOR COATING

A. Comply with requirements and recommendations of coating manufacturer.

END OF SECTION

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SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.
B. Gypsum sheathing for exterior walls and soffits.
C. Gypsum wallboard.
D. Backing board.
E. Joint treatment and accessories.
F. Sound barrier mullion trim cap.

1.02 RELATED REQUIREMENTS

A. Section 07 2700 - Air Barriers: Air- and water-resistive barrier over sheathing.
B. Section 09 2216 - Non-Structural Metal Framing.
C. Section 09 8100 - Acoustic Insulation.

1.03 REFERENCE STANDARDS

A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
D. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.
F. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.
G. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
H. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
I. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
J. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
K. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018 (Reapproved 2023).
L. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

M. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2023.
N. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019, with Editorial Revision (2020).
O. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
P. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
Q. ASTM E413 - Classification for Rating Sound Insulation; 2022.
R. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
S. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.
T. GA-226 - Application of Gypsum Board to Form Curved Surfaces; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: For each item to be installed.
C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
    1. VOC content restrictions data.
D. Shop Drawings: Coordinate requirements with Section 09 2216 - Non-Structural Metal Framing. Indicate special details associated with fireproofing and acoustic seals.
E. Evaluation Service Reports: Show compliance with specified requirements, including grid suspension systems.
F. Qualification Statements: For Contractor's professional engineer, manufacturer, and installer.

1.06 COORDINATION

A. Confirm with panel manufacturers suitability of gypsum panel products at locations subject to water and water vapor.

1.07 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
    1. Contractor's Professional Engineer: Experienced in providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which the project is located.
    2. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.
    3. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
B. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
    1. Convene minimum 2 weeks before starting work of this Section.

2. Require attendance by all affected installers.

C. Documents at Project Site: Maintain at the project site a copy of manufacturer's instructions, erection drawings, and shop drawings.

1.08 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

C. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

D. Store metal products to prevent corrosion.

1.09 WARRANTY

A. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 DELEGATED DESIGN

A. Delegated Design: See Section 01 3000 - Administrative Requirements.

B. Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design metal stud wall assemblies and shaft wall assemblies. Coordinate with Section 09 2216 - Non-Structural Metal Framing.

2.02 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.03 GYPSUM BOARD ASSEMBLIES

A. See Section 09 2216 - Non-Structural Metal Framing for metal studs, shaft studs, and accessories required for complete partition, ceiling, and soffit assemblies.

B. Provide completed assemblies complying with ASTM C840 and GA-216.
1. See PART 3 for finishing requirements.

C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

D. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics:
1. Air Pressure Within Shaft: Intermittent loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

E. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions in accordance with ASCE 7 for Seismic Design as shown on the Structural drawings and complying with the following:
   1. Local authorities having jurisdiction.
   2. ICC-ES Evaulation Report.

F. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216 complying with the following:
   1. ICC-ES Evaulation Report.

G. Fire-Resistance-Rated Assemblies: Provide completed assemblies as shown on the Architectural drawings

2.04 METAL FRAMING MATERIALS

A. See Section 09 2216 - Non-Structural Metal Framing.

2.05 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. American Gypsum.
   2. CertainTeed.
   3. Georgia-Pacific.
   4. National Gypsum.
   5. Pabco.
   6. USG.
   7. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Interior Gypsum Wallboard: Paper- and glass-mat-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for interior vertical surfaces and ceilings, unless otherwise indicated.
      a. Use exterior gypsum sheathing board for exterior applications. Refer to products below.
   2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
   3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   4. Thickness:
      a. Vertical Surfaces: 5/8 inch.
      b. Ceilings: 5/8 inch.
      c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
   5. Interior Paper-Faced Type X Products:
      a. Locations:
         1) Standard unless noted otherwise.
      b. American Gypsum Company; FireBloc Type X Gypsum Wallboard: www.americangypsum.com/#sle.
      c. CertainTeed Corporation; Type X Drywall: www.certainteed.com/#sle.
      d. Georgia-Pacific Gypsum; ToughRock Fireguard X: www.gpgypsum.com/#sle.
      e. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond Fire-Shield C 5/8" Gypsum Board: www.goldbondbuilding.com/#sle.
      f. Pabco; Flame Curb.
      g. USG Corporation; Sheetrock Brand EcoSmart Panels Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.

h. Substitutions: See Section 01 2500 - Substitution Procedures.

6. Interior Paper-Faced Type C Products:
   a. Locations:
      1) Where required to meet partition rating, as shown on the Architectural drawings.
   b. American Gypsum; Firebloc Type C.
   c. CertainTeed.; ProRoc Type C.
   d. Georgia-Pacific; Fireguard C.
   e. National Gypsum; Gold Bond Fire-Shield C.
   f. Pabco; Flame Curb Type Super C.
   g. USG; Firecode C Core.
7. Interior Mold-Resistant, Paper-Faced Products:
   a. Locations:
      1) Drinking fountains.
      2) Adjacent to sinks in break rooms and similar.
      3) Where shown on the Architectural drawings.
   b. American Gypsum Company; M-Bloc Type X: www.americangypsum.com/#sle.
   c. CertainTeed Corporation; M2Tech 5/8" Type X Moisture & Mold Resistant Drywall: www.certainteed.com/#sle.
   d. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard: www.gpgypsum.com/#sle.
   e. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Fire-Shield Gypsum Board: www.goldbondbuilding.com/#sle.
   f. Pabco; Mold Curb Plus.
   g. USG Corporation; Sheetrock Brand EcoSmart Panels Mold Tough Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.
   h. Substitutions: See Section 01 2500 - Substitution Procedures.
8. Interior Glass Mat Faced Products:
   a. Locations:
      1) Building interior side of exterior wall assembly.
      2) Bathroom areas without tile.
         (a) See Section 09 3000 - Tiling, for tile backer board panels.
      3) Where shown on the Architectural drawings.
   b. CertainTeed Corporation; 5/8" GlasRoc Interior Type X: www.certainteed.com/#sle.
   c. Georgia-Pacific Gypsum; DensArmor Plus: www.gpgypsum.com/#sle.
   d. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Interior Extreme Fire-Shield Gypsum Panel: www.goldbondbuilding.com/#sle.
   e. Pabco; Pabco Glass Interior.
   f. USG Corporation; Sheetrock Brand Glass-Mat Panels Mold Tough Regular 5/8 in. (15.9 mm): www.usg.com/#sle.
   g. Substitutions: See Section 01 2500 - Substitution Procedures.
9. Flexible Gypsum Board Products:
   a. CertainTeed; 1/4 Inch Flex Drywall.
   b. Georgia-Pacific; ToughRock Flexroc Gypsum Board.
   c. National Gypsum; Gold Bond High Flex Gypsum Board.
   d. Pabco; Pabco Flex.
   e. USG; Sheetrock Brand Flexible Gypsum Panels.

C. Interior Abuse Resistant Wallboard:
   1. Application: High-traffic areas indicated.

2. Surface Abrasion: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
4. Soft Body Impact: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
5. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
6. Paper-Faced Type: Gypsum wallboard, as defined in ASTM C1396/C1396M.
7. Glass Mat-Faced Type: Gypsum wallboard, as defined in ASTM C1658/C1658M.
8. Type: Fire-resistance-rated Type X, UL or WH listed.
9. Thickness: 5/8 inch.
10. Edges: Tapered.
11. Paper-Faced Products:
    a. American Gypsum Company; M-Bloc AR Type X: www.americangypsum.com/#sle.
    b. CertainTeed Corporation; Extreme Abuse Resistant Drywall with M2Tech: www.certainteed.com/#sle.
    c. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold Guard Abuse-Resistant: www.gpgypsum.com/#sle.
    d. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Hi-Abuse Gypsum Board: www.goldbondbuilding.com/#sle.
    e. Pabco; Abuse Curb.
    f. USG Corporation; Sheetrock Brand AR Firecode X Panels 5/8 in.. (15.9 mm): www.usg.com/#sle.
    g. Substitutions: See Section 01 2500 - Substitution Procedures.
12. Glass Mat Faced Products:
    a. Georgia-Pacific Gypsum; DensArmor Plus Abuse-Resistant: www.gpgypsum.com/#sle.
    b. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Interior Extreme AR Gypsum Panel: www.goldbondbuilding.com/#sle.
    c. USG Corporation; Sheetrock Brand Glass-Mat Panels Mold Tough AR Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.
    d. Substitutions: See Section 01 2500 - Substitution Procedures.

D. Interior Impact Resistant Wallboard:
1. Application: High-traffic areas indicated.
2. Surface Abrasion: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
4. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
5. Hard Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
7. Paper-Faced Type: Gypsum wallboard, as defined in ASTM C1396/C1396M.
8. Glass Mat-Faced Type: Gypsum wallboard, as defined in ASTM C1658/C1658M.
9. Type: Fire-resistance-rated Type X, UL or WH listed.
10. Thickness: 5/8 inch.
11. Edges: Tapered.
12. Paper-Faced Products:
    a. American Gypsum Company; M-Bloc IR Type X: www.americangypsum.com/#sle.
    b. CertainTeed Corporation; Extreme Impact Resistant Drywall with M2Tech: www.certainteed.com/#sle.

c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Hi-Impact Gypsum Board: www.goldbondbuilding.com/#sle.
d. USG Corporation; Sheetrock Brand Mold Tough VHI Firecode X Panels 5/8 in. (15.9 mm): www.usg.com/#sle.
e. Substitutions: See Section 01 2500 - Substitution Procedures.

13. Glass Mat Faced Products:
a. Georgia-Pacific Gypsum; DensArmor Plus Impact-Resistant: www.gpgypsum.com/#sle.
b. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Interior Extreme IR Gypsum Panel: www.goldbondbuilding.com/#sle.
c. USG Corporation; Sheetrock Brand Glass-Mat Panels Mold Tough VHI Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.
d. Substitutions: See Section 01 2500 - Substitution Procedures.

E. Backing Board For Wet Areas:
1. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
2. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
a. Fire-Resistance-Rated Type: Type X core, thickness 5/8 inch.
b. Products:
1) CertainTeed Corporation; 5/8" GlasRoc Tile Backer Type X: www.certainteed.com/#sle.
2) Georgia-Pacific Gypsum; DensShield Tile Backer: www.gpgypsum.com/#sle.
3) Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Tile Backer: www.goldbondbuilding.com/#sle.
4) USG Corporation; Durock Brand Glass-Mat Tile Backerboard 5/8 in. (15.9 mm): www.usg.com/#sle.
5) Substitutions: See Section 01 2500 - Substitution Procedures.

F. Exterior Gypsum Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Fungal Resistance: No fungal growth when tested in accordance with ASTM G21.
4. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
5. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
6. Type X Thickness: 5/8 inch.
7. Edges: Square.
8. Glass Mat Faced Products:
a. American Gypsum Company; M-Glass Exterior Sheathing Type X: www.americangypsum.com/#sle.
b. CertainTeed Corporation; GlasRoc Type X Exterior Sheathing: www.certainteed.com/#sle.
c. Georgia-Pacific Gypsum; DensGlass Fireguard Sheathing: www.gpgypsum.com/#sle.
d. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Sheathing: www.goldbondbuilding.com/#sle.
e. Pabco; Pabco Glass Type X Sheathing.
f. USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.
g. Substitutions: See Section 01 2500 - Substitution Procedures.

G. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
   1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
   2. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C1658/C1658M.
   3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   4. Paper-Faced Products:
      a. Locations:
         1) Standard shaft wall assemblies not subject to moisture.
      b. American Gypsum Company; M-Bloc Shaft Liner: www.americangypsum.com/#sle.
      c. CertainTeed Corporation; M2Tech Type X Shaftliner: www.certainteed.com/#sle.
      d. Georgia-Pacific Gypsum; ToughRock Shaftliner: www.gpgypsum.com/#sle.
      e. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond Shaftliner XP: www.goldbondbuilding.com/#sle.
      f. Pabco; Pabcore Shaftliner Type X.
      g. USG Corporation; Sheetrock Brand Mold Tough Gypsum Liner Panels 1 in. (25.4 mm) SLX: www.usg.com/#sle.
      h. Substitutions: See Section 01 2500 - Substitution Procedures.
   5. Glass Mat Faced Products:
      a. Locations:
         1) Shaft wall assemblies subject to moisture.
         2) Elevator shafts and other locations indirectly exposed to the exterior.
      b. American Gypsum Company; M-Glass Shaft Liner: www.americangypsum.com/#sle.
      c. CertainTeed Corporation; GlasRoc Shaftliner Type X: www.certainteed.com/#sle.
      d. Georgia-Pacific Gypsum; DensGlass Shaftliner (mold-resistant): www.gpgypsum.com/#sle.
      e. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Shaftliner: www.goldbondbuilding.com/#sle.
      f. Pabco; Pabco Glass Shaftliner.
      g. USG Corporation; Sheetrock Brand Glass-Mat Liner Panels Mold Tough 1 in. (25.4 mm): www.usg.com/#sle.
      h. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 ACOUSTIC INSULATION

A. See Section 09 8100 - Acoustic Insulation.

1.03 GYPSUM BOARD ACCESSORIES

A. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
   1. Products:
      a. Accumetric LLC; BOSS 826 Acoustical Sound Sealant.
      b. Franklin International, Inc; Titebond Acoustical Smoke & Sound Sealant: www.titebond.com/#sle.
      c. Grabber Construction Products; Acoustical Sealant GSC.
      d. Pecora Corporation; AC-20 FTR.
      e. Specified Technologies Inc; Smoke N Sound Acoustical Sealant: www.stifirestop.com/#sle.

f. USG; Sheetrock Acoustical Sealant.
g. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Sound Barrier Mullion Trim Cap: Extruded aluminum trim for maintaining sound barriers at intersections between gypsum walls and glazing assemblies.
1. Products:
a. Balco; BQSWA (SilentSeal).
b. Emseal (Sika); QuietJoint.
c. Gordon Incorporated; Mullion Mate, Series 30.
d. Mull-It-Over Products, Inc; Mull-It-Over 55 - Classic: mullitoverproducts.com/#sle.
e. Substitutions: See Section 01 2500 - Substitution Procedures.

C. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
1. Manufacturers:
a. Amico.
b. Flannery.
c. Fry Reglet.
d. Gordon.
e. Phillips Manufacturing.
f. Pittcon.
g. Stockton Products.
h. USG.
i. Substitutions: See Section 01 2500 - Substitution Procedures.
2. Types: As detailed or required for finished appearance.

D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
2. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
3. Joint Compound: Drying type, vinyl-based, ready-mixed.
4. Joint Compound: Setting type, field-mixed.

E. Finishing Compound: Surface coat and primer, takes the place of skim coating.

F. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

G. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

2.02 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
1. Install studs at spacing required to meet performance requirements.

B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.
   1. Seal perimeter of shaft wall and penetrations with acoustical sealant.

2.03 FRAMING INSTALLATION

A. See Section 09 2216 - Non-Structural Metal Framing.

2.04 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

C. Sound Barrier Mullion Trim Cap Installation: Install in accordance with manufacturer's instructions for installation of fire-rated mullion trim caps.

2.05 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

C. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.

D. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

E. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

2.06 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

E. Moisture Guard Trim: Install on bottom edge of gypsum board according to manufacturer's instructions and in locations indicated on drawings.

2.07 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.

B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.

C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.

1. Feather coats of joint compound so that camber is maximum 1/32 inch.

E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

2.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

2.09 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

2.10 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION

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SECTION 09 2216
NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal partition, ceiling, and soffit framing.

B. Framing accessories.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies: Metal studs for gypsum board partition framing.

1.03 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).

B. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

D. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

F. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

G. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.

H. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.

I. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

J. CBC Section 1614A - California Building Code; Structural Integrity.

K. CBC Section 2504.2 - California Building Code; Vertical and Horizontal Assemblies.

L. CBC Section 2506.2.1 - California Building Code; Gypsum Board Materials.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Coordinate requirements with Section 09 2116 - Gypsum Board Assemblies.

1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.

C. Product Data: For each item to be installed. Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
   1. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

D. Delegated Design Documents: See Section 01 3000 - Administrative Requirements.
   1. Provide design documentation prepared by Contractor's Licensed Professionals.

E. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

F. Steel Framing Industry Association (SFIA) Certification:
   1. Submit documentation that metal studs and connectors used on project meet or exceed requirements of International Building Code.
   2. Submit current documentation of contractor and fabricator accreditation. Keep copies of each on-site during and after installation, and present upon request.

G. Test Reports: For stud framing products that do not comply with AISI S220 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

H. Manufacturer's installation instructions.

I. Qualification Statements: For manufacturer and installer.

J. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

K. Evaluation Reports: For steel studs and runners, slip-type head joints, firestop tracks, suspension systems, and hanger anchors from ICC-ES.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

C. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.07 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 DELEGATED DESIGN

A. Delegated Design: See Section 01 3000 - Administrative Requirements.

B. Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design metal stud wall assemblies and shaft wall assemblies. Coordinate with Section 09 2116 - Gypsum Board Assemblies.

2.02 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.03 PERFORMANCE REQUIREMENTS

A. Refer to Section 09 2116 - Gypsum Board Assemblies for additional information.

2.04 MANUFACTURERS

A. Metal Framing, Connectors, and Accessories:
   1. Cemco.
   2. ClarkDietrich.
   3. Jaimes Industries.
   4. MarinoWare.
   5. R-Stud,
   6. Scafco.
   7. Simpson Strong Tie.
   8. Steel Construction Systems.
   9. Steel Network.
   10. Super Stud Building Products.
   11. Telling Industries.
   12. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 FRAMING MATERIALS

A. Fire-Resistance-Rated Assemblies: Comply with applicable code and as indicated on drawings.

B. Loadbearing Studs: As specified in Section 05 4000.

C. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220.
   1. Structural Grade: As required to meet design criteria.
   2. Corrosion Protection Coating Designation: G40, or equivalent in accordance with AISI S220.

D. Non-Loadbearing Framing System Components: AISI S220; sheet steel, of size and properties necessary for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
   1. Studs: C-shaped with flat faces.
   2. Runners: U-shaped, sized to match studs.
   3. Furring: Hat-shaped sections, minimum depth of 7/8 inch.

4. Resilient Furring Channels: Single leg configuration; 1/2 inch channel depth.
   a. Products:
      1) ClarkDietrich; RC Deluxe Resilient Channel: www.clarkdietrich.com/#sle.
      2) Substitutions: See Section 01 2500 - Substitution Procedures.
5. Resilient Sound Isolation Clips: Steel resilient clips with molded rubber isolators, attach to framing; improve noise isolation for areas between gypsum board assemblies and adjacent sources of noise.
   a. Basis of Design Product:
      1) Kinetics Noise Control; IsoMax Sound Isolation Clips.
      2) Substitutions: See Section 01 2500 - Substitution Procedures.
6. Resilient Partition Isolation Pad System: Custom molded fiberglass board which resiliently decouples a sound-rated partition from non-isolated structure. Rubber bushing assemblies (KAI) at each anchor point through the top and bottom tracks ensure effective isolation.
   a. Basis of Design Product:
      1) Kinetics Noise Control; Wallmat Stud Wall Isolator.
      2) Substitutions: See Section 01 2500 - Substitution Procedures.
7. Resilient Floor Isolation System: Floor pad consisting of acoustic batts with a grid of isolation pads, covered with wood sleepers and 2 layers of plywood.
   a. Basis of Design Product:
      1) Kinetics Noise Control; RIM Wood.
      2) Substitutions: See Section 01 2500 - Substitution Procedures.

E. Gypsum Board Ceiling Suspension Grid: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
   1. Products:
      a. Armstrong; Drywall Grid Systems.
      b. Rockfon; Chicago Metallic Drywall Grid System.
      c. USG; Drywall Suspension System.
      d. Substitutions: See Section 01 2500 - Substitution Procedures.

F. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.

G. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code when evaluated in accordance with AISI S100.
   2. Material: ASTM A653/A653M steel sheet, SS Grade 50.
   3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.

H. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
   1. Products:
      a. ClarkDietrich; BlazeFrame Firestop Deflection Track: www.clarkdietrich.com/#sle.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.

I. Preformed Top Track Firestop Seal:
   1. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
   2. Products:
      a. Hilti, Inc; Top Track Seal CFS TTS: www.us.hilti.com/#sle.

b. Specified Technologies Inc; SpeedFlex TTG Track Top Gasket: www.stfirestop.com/#sle.
c. Substitutions: See Section 01 2500 - Substitution Procedures.

J. Non-Loadbearing Framing Accessories:
1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
b. Height: As shown on the Architectural drawings.
c. Products:
1) ClarkDietrich; Pony Wall (PW): www.clarkdietrich.com/#sle.
2) Simpson Strong-Tie; RCKW Kneewall Connector: www.strongtie.com/#sle.
3) Substitutions: See Section 01 2500 - Substitution Procedures.
3. Bracing and Bridging: ASTM A653/A653M G90 galvanized steel; for lateral bracing of wall studs with slots for engaging on-module studs.
4. Framing Connectors: ASTM A653/A653M steel clips; secures cold rolled channel to wall studs for lateral bracing.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that rough-in utilities are in proper location.

2.02 INSTALLATION, GENERAL

A. Install components in accordance with manufacturer's written instructions and approved shop drawings.

2.03 INSTALLATION OF STUD FRAMING

A. Comply with requirements of ASTM C1007.
B. Install structural members and connections complying with ASTM C1007.
C. Comply with requirments of CBC Section 1614A and Section 2504.2.
D. Extend partition framing to structure where indicated and to ceiling in other locations.
E. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
F. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
G. Align and secure top and bottom runners at 24 inches on center.
H. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
I. Install studs vertically at spacing indicated on drawings.
J. Align stud web openings horizontally.

K. Secure studs to tracks using crimping method. Do not weld.

L. Fabricate corners using a minimum of three studs.

M. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.

N. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

O. Sound Isolation Clips: Mechanically attach to framing or structure with fasteners recommended by clip manufacturer. Install at spacing indicated on drawings.

P. Furring: Coordinate with sound isolation clip spacing and locations. Lap splices a minimum of 6 inches.

2.04 CEILING AND SOFFIT FRAMING

A. Comply with requirements of ASTM C754.

B. Comply with requirements of CBC Section 1614A.

C. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

D. Install furring independent of walls, columns, and above-ceiling work.

E. Securely anchor hangers to structural members or embed them in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.

F. Space main carrying channels at maximum 72 inches on center, and not more than 6 inches from wall surfaces. Lap splice securely.

G. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

H. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

I. Laterally brace suspension system.

2.05 TOLERANCES

A. Maximum Variation From True Position: 1/8 inch in 10 feet.

B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION

SECTION 09 2236
LATH

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal lath for cement plaster.
B. Furring for metal lath.
C. Metal ceiling framing.
D. Access panels.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Sheathing on exterior walls.
B. Section 08 3100 - Access Doors and Panels: Product requirements for metal access panels integral with metal lath.
C. Section 09 2400 - Cement Plastering.

1.03 REFERENCE STANDARDS

A. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
C. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process; 2022a.
D. ASTM C841 - Standard Specification for Installation of Interior Lathing and Furring; 2023.
E. ASTM C847 - Standard Specification for Metal Lath; 2018.
F. ASTM C933 - Standard Specification for Welded Wire Lath; 2023.
G. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.
H. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
I. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2023.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on furring and lathing components, structural characteristics, material limitations, and finish.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Lath:
   1. Basis of Design Manufacturer:
      a. Structa Wire Corp.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Accessories:
   1. Alabama Metal Industries Corporation (AMICO).
   2. Cemco.
   3. ClarkDietrich.
   4. MarinoWare.
   5. Phillips Manufacturing.
   6. Stockton Products.
   7. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 FRAMING AND LATH ASSEMBLIES

A. Provide completed assemblies with the following characteristics:
   1. Maximum Deflection of Vertical Assemblies: 1:360 under lateral point load of 100 lbs.
   2. Maximum Deflection of Horizontal Assemblies: 1:240 deflection under dead loads and wind uplift.

B. Fire Rated Assemblies: Provide components complying with requirements for fire rated assemblies specified in the section where the plaster finish is specified.

1.03 FRAMING MATERIALS

A. Furring Channels: Formed steel, minimum 0.020 inch thick, 3/8 inch deep by 7/8 inch high, splicing permitted; galvanized.

B. Main Ceiling Channels: Formed steel, asphalt coated, minimum 0.05 inch thick, 3/4 inch deep by 1-1/2 inch high, single piece, no splicing; galvanized.

C. Resilient Channels: Formed steel, minimum 0.020 inch thick; serrated face, flattened Z profile, splicing permitted; galvanized.

D. Hangers: Steel wire, of size and type to suit application, to support ceiling components in place to deflection limits as indicated.

E. Ceiling Hangers: Rolled steel sections, of size and type to suit application, to rigidly support ceiling components in place to deflection limits as indicated; galvanized.

F. Lateral Bracing: Formed steel, minimum 0.060 inch thick, size and length as required; galvanized.

1.04 LATH

A. Wire Lath: ASTM C933, Class 1 Galvanized Coating complying with ASTM A641/A641M:
   1. Basis of Design Products:
      a. Structa Wire Corporation; Structa Mega Lath.
         1) Application: Heavy duty reinforcing for commercial and institutional construction.
         2) Weight 1.95 lb/yd² (1.1 kg/sq.m).
         3) Finish - Class 1 Galvanized Coating complying with ASTM A641/A641M.
         4) Alternate lath to 3.4 lb/yd² diamond mesh metal lath specified in ASTM C847.
         5) As per IAPMO - UES 2017.
      b. Structa Wire Corporation; V Truss Wall & Ceiling - Rib Lath.
         1) Application: Soffits and open frame ceilings.
         2) Weight 2.2 lb/yd² (1.2 kg/sq.m)
         3) Finish - Class 1 Galvanized Coating complying with ASTM A641/A641M.
         4) Alternate lath to 3.4 lb/yd² rib metal lath specified in ASTM C847.
         5) As per IAPMO - UES 2017
      c. Structa Wire Corporation; V Truss Corners.
         1) Application: Exterior corner reinforcements.
         2) Available in Straight, Bullnose, Arch & One Coat profiles.
         3) Finish - Class 1 Galvanized Coating complying with ASTM C847.
         4) As per IAPMO - UES 2017.

B. Finishing Accessories: ASTM C841 (gypsum plaster) or ASTM C1063 (cement plaster); extruded aluminum alloy (6063 T5), galvanized steel sheet ASTM A924/A924M G90, or galvanized steel wire, unless noted otherwise.
   1. Types: As detailed or required for finished appearance.

C. Beads, Screeds, Joint Accessories, and Other Trim: Depth governed by plaster thickness, and maximum possible lengths.
   1. Material: Formed zinc, expanded metal flanges.
   2. Casing Beads with Weep Holes: Square edges.
      a. Products:
         1) Alabama Metal Industries Corporation; E-Z Bead: www.amicoglobal.com/#sle.
         2) Phillips Manufacturing Co; #66 Expanded Flange Square Casing Bead: www.phillipsmfg.com/#sle.
         3) Stockton Products; CDB Casing Bead.
         4) Substitutions: See Section 01 2500 - Substitution Procedures.
   3. Corner Beads: Radiused corners.
      a. Products:
         1) Phillips Manufacturing Co; #1 Expanded Corner Bead: www.phillipsmfg.com/#sle.
         2) Stockton Products; CA CornerAid and CRT CornerRite.
         3) Substitutions: See Section 01 2500 - Substitution Procedures.
   4. Base Screeds:
      a. Material: Galvanized steel, ASTM A653/A653M, with G90/Z275 zinc coating; minimum 26-gauge, 0.0179-inch thick base metal.
      b. Products:
         1) Masonry Technology Incorporated; L & R Weep Screed: www.mtidry.com/#sle.
         2) Stockton Products; OWS Offset Weep Screed.
         3) Substitutions: See Section 01 2500 - Substitution Procedures.

5. Expansion Joints: Two-piece sliding type with reveal, 2 inch wide flanges.
   a. Products:
      1) Stockton Products; OWC Offset Water-Resistant Expansion Channel.
      2) Substitutions: See Section 01 2500 - Substitution Procedures.
6. Control Joints: Accordion profile with factory-installed protective tape, 2 inch flanges.
   a. Products:
      1) Stockton Products; NVS Narrow V-Screed.
      2) Substitutions: See Section 01 2500 - Substitution Procedures.
7. Soffit Vents:
   a. Products:
      1) Stockton Products; Metal-SVR.
      2) Substitutions: See Section 01 2500 - Substitution Procedures.
8. Reveal Moldings: Aluminum extruded alloy 6063 TS with chemical conversion coating, clear anodized:
   a. Manufacturers:
      1) Fry Reglet.
      2) Substitutions: See Section 01 2500 - Substitution Procedures.
   b. Profiles as shown on the Architectural drawings.

1.05 ACCESSORIES

A. Access Panels: See Section 08 3100.

B. Anchorage: Tie wire, nails, and other metal supports, of type and size to suit application; to rigidly secure materials in place, galvanized.

C. Fasteners: Self-piercing tapping screws; ASTM C1002 or ASTM C954.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that substrates are ready to receive work and conditions are suitable for application.

C. For exterior plaster and stucco on stud walls, verify that weather barrier has been installed over sheathing substrate completely and correctly.

D. Do not begin until unacceptable conditions have been corrected.

E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

2.02 INSTALLATION - GENERAL

A. Install metal lath and furring for Portland cement plaster in accordance with ASTM C1063.

B. Install lath and furring for fire-rated assemblies in accordance with requirements of assembly as indicated.

2.03 WALL FURRING INSTALLATION

A. Install furring channels horizontally; secure with fasteners on alternate channel flanges at maximum 24 inches on center.

B. Space furring channels maximum 16 inches on center, and not more than 4 inches away from floor and ceiling lines.

C. Space resilient channels at maximum 24 inches on center. Place joints over framing members.

2.04 CEILING AND SOFFIT **FRAMING AND FURRING INSTALLATION**

A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

B. Install furring independent of walls, columns, and above-ceiling work.

C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.

D. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.

E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

F. Install furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

G. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.

H. Laterally brace suspension system.

2.05 CONTROL AND EXPANSION JOINT INSTALLATION

A. Locate joints as indicated on drawings and comply with ASTM C1063.
   1. Area of plaster panel not to exceed 144 sq ft for vertical surfaces.
   2. Area of plaster panel not to exceed 100 sq ft for horizontal, curved or angled surfaces.
   3. Spacing between control joints not to exceed 18 ft in each direction.
   4. Area bounded by control joints not to exceed a length-to-width ratio of 2-1/2 to 1.

B. Install prefabricated joint accessories in accordance with ASTM C1063.

2.06 ACCESS PANELS INSTALLATION

A. Install access panels and rigidly secure in place.

B. Install frames plumb and level in opening. Secure rigidly in place.

C. Position to provide convenient access to concealed work requiring access.

2.07 LATH INSTALLATION

A. Attach metal lath to metal supports at maximum 6 inches on center.

B. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches from corner to form the angle reinforcement; fasten at perimeter edges only.

C. Place corner bead at external wall corners; fasten at outer edges of lath only.

D. Place base screeds at termination of plaster areas; secure rigidly in place.

E. Place lath vertically above each top corner and each side of door frames to 6 inches above ceiling line.

F. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.

G. Place additional strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

2.08 TOLERANCES

A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet.

B. Maximum Variation from True Position: 1/8 inch.

END OF SECTION

SECTION 09 2400
CEMENT PLASTERING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cement plastering.

1.02 RELATED REQUIREMENTS

A. Section 07 2700 - Air Barriers.
B. Section 09 2236 - Lath: Lath, furring, beads, screeds, and joint accessories for plaster base.

1.03 REFERENCE STANDARDS

A. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
B. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
C. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster; 2023a.
D. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2023.
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
F. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittals procedures.
B. Product Data: Provide data on plaster materials and trim accessories.
C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
    1. VOC content restrictions data.
D. Manufacturer's installation instructions.
E. Evaluation Service Reports: Show compliance with specified requirements.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.
C. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
    1. Convene minimum 2 weeks before starting work of this Section.

1.06 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Construct mock-up of exterior and interior wall, illustrating surface finish.
   1. Locate where directed by Architect.
   2. Mock-up may remain as part of this work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.08 FIELD CONDITIONS

A. Comply with ASTM C926.

B. Exterior Plaster Work: Do not apply plaster when substrate or ambient air temperature is 40 degrees F or lower, or when temperature is expected to drop below 40 degrees F within 48 hours of application.

C. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.

D. Interior Plaster Work: Maintain minimum ambient temperature of 50 degrees F during installation of plaster and until fully cured.

E. Factory-Prepared Finish Coats: Comply with manufacturer's written instructions for environmental conditions for applying finish coats.

1.09 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Where indicated on Drawings, provide cement plaster assemblies identical to those of assemblies tested for fire resistance in accordance with ASTM E119 by a qualified testing agency.

2.03 CEMENT PLASTER ASSEMBLIES

A. Refer to Architectural drawings for locations and extents of assembly types.

B. Exterior Cement Plaster on Metal Studs.
   1. Substrate: Gypsum sheathing.
      a. See Section 09 2116 - Gypsum Board Assemblies.
   2. Air barrier.
      a. See Section 07 2700 - Air Barriers.
   3. Drainage plane mat.
   4. Continuous rigid insulation.
   5. Metal lath and accessories.
      a. See Section 09 2236 - Lath.
   6. Plaster Type: Factory prepared plaster mix.
      a. Number of Coats: Three.
      b. First Coat: Apply to a nominal thickness of 3/8 inch.
      c. Second Coat: Apply to a nominal thickness of 3/8 inch.
      d. Finish Coat: Apply to a nominal thickness of 1/8 inch.
         1) Finish: Acrylic.

C. Exterior Cement Plaster on Concrete and Masonry.
   1. Substrate: Cast-in-place concrete, precast concrete, and CMU.
   2. Bonding agent, as recommended by cement plaster manufacturer.
   3. Metal accessories.
      a. See Section 09 2236 - Lath.
   4. Plaster Type: Jobsite mixed plaster.
      a. Number of Coats: Two.
      b. First Coat: Apply to a nominal thickness of 1/4 inch.
      c. Finish Coat: Apply to a nominal thickness of 1/8 inch.
         1) Finish: Acrylic.

2.04 MANUFACTURERS

A. Cement Plaster Material:
   1. Dryvit.
   2. LaHabra.
   3. Omega Products International.
   4. Parex USA.
   5. Sika.
   6. Sto.
   7. Stuc-O-Flex.
   8. Substitutions: See Section 01 2500 - Substitution Procedures.

2.05 FACTORY PREPARED CEMENT PLASTER

A. Exterior Portland cement plaster system made of scratch and brown base coat, leveling coat with reinforcing mesh, and acrylic finish coat; install in accordance with ASTM C926.

B. Premixed One-Coat Base: Mixture of Type I Portland cement complying with ASTM C150/C150M, hydrated lime complying with ASTM C207, fibers and other approved ingredients; install in accordance with ASTM C926.
   1. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch long, free of contaminants, manufactured for use in portland cement plaster.

C. Primer: Acrylic, as recommended by coating manufacturer and compatible with plaster base coat.

D. Premixed Finish Coating: Integrally colored, acrylic coating.

E. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories, including:
   1. Water containing salt, alum, or plaster residue accelerates plaster set and may cause efflorescence.
   2. Water containing organic or vegetable matter may retard plaster set, cause staining, and interfere with plaster bond.

2.06 ACCESSORIES

A. Lath: See Section 09 2236 - Lath.

B. Finishing Accessories: See Section 09 2236 - Lath.

C. Reinforcing Mesh: 4.5 oz/sq yd alkali-resistant mesh.

D. Rainscreen Drainage Material:
   1. Rainscreen Drainage Mat: Polyester or polypropylene mesh.
      a. Thickness: 1/8 inch.
      b. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less (Class A), when tested in accordance with ASTM E84.
      c. Seam Tape and Bug Screen: As recommended by rainscreen drainage mat manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.

B. Verify masonry joints are flush and surfaces are ready to receive work of this section, and that there are no existing bituminous or water repellent coatings on masonry surfaces.

C. Verify concrete surfaces are flat, honeycombs are filled flush, and surfaces are ready to receive work of this section, and that there are no existing bituminous, water repellent, or form release agent coatings on concrete surfaces that may be detrimental to plaster bond.

D. Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are properly in place.

E. Verify mechanical and electrical equipment and services located within areas to receive this work have been properly tested and approved.

3.02 PREPARATION

A. Dampen masonry surfaces to reduce excessive suction.

B. Clean concrete surfaces of foreign matter using approved acid solutions, solvents, or detergents, and then rinse surfaces thoroughly with clean water.

C. Roughen smooth concrete surfaces and apply bonding compound in accordance with manufacturer's written installation instructions.

D. Apply dash bond coat of plaster to solid bases and moist cure for at least 24 hours before applying first coat of jobsite mixed plaster.

3.03 INSTALLATION - RAINSCREEN DRAINAGE MATERIAL

A. Install rainscreen drainage material and metal lath with accessories over sheathing material and water-resistive barrier with fastening system in accordance with ASTM C1063 into wood or metal studs. Install drainage material with filter fabric mortar screen to exterior.

3.04 MIXING

A. Mix only as much plaster as can be used prior to initial set.

B. Mix materials dry, to uniform color and consistency, before adding water.

C. Do not retemper mixes after initial set has occurred.

D. Protect mixtures from frost or freezing temperatures, contamination, and excessive evaporation.

3.05 APPLICATION

A. Apply plaster in accordance with manufacturer's written instructions and comply with ASTM C926.

B. Base Coats:
   1. Apply base coat(s) to fully embed lath and to specified thickness.
   2. Follow guidelines in ASTM C926 and manufacturer's written installation instructions for moist curing base coats and application of subsequent coats.

C. Finish Coats:
   1. Primer and Acrylic Coatings:
      a. Remove surface contaminants such as dust and dirt without damaging substrate.
      b. Apply primer in accordance with manufacturer's instructions.
      c. Apply finish coating in number of coats and to thickness recommended by manufacturer.

3.06 TOLERANCES

A. Maximum Variation from True Flatness: 1/4 inch in 10 feet.

3.07 REPAIR

A. Patching: Remove loose, damaged or defective plaster and replace with plaster of same composition; finish to match surrounding area.

END OF SECTION

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SECTION 09 3000
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile.
B. Thresholds.
C. Ceramic trim.
D. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

A. Section 09 0561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
B. Section 09 2116 - Gypsum Board Assemblies: Tile backer board.

1.03 DEFINITIONS

A. General: Definitions in the ANSI A108 Series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
B. Large Format Tile: Tiles with at least one side greater than 15 inches long, per TCNA Handbook.
C. Heavy Tile: Tile that weighs over 5 pounds per square foot.
D. Module Size: Actual tile size plus joint width indicated.
E. Face Size: Actual tile size, excluding spacer lugs.
F. Dimension Stone Tile: Modular stone units less than 3/4 inch thick.
G. Gauged Porcelain: Products compliant with ANSI A137.3 produced from clay.
    1. Gauged Porcelain Tile: Gauged porcelain that is 36 inches by 36 inches and smaller.
    2. Gauged Porcelain Panel: Gauged porcelain that is larger than 36 inches by 36 inches.
H. Sintered Stone: Products formed by proprietary dry materials that are sintered: compacted under intense heat and pressure, without melting to the point of liquefaction.

1.04 REFERENCE STANDARDS

A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2017 (Reaffirmed 2022).
B. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.

D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.
F. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.
G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.
H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2024).
I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.
J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
L. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.
M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).
N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.
O. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs; 2020.
P. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.
Q. ANSI A118.5 - American National Standard Specifications for Chemical Resistant Furan Mortars and Grouts for Tile Installation; 1999 (Reaffirmed 2021).
R. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2019.
S. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2023.
T. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).
U. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2019.
V. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
W. ANSI A137.3 - American National Standard Specifications for Gauged Porcelain Tile and Gauged Porcelain Tile Panels/Slabs; 2021.
X. ANSI A326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials; 2021.

Y. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).

Z. ASTM C847 - Standard Specification for Metal Lath; 2018.

AA. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2023.

BB. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation; 2023.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting minimum 2 weeks before starting work of this section; require attendance by affected installers.
   1. See Section Section 01 3000 - Administrative Requirements, for additional information.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.

E. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.

F. Manufacturer's installation instructions.

G. Evaluation Service Reports: From ICC or similar. Show compliance with specified requirements.

H. Installer's Qualification Statement:

I. Field Quality Control Reports: As specified in Part 3 of this Section.

J. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Tile: 1 percent of each size, color, and surface finish combination.

1.07 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.

B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

C. Installer Qualifications:
   1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.08 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for general requirements for mock-up.

B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
   1. Minimum size of mock-up is indicated on drawings.
   2. Approved mock-up may remain as part of work.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.10 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. Dynamic Coefficient of Friction (DCOF): Tile floors to be minimum 0.42, in accordance with ANSI A326.3.

2.03 REGULATORY REQUIREMENTS

A. Ceramic tile flooring shall be stable, firm, and slip resistant. CBC Section 11B-302.1.

2.04 TILE

A. Tile Types: Refer to Materials Schedule on the Architectural drawings.

B. Ceramic Mosaic Tile: ANSI A137.1 standard grade.
   1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.

C. Glazed Wall Tile: ANSI A137.1 standard grade.
   1. Moisture Absorption: 7.0 to 20.0 percent as tested in accordance with ASTM C373.

D. Pressed Floor Tile: ANSI A137.1 standard grade.
   1. Moisture Absorption: 0.5 to 3.0 percent as tested in accordance with ASTM C373.

E. Porcelain Tile: ANSI A137.1 standard grade.
   1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.

1.02 TRIM AND ACCESSORIES

A. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
   1. Products:
      a. See Finish Schedule on the Architectural drawings.
   2. Applications: As shown on the Architectural drawings.
   3. Manufacturers: Same as for tile.

B. Non-Ceramic Trim: Satin brass anodized extruded aluminum, style and dimensions to suit application, set with tile mortar or adhesive.
   1. Applications: As shown on the Architectural drawings.
   2. Products:
      a. Schluter-Systems; Schiene: www.schluter.com/#sle.
      b. Substitutions: Section 01 2500 - Substitution Procedures.

1.03 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

B. Products:
   1. See Finish Schedule on the Architectural drawings.

C. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

1.04 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Manufacturers:
   1. Ardex.
   2. Bostik.
   3. Custom Building Products.
   4. H.B. Fuller.
   5. Laticrete.
   6. Mapei.
   7. Parex.
   8. Schluter Systems.
   9. Sika.
   10. Substitutions: See Section 01 2500 - Substitution Procedures.

C. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
   1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated.
   2. Products:
      a. ARDEX Engineered Cements; S 28: www.ardexamericas.com/#sle.
      b. Custom Building Products; Complete Contact-LFT Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer: www.custombuildingproducts.com/#sle.
      c. H.B. Fuller Construction Products, Inc; TEC TotalFlex 150 Universal Mortar: www.tecspecialty.com/#sle.

d. LATICRETE International, Inc; MULTIMAX LITE: www.laticrete.com/#sle.
e. Mapei Corporation; Granirapid System: www.mapei.com/#sle.
f. Schluter-Systems; ALL-SET: www.schluter.com/#sle.
g. Substitutions: See Section 01 2500 - Substitution Procedures.

D. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
1. Applications: Where indicated on drawings.
2. Products:
a. Custom Building Products; EBM-Lite Epoxy Bonding Mortar: www.custombuildingproducts.com/#sle.
b. LATICRETE International, Inc; LATICRETE LATAPOXY 300 Adhesive: www.laticrete.com/#sle.
c. Mapei Corporation; Kerapoxy 410: www.mapei.com/#sle.
d. Merkrete, by Parex USA, Inc; Merkrete Pro Epoxy: www.merkrete.com/#sle.
e. Sika Corp; SikaTile 350 Flex Set: www.sika.com/#sle.
f. Substitutions: See Section 01 2500 - Substitution Procedures.

1.05 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
1. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
2. Products:
a. ARDEX Engineered Cements; ARDEX FL: www.ardexamericas.com/#sle.
b. Custom Building Products; Prism Color Consistent Grout: www.custombuildingproducts.com/#sle.
c. H.B. Fuller Construction Products, Inc; TEC AccuColor Plus Grout: www.tecspecialty.com/#sle.
d. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: www.laticrete.com/#sle.
e. Mapei Corporation; Ultracolor Plus FA: www.mapei.com/#sle.
f. Merkrete, by Parex USA, Inc; Merkrete Pro Grout: www.merkrete.com/sle.
g. Substitutions: See Section 01 2500 - Substitution Procedures.

C. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
1. Products:
a. ARDEX Engineered Cements; ARDEX WA: www.ardexamericas.com/#sle.
b. Custom Building Products; CEG-IG 100% Solids Industrial Grade Epoxy Grout: www.custombuildingproducts.com/#sle.
c. H.B. Fuller Construction Products, Inc; TEC AccuColor EFX Epoxy Special Effects Grout: www.tecspecialty.com/#sle.
d. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout: www.laticrete.com/#sle.
e. Mapei Corporation; Kerapoxy CQ: www.mapei.com/#sle.
f. Merkrete, by Parex USA, Inc; Merkrete Pro Epoxy: www.merkrete.com/#sle.
g. Sika Corp; SikaTile 825 Epoxy: www.sika.com/#sle.
h. Substitutions: See Section 01 2500 - Substitution Procedures.

D. Furan Grout: ANSI A118.5 chemical resistant furan resin grout.
1. Products:

a. Custom Building Products; CEG-IG 100% Solids Industrial Grade Epoxy Grout: www.custombuildingproducts.com/#sle.
b. LATICRETE International, Inc; LATICRETE SPECTRALOCK 2000 IG: www.laticrete.com/#sle.
c. Mapei Corporation; Kerapoxy IEG CQ: www.mapei.com/#sle.
d. Substitutions: See Section 01 2500 - Substitution Procedures.

1.06 SEALANT AND MAINTENANCE MATERIALS

A. Movement Joints: Refer to Article in Part 3 of this Section.

B. Sealant: See Section 07 9200 - Joint Sealants.

C. Backer Rods: Closed-cell foam polyethylene or butyl rubber, as recommended by setting material manufacturer, for use in movement joints.
1. See Section 07 9200 - Joint Sealants, for products.
2. Refer to Part 3 article "Movement Joints" for additional information.

D. Bond Breaker Tape: For use in movement joints, to prevent 3-sided adhesion.
1. See Section 07 9200 - Joint Sealants, for products.
2. Refer to Part 3 article "Movement Joints" for additional information.

E. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
1. Composition: Water-based colorless silicone.
2. Color(s): As selected by Architect from manufacturer's full line.
3. Products:
a. STONETECH, a Division of LATICRETE International, Inc; STONETECH Heavy Duty Grout Sealer: www.laticrete.com/#sle.
b. Merkrete, by Parex USA, Inc; Merkrete Revive: www.merkrete.com/#sle.
c. Substitutions: See Section 01 2500 - Substitution Procedures.

F. Tile Sealer: Stain protection for ceramic tile and natural stone tile. Compliant with DCOF established in Performance Requirements article above.
1. Products:
a. Custom Building Products; Aqua Mix Enrich 'N' Seal: www.custombuildingproducts.com/#sle.
b. Rust-Oleum Corporation; Miracle Sealants 511 Impregnator Natural Looking Penetrating Sealer: www.rustoleum.com/#sle.
c. STONETECH, a Division of LATICRETE International, Inc; STONETECH BulletProof Stone Sealer: www.laticrete.com/#sle.
d. Substitutions: See Section 01 2500 - Substitution Procedures.

1.07 ACCESSORY MATERIALS

A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
1. Crack Resistance: No failure at 1/8 inch gap, minimum.
2. Fluid or Trowel Applied Type:
a. Material: Synthetic rubber or Acrylic.
b. Thickness: Per manufacturer's written installation instructions.
c. Products:
1) H.B. Fuller Construction Products, Inc; TEC HydraFlex Waterproofing Crack Isolation Membrane: www.tecspecialty.com/#sle.

2) LATICRETE International, Inc; LATICRETE FRACTURE BAN SC: www.laticrete.com/#sle.
3) Mapei Corporation; Mapelastic CI: www.mapei.com/#sle.
4) Merkrete, by Parex USA, Inc; Merkrete Fracture Guard: www.merkrete.com/#sle.
5) Sika Corp; SikaTile 200 Fracture Guard Rapid: www.sika.com/#sle.
6) Substitutions: Section 01 2500 - Substitution Procedures.

B. Waterproofing Membrane at Floors and Walls: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
1. Crack Resistance: No failure at 1/16 inch gap, minimum; comply with ANSI A118.12.
2. Fluid or Trowel Applied Type:
a. Material: Synthetic rubber or Acrylic.
b. Thickness: Per manufacturer's written installation instructions.
c. Products:
1) LATICRETE International, Inc; LATICRETE HYDRO BAN: www.laticrete.com/#sle.
2) Mapei Corporation; Mapelastic AquaDefense: www.mapei.com/#sle.
3) Merkrete, by Parex USA, Inc; Merkrete Hydro Guard 1: www.merkrete.com/#sle.
4) Polycoat Products; Aquatight: www.polycoatusa.com/#sle.
5) Sika Corp; SikaTile 100 Moisture Guard: www.sika.com/#sle.
6) USG Corporation; Durock Brand Waterproofing Membrane: www.usg.com/#sle.
7) Substitutions: See Section 01 2500 - Substitution Procedures.
3. Bonded Sheet Membrane Type:
a. Products:
1) LATICRETE International, Inc; LATICRETE HYDRO BAN Sheet Membrane: www.laticrete.com/#sle.
2) Mapei Corporation; Mapeguard WP 200 Membrane: www.mapei.com/#sle.
3) Noble Company; NobleSeal TS: www.noblecompany.com/#sle.
4) Schluter-Systems; KERDI: www.schluter.com/#sle.
5) Substitutions: See Section 01 2500 - Substitution Procedures.

C. Metal Lath: ASTM C847 Flat diamond mesh, of weight to suit application, galvanized finish.

D. Backer Board: See Section 09 2116 - Gypsum Board Assemblies.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
1. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.

2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
3. Follow moisture and alkalinity remediation procedures in Section 09 0561.

E. Verify that required floor-mounted utilities are in correct location.

2.02 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

2.03 INSTALLATION - GENERAL

A. Install all components in accordance with manufacturer's written instructions and approved shop drawings.
1. Do not exceed pot life of material as documented in writing by manufacturer.

B. Install tile, thresholds, and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, TCNA (HB) or TCNA (HB-GP) recommendations, as applicable, and approved shop drawings.

C. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

D. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

E. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

F. Form internal angles square and external angles bullnosed.

G. Install non-ceramic trim in accordance with manufacturer's instructions.

H. Install thresholds where indicated.

I. Sound tile after setting. Replace hollow sounding units.

J. Keep control and expansion joints free of mortar, grout, and adhesive.

K. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

L. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

M. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

2.04 MOVEMENT JOINTS

A. Refer to TCNA (HB), section EJ171 "Movement Joint Guidelines for Ceramic, Glass, and Stone", for graphics and additional information.

B. Provide movement joints in each tile assembly to alleviate pressure from building movement, and reduce cracking of grout and tile. A movement joint substitutes grout for sealant, minimum 3/8 inch deep, installed on top of:
1. Bond breaker tape, at thinset tile installations.

2. Backer rod, at deeper mortarbed installations.

C. Locate movement joints:
1. At each room perimeter, between floor tiles and wall material.
2. Vertical inside wall corners.
3. Exterior: Maximum 12 feet in each direction.
4. Interior: Maximum 25 feet in each direction.
5. Interior, exposed to direct sunlight: Maximum 12 feet in each direction.
6. Above grade concrete slab: Maximum 12 feet in each direction.
7. Change in floor finish material.
8. Curbs.
9. Ceilings.
10. Change in substrate:
a. Expansion joints.
b. Control joints.
c. Cold joints.
d. Saw-cut joints.
e. Isolation joints.

D. Provide continuous waterproof membrane below movement joints.

E. Movement Joint Width:
1. Exterior, 8 foot on center: 3/8 inch.
2. Exterior, 12 foot on center: 1/2 inch.
3. Interior, at perimeter walls: 1/4 inch.
4. Interior, other: Grout width, or 1/8 inch minimum.

2.05 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over exterior concrete substrates, install in accordance with TCNA (HB) Method F102, with high performance polymer modified grout, or as otherwise specified.

B. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with high performance polymer modified grout, or as otherwise specified.
1. Use uncoupling membrane under all tile unless other underlayment is indicated.
2. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
3. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCNA (HB) Method F115.

2.06 INSTALLATION - FLOORS - MORTAR BED METHODS

A. Over exterior concrete substrates, install in accordance with TCNA (HB) Method F101, bonded, with high performance polymer modified grout, unless otherwise specified.

B. Over interior concrete substrates, install in accordance with TCNA (HB) Method F111, with cleavage membrane, unless otherwise indicated.
1. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F121, with high performance polymer modified grout, unless otherwise specified.
2. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCNA (HB) Method F114, with cleavage membrane.

C. Mortar Bed Thickness: 5/8 inch, unless otherwise indicated.

2.07 INSTALLATION - WALL TILE

A. On exterior walls install in accordance with TCNA (HB) Method W244, thin-set over cementitious backer units, with waterproofing membrane.

B. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.

C. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

2.08 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Owner to engage a qualified testing agency to perform tests and inspections.
   1. Tile assemblies will be considered defective if they do not pass tests and inspections.
   2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
   4. Submit field quality control reports to Architect.

C. Tests:
   1. Slip-Resistance.
      a. Confirm the dynamic coefficient of friction (DCOF) meets or exceeds the value in Performance Requirements article above. Test to ANSI A326.3.
   2. Flood Testing.
      a. Flood test each waterproofed area for leaks, in accordance with manufacturer’s recommendations, after completing and protecting waterproofing but before overlaying construction is placed.
         1) After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.

2.09 CLEANING

A. Clean tile and grout surfaces.

B. Seal tile, grout, and stone surfaces.

2.10 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

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SECTION 09 5100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units (CLG-#).

1.02 DEFINITIONS

A. Refer to ASTM E1264 for additional information for the following:
   1. LR: Light Reflectance, the measurement of the luminous reflectance factor of acoustical materials for use in predicting the levels of room illumination, indicated as a percentage from 0.00 to 1.00, per ASTM E1477.
   2. NRC: Noise Reduction Coefficient, is the sound absorption performance of a material, indicated as a percentage from 0.00 to 1.00, per ASTM C423.
   3. CAC: Ceiling Attenuation Class, measures the reduction of sound reflectance through a material and over a partition through a shared plenum, per ASTM E1414/E1414M. The CAC number is equivalent to the noise level reduction, in decibels (dB). For example, a CAC of 30 will reduce transmitted sound by 30 dB.
   4. AC: Articulation Class, used for products in open-plan layouts, in lieu of NRC. It measures the reduction of sound reflected over a partition into adjoining workstations through a shared plenum, per ASTM E1110. AC is indicated as a range from 100 (low) to 250 (high).

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.

D. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

E. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

G. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.

H. ASTM E1110 - Standard Classification for Determination of Articulation Class; 2019.

I. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

J. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum; 2021a.

K. ASTM E1477 - Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers; 1998a (Reapproved 2022).

L. ASCE 7 - Minimum Design Loads for buildings and Other Structures; 2010.

M. CBC Section 1705 - California Building Code Section 1705A; Statement of Special Inspections.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning.

C. Product Data: Provide data on each item to be installed.

D. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

E. Evaluation Service Reports: Current ICC-ES reports for each acoustical panel ceiling and suspension components, including anchor and fastener types. Show compliance with specified requirements.

F. Samples: Submit two samples 4 by 4 inches in size, or manufacturer's standard sample size, illustrating material and finish of acoustical units.

G. Samples: Submit two samples each, 10 inches long, of suspension system main runner, cross runner, and perimeter molding.

H. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

I. Manufacturers' qualification statement.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.

B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

D. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.07 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.08 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 REGULATORY REQUIREMENTS

A. Seismic Design: CBC Seismic Design Catagory E, including:
   1. ASCE 7, "Minimum Design Loads for Buildings and Other Structures"; Section 13, "Seismic Design Requirements for Nonstructural Components."
   2. Additional requirements of CBC Section 1614A.1.12.
   3. Requirements of the Division of the State Architect (DSA) for seismic-resistant design and installation of ceiling suspension systems, including DSA Interpretation of Regulations, IR 25-5.
   4. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4," where more stringent than CBC requirements.

2.03 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. Armstrong.
   2. CertainTeed.
   3. Rockfon.
   4. USG.
   5. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category D, E, or F and complying with the following:
   1. Local authorities having jurisdiction.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

1.03 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.

B. Acoustical Panel Types (CLG-#):
   1. CLG-1: CertainTeed; Symphony M High NRC.
      a. Color: White.
      b. NRC: Not less than 0.85.
      c. CAC: Not less than 35.
      d. Edge / Joint Detail: Reveal.
      e. Thickness: 7/8 inch.
      f. Modular Size: 24 by 48 inches.
      g. Suspension System: SS-
   2. CLG-4: Armstrong; Acoustibuilt.
      a. Color: White.
      b. LR: Not less than 0.87.
      c. NRC: Not less than 0.80.
      d. CAC: Not less than 46.
      e. Edge / Joint Detail: Square.
      f. Thickness: 7/8 inch.
      g. Modular Size: 48 by 72 inches.
      h. Suspension System: Gypsum board ceiling suspension grid.
         1) See Section 09 2216 - Non-Structural Metal Framing, for additional information.
   3. CLG-6: Match CLG-4, except:
      a. Size: Custom, refer to Architectural drawings.
      b. Color: Custom, refer to Architectural drawings.

1.02 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
   1. Products:
      a. See Legend on the Reflected Ceiling Plans.
   2. Materials:
      a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

B. Exposed Suspension System, Type SS-: Hot-dipped galvanized steel grid with steel cap.
   1. Application(s): Seismic.
   2. Structural Classification: Heavy-duty, when tested in accordance with ASTM C635/C635M.
   3. Profile: Tee; 15/16 inch face width.
   4. Finish: Baked enamel.
   5. Color: White.
   6. Products:
      a. Certainteed Architectural; 15/16" EZ Stab Classic System: www.certainteed.com/ceilings-and-walls/#sle.
      b. USG Corporation; Donn Brand ZXLA 15/16 inch Acoustical Suspension System: www.usg.com/ceilings/#sle.

c. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.

C. Hold-Down Clips: Manufacturer's standard clips to suit application.

D. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.

E. Seismic Bracing: Manufacturer's standard perimeter stabilizer bars, compression struts, and seismic ceiling panel clips designed to accommodate seismic forces.

F. Perimeter Moldings: Same metal and finish as grid.
   1. Size: As required for installation conditions and specified Seismic Design Category.
   2. Angle Molding: L-shaped, for mounting at same elevation as face of grid.

G. Gypsum Board: Fire rated type; 5/8 inch thick, ends and edges square, paper faced.

H. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

2.02 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

2.03 INSTALLATION, GENERAL

A. Install acoustical ceiling assemblies according to manufacturer's written instructions and approved shop drawings.

2.04 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions, and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.

E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Seismic Suspension System, Seismic Design Category C: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Maintain a 3/8 inch clearance between grid ends and wall.

G. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch clearance between grid ends and wall.

H. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

I. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

J. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

K. Do not eccentrically load system or induce rotation of runners.

L. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.

2.05 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.
   3. Double cut and field paint exposed reveal edges.

F. Where round obstructions occur, provide preformed closures to match perimeter molding.

G. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.

H. Install hold-down clips on panels within 20 ft of an exterior door.

2.06 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Regulatory Requirements: Special tests and inspections for suspended ceiling systems and anchorages per CBC Section 1705.3.

C. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:
   1. Suspended ceiling system.
   2. Hangers, anchors and fasteners.

D. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

E. Tests and Inspections: Completed installations of acoustical panel ceiling hangers and anchors and fasteners; in successive stages; do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.

1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
   a. Hanging Wire Tests: Select 1 of every 10 wire/anchor assemblies using power-actuated fasteners or postinstalled anchors to attach hangers to concrete; a test for 200 lbf (800 N) of tension.
   b. Bracing Wire Tests: Select 1 of every 2 wire/anchor assemblies using postinstalled anchors to attach bracing wires to concrete; test for 400 lbf (1957 N) of tension along the axis of the bracing wire.
2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

F. Remove and replace acoustical panel ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.

G. Prepare test and inspection reports.

2.07 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

2.08 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Clean surfaces.

C. Replace damaged or abraded components.

END OF SECTION

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SECTION 09 5426
SUSPENDED WOOD CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood grilles (CL-2).

B. Metal suspension system.

1.02 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.

C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.

D. CISCA (WC) - Wood Ceilings Technical Guidelines; 2009.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: For each item to be installed.

C. Shop Drawings: Indicate grid layout and related dimensioning, attachment of wood ceiling components to grid, accessory attachments, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.

D. Samples: Panels, in manufacturer's standard sample size.

E. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for fire, acoustical, and seismic performance.

F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.04 QUALITY ASSURANCE

A. Designer Qualifications for Seismic Design: Perform design under direct supervision of Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with at least five years documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.05 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Construct 4 feet by 4 feet mock-up including suspension members, trim, and wood ceiling components.
C. Locate where directed.
D. Mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver wood ceiling components to project site in original, unopened packages.
B. Store in fully enclosed space, flat, level and off the floor.

1.07 FIELD CONDITIONS

A. Do not install suspended wood ceiling system until wet construction work is complete and permanent heat and air conditioning is installed and operating.
B. Maintain room temperature between 60 degrees F and 75 degrees F and relative humidity between 35 to 55 percent before, during, and after installation.

1.08 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Suspended Wood Ceilings:
1. 9Wood.
2. Armstrong.
3. CertainTeed.
4. Rulon.
5. USG.
6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SUSPENDED WOOD CEILING SYSTEM

A. Suspended Wood Ceiling System (CL-2):
1. Basis of Design Product:
a. Armstrong; Woodworks Grille Forte, Item 6326L, S02.
b. Substitutions: See Section 01 2500 - Substitution Procedures.
2. Acoustical Infill Panel Product:
a. Basis of Design Product:
1) Armstrong; Acoustical Infill Panels.
b. Thickness: 5/8 inch.
c. Color: Black

B. Performance Requirements:
1. Design for maximum deflection of 1/360 of span.
2. Design to resist seismic load by using practices specified in ASTM E580.

C. Metal Suspension System:
   1. General: Comply with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
   2. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement.

D. Accessories: Manufacturer's standard accessories for installation method indicated, seismic requirements and above-ceiling accessibility.

2.03 FABRICATION

A. Shop fabricate wood ceiling components to the greatest extent possible.

B. Fabricate components to allow access to ceiling plenum as required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not install ceiling until after interior wet work is dry.

3.02 PREPARATION

A. Coordinate the location of hangers with other work.

B. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

C. Layout wood ceiling components in pattern according to reflected ceiling plan and as shown on shop drawings.

D. Acclimate wood ceiling materials by removing from packaging in installation area a minimum of 48 hours prior to installation.

3.03 INSTALLATION

A. General: Install suspended wood ceiling system in accordance with CISCA (WC).

B. Suspension System:
   1. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
   2. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
   3. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
   4. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
   5. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
   6. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
   7. Do not eccentrically load system or induce rotation of runners.

8. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch movement. Maintain visual closure.

C. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.

D. Wood Ceiling:
1. Install wood ceilings in accordance with manufacturer's instructions.
2. Fit wood components in place, free from damaged edges or other defects detrimental to appearance and function.
3. Install components in uniform plane, and free from twist, warp, and dents.
4. Cut to fit irregular grid and perimeter edge trim.
5. Make field cut edges of same profile as factory edges, seal and finish according to manufacturer.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

3.05 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Clean and touch up minor finish damage. Remove and replace components that cannot be successfully cleaned and repaired.

END OF SECTION

SECTION 09 6500
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient sheet flooring.
B. Resilient tile flooring.
C. Static control resilient tile flooring.
D. Resilient base.
E. Installation accessories.

1.02 REFERENCE STANDARDS

A. ANSI A326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials; 2021.
B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2019a, with Editorial Revision (2020).
C. ASTM F150 - Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring; 2006 (Reapproved 2018).
D. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2020.
E. ASTM F1859 - Standard Specification for Rubber Sheet Floor Covering Without Backing; 2021a.
F. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.
G. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2019.
H. ASTM F2034 - Standard Specification for Sheet Linoleum Floor Covering; 2018.
I. ASTM F2195 - Standard Specification for Linoleum Floor Tile; 2018 (Reapproved 2023).
J. BAAQMD 8-51 - Bay Area Air Quality Management District Regulation 8, Rule 51, Adhesive and Sealant Products; www.baaqmd.gov; 2002.
K. CAL (CHPS LEM) - Low-Emitting Materials Product List; California Collaborative for High Performance Schools (CHPS); current edition at www.chps.net/.
L. GEI (SCH) - GREENGUARD "Children and Schools" Certified Products; GREENGUARD Environmental Institute; current listings at www.greenguard.org.
M. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.
N. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; www.aqmd.gov.
O. SCS (CPD) - SCS Certified Products; Scientific Certification Systems; current listings at www.scscertified.com.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Shop Drawings: Indicate seaming plans and floor patterns.

E. Manufacturer's installation instructions.

F. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

G. Verification Samples: Submit two samples, 6 by 6 inch in size, or manufacturer's standard sample size, illustrating color and pattern for each resilient flooring product specified.

H. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

I. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.

J. Manufacturer's Qualification Statement.

K. Installer's Qualification Statement.

L. Field Quality Control Reports: As specified in Part 3 of this Section.

M. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.

1.04 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.

B. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum five years documented experience.

C. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience and approved by flooring manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

D. Store all materials off of the floor in an acclimatized, weather-tight space.

E. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

F. Protect roll materials from damage by storing on end.

G. Do not double stack pallets.

H. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.06 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

B. Ambient Conditions: Maintain ambient temperature and humidity as required by manufacturer for each product to be installed, before and after installation.

1.07 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. Dynamic Coefficient of Friction (DCOF): Resilient floors to be minimum 0.42, in accordance with ANSI A326.3.

B. Fire-Test-Response Characteristics: For resilient flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.03 REGULATORY REQUIREMENTS

A. Resilient flooring shall be stable, firm, and slip resistant. CBC Section 11B-302.1.

2.04 SHEET FLOORING

A. Vinyl Sheet Flooring - (RF-#): Homogeneous without backing, with color and pattern throughout full thickness.
   1. Products:
      a. Refer to Finish Schedule on the Architectural drawings.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Minimum Requirements: Comply with ASTM F1913.
   3. Seams: Heat welded.

B. PVC-Free Resilient Sheet Flooring - (RF-#): Mineral and thermoplastic polymer construction; ionomer-impregnated wear surface.
   1. Products:
      a. Refer to Finish Schedule on the Architectural drawings.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Seams: Heat welded.

C. Rubber Sheet Flooring - (RF-#): 100 percent rubber composition, color and pattern through total thickness.
   1. Products:
      a. Refer to Finish Schedule on the Architectural drawings.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Minimum Requirements: Comply with ASTM F1859, Type 1, without backing.
   3. Seams: Heat welded.

D. Linoleum Sheet Flooring - (RF-#): Homogeneous wear layer bonded to backing, with color and pattern through wear layer thickness.
   1. Products:
      a. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Minimum Requirements: Comply with ASTM F2034, Type corresponding to type specified.

E. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.

1.02 TILE FLOORING

A. Vinyl Tile - (RF-#): Solid vinyl with color and pattern throughout thickness.
   1. Products:
      a. Refer to Finish Schedule on the Architectural drawings.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.

B. Linoleum Tile: - (RF-#) Homogeneous wear layer bonded to backing, with color and pattern through wear layer thickness.
   1. Products:
      a. Refer to Finish Schedule on the Architectural drawings.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Minimum Requirements: Comply with ASTM F2195, Type corresponding to type specified.

C. Static Control Tile - (RF-#): Homogeneous; color and pattern throughout thickness.
   1. Products:
      a. Refer to Finish Schedule on the Architectural drawings.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Electrical Resistance:
      a. Conductive Tile: Resistance between 25 kiloohms and 1.0 megohms as tested in accordance with ASTM F150.

1.03 RESILIENT BASE

A. Resilient Base - (B-#): ASTM F1861, Type TP, rubber, thermoplastic.
   1. Products:
      a. Refer to Finish Schedule on the Architectural drawings.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Height: As shown on the Architectural drawings.

1.02 ACCESSORIES

A. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

B. Adhesive: As recommended by manufacturer for flooring type, location, and conditions.

C. Copper Grounding Strips: Type and size as recommended by static control flooring manufacturer.

D. Floor Polish for Static Control Flooring: Fluid-applied polish, intended to protect electrical properties of flooring, as recommended by static control flooring manufacturer.

1.03 SOURCE QUALITY CONTROL

A. Special Printing Procedures for Digitally Printed Resilient Flooring:
   1. General:
      a. Provide all files in one of the appropriate for- mats listed, including all support files used.
      b. Layout all files in the correct resolution, proportions or scale (1/4 scale) to final size.
      c. Convert all fonts to Outlines and remove any stray text that has not been converted.
      d. If using Photoshop Rasterize all text and re- move any text layers not raster.
   2. Color Matching:
      a. Color set to CMYK (Cyan, Magenta, Yellow, Black).
      b. Please set up all files for CMYK color mode.
      c. Illustrator files must have all colors used converted to CMYK.
      d. All photographic support files used in Illustrator must be CMYK and prepared to the proper resolution and format for the project.
      e. Call out critical colors as Pantone Solid Coat- ed colors.
      f. When PMS match is required a test print should be ordered. Additional charges apply.
   3. Blacks:
      a. Rich black should be used in place of all blacks and composed of 90%C, 90%M, 90%Y, 100%K. This will produce a richer shade of black.
      b. By default Adobe InDesign overprints 100% black onto whatever is behind it. There’s a good chance you will see the background layers through the black. To fix use a rich black (recommended) or set black to 99%.
   4. Bleeds:
      a. Create art with a 1” bleed on all four sides.
      b. 0.9 mm art material greater than 52” will have a seam in final production. Design as one file.
      c. 1.3 mm, 1.9 mm, 2.2 mm art greater than 10’ will have a seam in final production but when possi- ble designed as one file.
   5. Resolution:
      a. Photographs MUST be designed to have 150 DPI of resolution at FINISHED SIZE, and in CMYK Mode.
      b. Images MUST not be interpolated as this will greatly affect the resolution and quality of the final printed flooring.
      c. Images taken from the internet are usually at 72 DPI and are not usable.
   6. Spot White:
      a. Spot white layer must be created in the top most layer with a spot color titled “White_Ink”.

b. Choke the white layer by -.0125”.

7. Overprinting:
   a. Make sure that none of your design elements are set to overprint unless you are trying to achieve an overprint effect.
   b. White elements should never be set to overprint as this will simply make the white element disappear when printed.
8. Supported Formats:
   a. AI (Adobe Illustrator).
   b. EPS OUTLINES (Encapsulated Post Script) Also know as Vector Files or Outline Files. Provide support files or embed graphics used in your design.
   c. PSD (Adobe Photoshop Layered Files).
   d. TIFF (Tagged Image File Format).
   e. EPS Photographic (Encapsulated Post Script).
   f. JPEG (Compressed file).

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Concrete Substrate Verification: Substrate moisture content and alkalinity to be confirmed by testing. See Section 09 0561 - Common Work Results for Flooring Preparation, for additional information.

D. Verify that required floor-mounted utilities are in correct location.

2.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is fully cured.

D. Clean substrate.

E. Apply primer as recommended by flooring manufacturer.

2.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions and approved shop drawings.

C. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

D. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.

2. Resilient Strips: Attach to substrate using adhesive.

E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

F. Digitally Printed Flooring: Follow manufacturer's written instructions to ensure there is no cutoff on the graphic’s edges.

2.04 INSTALLATION - SHEET FLOORING

A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

B. Seams are prohibited in bathrooms, kitchens, toilet rooms, and custodial closets.

C. Seal seams by heat welding where indicated.

2.05 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

2.06 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Install base on solid backing. Bond tightly to wall and floor surfaces.

2.07 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Owner to engage a qualified testing agency to perform tests and inspections.
1. Resilient flooring will be considered defective if they do not pass tests and inspections.
2. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
3. Testing and inspecting agency to prepare reports and deliver to Owner or Contractor.
4. Submit field quality control reports to Architect.

C. Tests:
1. Slip-Resistance.
a. Confirm the dynamic coefficient of friction (DCOF) meets or exceeds the value in Performance Requirements article above. Test to ANSI A326.3.

2.08 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

2.09 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

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SECTION 09 6813
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile carpeting and walk-off carpet tile.

1.02 REFERENCE STANDARDS

A. ASTM D2646 - Standard Guide for Backing Fabric Characteristics of Pile Yarn Floor Coverings; 2018.

B. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).

C. ASTM D7330 - Standard Test Method for Assessment of Surface Appearance Change in Pile Floor Coverings Using Standard Reference Scales; 2015.

D. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2019a, with Editorial Revision (2020).

E. CBC Section 1124B; Ground and Floor Surfaces.

F. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Shop Drawings: Indicate layout of joints.

E. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

F. Manufacturer's Installation Instructions: Indicate special procedures.

G. Manufacturer's Qualification Statement.

H. Installer's Qualification Statement.

I. Sample warranty.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.04 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.

B. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum five years documented experience.

C. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.06 FIELD CONDITIONS

A. Ambient Conditions: Maintain ambient temperature and humidity as required by manufacturer for each product to be installed, before and after installation.

B. Store materials in area of installation for minimum period of 24 hours prior to installation.

1.07 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For tile carpet flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.

B. Appearance Retention Rating: Moderate traffic, 2.5 minimum according to ASTM D7330.

C. Dry Breaking Strength: Not less than 100 lbf according to ASTM D2646.

2.03 REGULATORY REQUIREMENTS

A. Carpet / Carpet Tile Flooring: CBC Section 11B-302.2
   1. Carpet shall be securely attached and shall have a firm cushion, pad, or backing or no cushion or pad. It shall have a level loop, textured loop, level cut pile, or level cut/uncut pile texture. Pile height shall be 1/2 inch maximum.
   2. Exposed edges shall be fastened to floor surfaces and shall have trim on the entire length. Carpet edges shall comply with CBC Section 11B-303.

B. Accessibility: Comply with the requirements of CBC section 1124B for carpet tile thickness limits, attachment requirements, backings and edge treatments.

2.04 CARPET TILE

A. Carpet Tile Types: See Finish Schedule on the Architectural drawings.

2.05 MATERIALS

A. Tile Carpeting: Tufted, manufactured in one color dye lot.
   1. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
   2. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").

2.06 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.

B. Edge Strips: Embossed aluminum, color as selected by Architect.

C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. See Section 01 7000 - Execution and Closeout Requirements.

B. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

D. Concrete Substrate Verification: Substrate moisture content and alkalinity to be confirmed by testing. See Section 09 0561 - Common Work Results for Flooring Preparation, for additional information.

E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Vacuum clean substrate.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.
B. Install carpet tile in accordance with manufacturer's instructions and approved shop drawings.
C. Blend carpet from different cartons to ensure minimal variation in color match.
D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
F. Trim carpet tile neatly at walls and around interruptions.
G. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
B. Remove excess adhesive without damage, from floor, base, and wall surfaces.
C. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 7200
WALL COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall coverings (WC-#).

1.02 REFERENCE STANDARDS

A. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Coating Systems; 2020.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes; 2002 (Reapproved 2007).

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on wall covering and adhesive.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Shop Drawings: Indicate wall elevations with seaming layout.

E. Samples: Submit two samples of wall covering, 6 by 6 inches in size or manufacturer's standard size, illustrating color, finish, and texture.

F. Test Reports: Indicate verification of flame and smoke ratings, when tested by UL.

G. Manufacturer's Installation Instructions: Indicate special procedures.

H. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.

I. Manufacturer's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum 5 years of documented experience.

1.05 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Provide panel, 3 panel drops wide, full height, illustrating installed wall covering and joint seaming technique.

C. Locate where directed.

D. Mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inspect roll materials at arrival on site, to verify acceptability.

B. Protect packaged adhesive from temperature cycling and cold temperatures.

C. Do not store roll goods on end.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.

B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 WALL COVERINGS

A. General Requirements:
   1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
   2. Chemical and Stain Resistance: No visible staining or discoloration and no damage to surface texture when tested in accordance with ASTM D1308.

B. Wall Covering (WC-#):
   1. Basis of Design Products: See Finish Schedule on the Architectural drawings.

C. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.

B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.

3.02 PREPARATION

A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.

B. Wash impervious surfaces with cleaner recommended by wall covering manufacturer, rinse and neutralize; wipe dry.

C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

D. Vacuum clean surfaces free of loose particles.

3.03 INSTALLATION

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.

B. Apply adhesive to wall surface immediately prior to application of wall covering.

C. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.

D. Butt edges tightly.

E. Horizontal seams are not acceptable.

F. Do not seam within 2 inches of internal corners or within 6 inches of external corners.

G. Install wall covering before installation of bases and items attached to or spaced slightly from wall surface.

H. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.

B. Reinstall wall plates and accessories removed prior to work of this section.

3.05 PROTECTION

A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION

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SECTION 09 8100
ACOUSTIC INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Acoustic batt insulation.

B. Sprayed acoustic insulation for miscellaneous voids.

1.02 REFERENCE STANDARDS

A. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements.

B. Product Data: For each item to be installed.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. CAL (CDPH SM) compliance data.

D. Manufacturer's installation instructions.

1.04 COORDINATION

A. Fire-Rated Assemblies: Confirm insulation products within fire-rated assemblies meet fire-rated assembly requirements.
   1. Substitutions will not be permitted when proprietary products are required to meet fire-rating requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

C. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.06 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.07 WARRANTY

A. Provide manufacturer's standard warranty for installed products.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Refer to Architectural drawings for minimum STC values to be achieved at interior assemblies.

2.03 ACOUSTIC BATT INSULATION

A. Mineral Wool Unfaced Acoustic Batts: ASTM C665, Type I (batts without membrane facing) produced by combining thermosetting resins free of added urea, phenol, and urea-extended phenol formaldehyde, and with mineral fibers manufactured from rock wool.
   1. Products:
      a. Rockwool; AFB Sound Attenuation Batts.
      b. Thermafiber (Owens Corning); Thermafiber SAFB (Sound Attenuation Fire Blanket).
      c. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Physical Properties:
      a. Thickness:
         1) Partitions: As required to fill cavity.
         2) Above suspended ceilings: 6 inches minimum.
   3. Location:
      a. Concealed applications.
      b. Where required to meet requirements of fire-rated partitions.
      c. Where shown on the drawings.

B. Glass-Fiber Unfaced Acoustic Batts: ASTM C665, Type I (batts without membrane facing) produced by combining thermosetting resins free of added urea, phenol, and urea-extended phenol formaldehyde, and with mineral fibers manufactured from glass.
   1. Products:
      a. CertainTeed; NoiseReducer.
      b. Johns Manville; Sound-Shield Sound Control Batts.
      c. Owens Corning; Ecotouch Sound Attenuation Batts (SAB).
      d. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Physical Properties:
      a. Thickness:
         1) Partitions: As required to fill cavity.
         2) Above suspended ceilings: 6 inches minimum.
   3. Location:

a. Concealed applications.
b. Where shown on the drawings.

2.04 SPRAYED ACOUSTIC INSULATION FOR MISCELLANEOUS VOIDS

A. Sprayed Polyurethane Foam Acoustic Insulation: Low-density, low-pressure, 2-component open-cell.
1. Products:
a. ICP Building Solutions; HandiFoam Low Density.
b. RHH Foam Systems; Versi-Foam System 31.
c. Substitutions: See Section 01 2500 - Substitution Procedures.
2. Location:
a. Concealed applications.

2.05 ACOUSTIC ACCESSORIES

A. Acoustic Joint Sealants: See 07 9200 - Joint Sealants.
B. Impaling Pin Adhesives: Type recommended by manufacturer to suit substrate conditions indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

3.02 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.
B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.03 BATT INSULATION INSTALLATION

A. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
B. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.04 SPRAY-APPLIED INSULATION INSTALLATION

A. Install according to manufacturer's written installation instructions and approved shop drawings.
B. Spray insulation to envelop entire area to be insulated and fill voids.

C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

3.05 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 09 8430
SOUND-ABSORBING WALL AND CEILING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sound-absorbing panels.

1.02 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

B. SAA: Sound Absorption Average.

1.03 REFERENCE STANDARDS

A. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.

B. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

D. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.

E. NFPA 265 - Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile or Expanded Vinyl Wall Coverings on Full Height Panels and Walls; 2019.

F. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: For each item to be installed.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.
   2. CAL (CDPH SM) compliance data.
   3. Life cycle data.
   4. Sustainable wood data.
   5. Recycled content data.
   6. Rapidly renewable content data.

D. Shop Drawings: Fabrication and installation details, panel layout, fabric orientation, and wood grain orientation.

E. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, and patterns available.

F. Verification Samples: Fabricated samples of each type of panel specified; 12 by 12 inch, showing construction, edge details, and fabric covering.

G. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.

H. Manufacturer's qualification statement.

I. Warranty.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with at least three years of documented experience.

B. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.

C. Mock-ups: See Section 01 4000 - Quality Requirements.
   1. Build mockups to verify selections made under sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   2. Approved mock-ups may remain as part of the completed Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.

C. Store units flat, in dry, well-ventilated space; do not stand on end.

D. Protect edges from damage.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.07 FIELD CONDITIONS

A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Verify actual dimensions by field measurement before fabrication. Show recorded measurements on shop drawings.

1.08 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to the following:
      a. Acoustical performance.

b. Fabric sagging, distorting, or releasing from panel edge.
c. Warping of core.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. CDPH: Products to comply with CAL (CDPH SM) .

D. Life Cycle: Products in this section to have LCA as specified in Section 01 6000.

E. Sustainable Wood: Products in this Section to meet sustainable wood requirements specified in Section 01 6000.

F. Recycled Content: Products in this Section to meet minimum recycled content thresholds specified in Section 01 6000.

G. Rapidly Renewable Content: Products in this Section to be made of rapidly renewable material as specified in Section 01 6000.

2.02 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol (textiles) or NFPA 286 (non-textiles).

2.03 FIBERGLASS SOUND-ABSORBING UNITS

A. Rigid Fiberglass Board for Walls (CLG-3):
1. Basis of Design Product:
a. Conwed; Coploymer Wall Panel, Metro Rebound.
b. Substitutions: See Section 01 2500 - Substitution Procedures.
2. Thickness: 1-1/16 inches.
3. Facing: 1/16-inch surface laminated to core.
4. Color: As selected by Architect from manufacturer's full range.

B. Semi-Rigid Fiberglass Board for Ceilings (CLG-5):
1. Basis of Design Product:
a. Armstrong; Soundscape Shapes.
b. Substitutions: See Section 01 2500 - Substitution Procedures.
2. Shape: Hexagon, 3'-10" x 3'-3".
3. Thickness: 7/8 inch.
4. Color: As selected by Architect from manufacturer's full range.

1.02 FABRICATION

A. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.

1.03 ACCESSORIES

A. Spline-Mounting Accessories: Manufacturer's standard concealed connecting splines of extruded aluminum designed for screw attachment to walls, with coordinating moldings and trim for interior and exterior corners and miscellaneous conditions.
   1. Color of Exposed Trim: As selected from manufacturer's standards.

B. Back-Mounting Accessories: Manufacturer's standard accessories for concealed support, designed to allow panel removal:

C. Tensioned Cable System: Manufacturer's standard accessories for mounting conditions and spans indicated.

D. Standoff Mounting System: Manufacturer's standard accessories for mounting conditions and spans indicated.

E. Panel Adhesive: Acceptable to acoustical panel manufacturer for application as indicated.

PART 3 EXECUTION

2.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

2.02 INSTALLATION

A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.

B. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

C. Install mounting accessories and supports in accordance with shop drawings.

D. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.

E. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:
   1. Plumb and level.
   2. Flatness.

2.03 CLEANING

A. Clean sound-absorptive panels upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

2.04 PROTECTION

A. Provide barrier or other delineation to prevent damage to installed Work from subsequent construction activities.

B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

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SECTION 09 9113
EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior painting.

1.02 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting.

1.03 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2023.

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

D. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

E. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

F. SSPC-SP 13/NACE No.6 - Surface Preparation of Concrete; 2018.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: For each item to be installed. Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   4. Manufacturer's installation instructions.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
3. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum five years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:
1. Benjamin Moore.

2. Dunn-Edwards.
3. Modern Masters (Rust-Oleum).
4. PPG.
5. Sherwin-Williams.
6. Tnemec.
7. Substitutions: See Section 01 2500 - Substitution Procedures.

2.03 PAINTS AND FINISHES - GENERAL

A. Paint Colors: See Finish Schedule on the Architectural drawings.

B. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. Supply each paint material in quantity required to complete entire project's work from a single production run.
   4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

2.04 PAINT SYSTEMS - EXTERIOR

A. Paint WE-OP-3A - Wood, Opaque, Alkyd, 3 Coat:
   1. One coat of alkyd primer sealer.
   2. Gloss: Two coats of alkyd enamel.
   3. Semi-gloss: Two coats of alkyd enamel.

B. Concrete:
   1. Primer: PPG; Perma-Crete Exterior alkali-resistant primer.
   2. Finish: Two coats Modern Masters; Theme Paint, Premixed Colors.
      a. Color: As selected by Architect from manufacturer's full range.

C. Paint GE-OP-3L - Exterior Plaster, Opaque, Latex, 3 Coat:
   1. One coat of latex primer sealer.
   2. Flat: Two coats of latex.

D. Paint ME-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
   1. One coat of alkyd primer.
   2. Gloss: Two coats of alkyd enamel.
   3. Semi-gloss: Two coats of alkyd enamel.

E. Paint ME-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
   1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
   2. Gloss: Two coats of alkyd enamel.
   3. Semi-gloss: Two coats of alkyd enamel.

F. Paint MgE-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
   1. One coat galvanize primer.
   2. Gloss: Two coats of alkyd enamel.
   3. Semi-gloss: Two coats of alkyd enamel.

G. Paint MaE-OP-3A - Aluminum, Unprimed, Alkyd, 3 Coat:
   1. One coat etching primer.
   2. Gloss: Two coats of alkyd enamel.
   3. Semi-gloss: Two coats of alkyd enamel.

2.05 PRIMERS

A. Provide primer as recommended by manufacturer for substrate and conditions.

2.06 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Exterior Plaster and Stucco: 12 percent.
   2. Fiber Cement Siding: 12 percent.
   3. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
   4. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
   2. Prepare surface as recommended by top coat manufacturer and in accordance with SSPC-SP 13/NACE No.6.

G. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
   2. Prepare surface as recommended by top coat manufacturer.

H. Fiber Cement Siding: Remove dirt, dust and other foreign matter with a stiff fiber brush. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

I. Exterior Plaster: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

J. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

K. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

L. Copper: Remove contamination by steam, high pressure water, or solvent washing.

M. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

N. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

O. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.

P. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.

Q. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

A. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 09 9123
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior painting.

1.02 RELATED REQUIREMENTS

A. Section 09 9113 - Exterior Painting.

1.03 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2023.

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

D. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

E. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

F. SSPC-SP 13/NACE No.6 - Surface Preparation of Concrete; 2018.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. MPI product number (e.g., MPI #47).
   3. Cross-reference to specified paint system products to be used in project; include description of each system.
   4. Manufacturer's installation instructions.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.

E. Manufacturer's Instructions: Indicate special surface preparation procedures.

F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Paint and Finish Materials: 1 gal of each color; from the same product run, store where directed.
3. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum five years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

D. Provide lighting level of 80 fc measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:
   1. Benjamin Moore.
   2. Dunn-Edwards.
   3. PPG.
   4. Sherwin-Williams.
   5. Substitutions: See Section 01 2500 - Substitution Procedures.

2.03 PAINTS AND FINISHES - GENERAL

A. Paint Colors: See Finish Schedule on the Architectural drawings.

B. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. Supply each paint material in quantity required to complete entire project's work from a single production run.
   4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
   1. Ceilings: Not moe than Gloss Level 3 (Eggshell).
   2. Trim: At least Gloss Level 6 (Gloss).
   3. Bathroom Walls: At least Gloss Level 5 (Semi-Gloss).
   4. Other Walls: At least Gloss Level 3 (Eggshell).

2.04 PAINT SYSTEMS - INTERIOR

A. Paint WI-OP-3L - Wood, Opaque, Latex, 3 Coat:
   1. One coat of latex primer sealer.
   2. Gloss: Two coats of latex enamel.
   3. Semi-gloss: Two coats of latex enamel.
   4. Eggshell: Two coats of latex enamel.
   5. Flat: Two coats of latex enamel.

B. Paint CI-OP-3A - Concrete/Masonry, Opaque, Alkyd, 3 Coat:
   1. One coat of block filler.
   2. Semi-gloss: Two coats of alkyd enamel.
   3. Flat: Two coats of alkyd enamel.

C. Paint MI-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
   1. One coat of alkyd primer.
   2. Gloss: Two coats of alkyd enamel.
   3. Semi-gloss: Two coats of alkyd enamel.

D. Paint MI-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
   1. Touch-up with alkyd primer.
   2. Gloss: Two coats of alkyd enamel.
   3. Semi-gloss: Two coats of alkyd enamel.

E. Paint MgI-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
   1. One coat galvanize primer.
   2. Gloss: Two coats of alkyd enamel.
   3. Semi-gloss: Two coats of alkyd enamel.

F. Paint MaI-OP-3A - Aluminum, Unprimed, Alkyd, 3 Coat:
   1. One coat etching primer.
   2. Gloss: Two coats of alkyd enamel.
   3. Semi-gloss: Two coats of alkyd enamel.

G. Paint CI-OP-3Af - Concrete/Masonry, Alkyd Floor Enamel, 3 Coat:
   1. One coat of alkali-resistant primer.
   2. Gloss: Two coats of alkyd floor enamel.

H. Paint GI-OP-3L - Gypsum Board/Plaster, Latex, 3 Coat:
   1. One coat of alkyd primer sealer.
   2. Gloss: Two coats of latex enamel.
   3. Semi-gloss: Two coats of latex enamel.
   4. Eggshell: Two coats of latex enamel.
   5. Flat: Two coats of latex enamel.

2.05 PRIMERS

A. Provide primer as recommended by manufacturer for substrate and conditions.

2.06 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been adequately prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Plaster and Stucco: 12 percent.
   3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
5. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
   2. Prepare surface as recommended by top coat manufacturer and in accordance with SSPC-SP 13/NACE No.6.

G. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
   2. Prepare surface as recommended by top coat manufacturer.

H. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

I. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

J. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high-alkali surfaces.

K. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

L. Copper: Remove contamination by steam, high-pressure water, or solvent washing.

M. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

N. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

O. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

P. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.

Q. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.

R. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Sand wood and metal surfaces lightly between coats to achieve required finish.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 09 9600
HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High performance coatings.

1.02 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2023.

C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.

D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

E. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

F. SSPC V1 (PM1) - Good Painting Practice: Painting Manual Volume 1; 2024.

G. SSPC V2 (PM2) - Systems and Specifications: Steel Structures Painting Manual Volume 2; 2021.

H. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals; 2016.

I. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

J. SSPC-SP 2 - Hand Tool Cleaning; 2018.

K. SSPC-SP 3 - Power Tool Cleaning; 2018.

L. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

M. SSPC-SP 11 - Power-Tool Cleaning to Bare Metal; 2020.

N. SSPC-SP 13/NACE No.6 - Surface Preparation of Concrete; 2018.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
   4. Manufacturer's installation instructions.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Manufacturer's Certificate: Certify that high-performance coatings comply with VOC limits specified.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
G. Maintenance Data: Include cleaning procedures and repair and patching techniques.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Coating Materials: 1 gallon of each type and color.
   2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.04 QUALITY ASSURANCE

A. Maintain one copy of each referenced document that applies to application on site.
B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum tenyears documented experience.
C. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.
B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
C. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
D. Coating Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.
E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.06 FIELD CONDITIONS

A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the coating product manufacturer.
C. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.
D. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
E. Restrict traffic from area where coating is being applied or is curing.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Correct defective Work within a one (1) year period after Date of Substantial Completion.
C. Warranty: Include coverage for bond to substrate.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 MANUFACTURERS

A. High-Performance Coatings:
   1. Dow.
   2. Dunn Edwards.
   3. ICI.
   4. Kelly-Moore.
   5. PPG.
   6. Precision Coatings.
   7. Rust-Oleum
   8. Sika.
   9. Sherwin-Williams.
   10. Tnemec.
   11. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 HIGH-PERFORMANCE COATINGS

A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in MPI Approved Products List.

1.03 TOP COAT MATERIALS

A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
   1. Colors: As shown on the Architectural drawings, or as otherwise selected from manufacturer's full range.

B. Elastomeric Coating:
   1. Number of Coats: Two.
   2. Top Coat(s): Exterior Pigmented Elastomeric, Water Based; MPI #113.
      a. Sheen: Flat.
      b. Products:
         1) Dow; DOWSIL ALLGUARD Silicone Elastomeric Coating: www.dow.com/#sle.
         2) Pittsburgh Paints; Perma-Crete Pitt-Flex Elastomeric Coating, 4-110XI Series, Flat: www.ppgpaints.com/#sle. (MPI #113)
         3) Tnemec Company, Inc; Series 156 Enviro-Crete: www.tnemec.com/#sle.
         4) Substitutions: See Section 01 2500 - Substitution Procedures.

C. Urethane Coating for Steel:
   1. Number of Coats: Two.
   2. Product Characteristics:
      a. Dry film thickness, per coat: 2-3 mils, minimum.

3. Top Coat(s): Polyurethane, Two-Component; MPI #72, #174.
   a. Sheen: Semi-Gloss.
   b. Products:
4. Top Coat(s): Polyurethane, Water Based, Two-Component.
   a. Sheen: Satin.
   b. Products:
      1) PPG Paints; Amerishield VOC Polyester Acrylic Polyurethane, AMV-3 Series, Gloss: www.ppgpaints.com/#sle.
      2) Sherwin-Williams Pro Industrial Waterbased Alkyd Urethane, Low Sheen: www.protective.sherwin-williams.com/#sle.
      3) Tnemec Company, Inc; Series 297 Enviro-Glaze: www.tnemec.com/#sle.
      4) Substitutions: See Section 01 2500 - Substitution Procedures.

D. Primers: As recommended by coating manufacturer for specific substrate, unless otherwise specified.

E. Shellac: Pure, white type.

1.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not begin application of coatings until substrates have been properly prepared.

C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Cementitious Substrates: Do not begin application until substrate has cured 28 days minimum and measured moisture content is not greater than 12 percent.
   2. Plaster and Stucco: 12 percent.
   3. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
   4. Concrete Floors and Traffic Surfaces: 8 percent.
   5. Wood: Do not begin application if substrate has moisture content over 12 percent.

F. Proceed with coating application only after unacceptable conditions have been corrected.
   1. Commencing coating application constitutes Contractor's acceptance of substrates and conditions.

2.02 PREPARATION

A. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

B. Clean surfaces of loose foreign matter.

C. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.

D. Remove finish hardware, fixture covers, and accessories and store.

E. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
   2. Prepare surface as recommended by coating manufacturer and in accordance with SSPC-SP 13/NACE No.6.

F. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
   2. Prepare surface as recommended by coating manufacturer.

G. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

H. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3, and protect from corrosion until coated.

2.03 PRIMING

A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

B. Concrete: Prior to priming, patch with masonry filler to produce smooth surface.

2.04 COATING APPLICATION

A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in MPI - Architectural Painting and Specification Manual.

B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

2.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

2.06 PROTECTION

A. Protect finished work from damage.

END OF SECTION

SECTION 09 9620
PERMANENT NON-SACRIFICIAL ANTI-GRAFFITI COATING

PART 1 - GENERAL

1.01 **SECTION INCLUDES**

A. Anti-graffiti coating systems vertical surfaces for cast stone, brick masonry, concrete unit masonry (painted and unpainted), cast-in-place building concrete, cast-in-place site concrete, and architectural site concrete.

B. Surface preparation

C. field application

1.02 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 079005 - Joint Sealers; Joint sealants.

1.03 REGULATORY REQUIREMENTS

A. California Air Resources Board, Volatile Organic Compound (VOC) Limitation: Provide anti-graffiti coating materials, including primers, undercoats, and finish-coat materials, that have a VOC content of 100 g/l or less, consistent with Southern California Air Quality Management District (SCAQMD) Rule 1113 for architectural flat coatings.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating coating materials and installation recommendations.

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Maintenance Data: Include cleaning procedures and repair and patching techniques.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Coating Materials: 1 gallon of each type and color.
   2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.05 QUALITY ASSURANCE

A. Maintain one copy of each referenced document that applies to application on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

C. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

1.06 MOCK-UP

A. Apply Sealer and Anti-graffiti coating to approved Architectural Site Concrete Mock-ups for review and approval by Architect and client prior to beginning work.
B. Locate where directed.
C. Mock-up may not remain as part of the Work.

1.07 FIELD CONDITIONS

A. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.
B. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
C. Restrict traffic from area where coating is being applied or is curing.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within one year period after Date of Substantial Completion.
C. Warranty: Include coverage for bond to substrate.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
    1. Euclid Chemical.
    2. Evonik Industries.
    3. Prosoco.
    4. RainGuard.
    5. Sika.
    6. Tnemec.
    7. W.R. Meadows.
    8. Substitutions: See Section 01 2500 - Substitution Procedures.

2.02 ANTI-GRAFFITI COATINGS

A. Type 2, Silane/Siloxane-Based Systems:
    1. Rainguard International Inc., VandlGuardTEN non-sacrificial Anti-Graffiti System.
        a. Sealer; Product Micro-Seal Water Repellant.
        b. Non-Sacrificial Coating; Product VandlGuardTEN
        c. Finish Coat; Product VandlGuard Finish Coat.

2.03 PERFORMANCE REQUIREMENTS

A. General: Non-sacrificial anti-graffiti coating system with the following properties:
    1. Superior protection against, and easy removal of, unwanted graffiti.
    2. Minimum alteration of appearance of treated surface when compared to untreated surface, including gloss and color.
    3. Minimum alteration of water vapor transmission rate through complete wall system.

a. Coating system shall have a minimum water vapor transmission rate of 95 percent when tested per ASTM D1653.

B. Completed coating system performance shall comply with ASTM D 6578 “Standard Practice for Determination of Graffiti Resistance,” and the following:
1. Cleanability Level 3: Achieve Level 3 cleaning performance, removing all test graffiti items using citrus-based cleaners or milder solvents.

C. Apply to all exposed surfaces of site architectural concrete vertical surfaces.
1. Cast in place concrete.
2. Concrete masonry units.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions under which anti-graffiti coatings will be applied, for compliance with coating application requirements.

B. Apply coatings only after unsatisfactory conditions have been corrected and surfaces to receive coatings are thoroughly dry.

3.02 PREPARATION

A. General: Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item; provide surface-applied protection before surface preparation and coating.
1. After completing coating operations, reinstall items that were removed, using workers skilled in the trades involved.

B. Surface Preparation: Clean and prepare surfaces to be coated according to manufacturer's written instructions for each substrate condition and as specified.
1. Prepare concrete to be coated. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods to prepare surfaces.
2. Surfaces to receive sealer shall be cleaned of dirt, oil, graffiti, grease, laitance, and other contaminants.
3. Mid-pressure water (1500 psi) washing is the minimum cleaning that will be accepted, other methods, such as abrasive blasting and power may be submitted for review.
4. Schedule cleaning and coating application so dust and other contaminates from cleaning process will not fall on wet, newly coated surfaces.

C. Material Preparation: Carefully mix and prepare coating materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying coatings in a clean condition, free of foreign materials and residue.
2. Stir materials before applying to produce a mixture of uniform density. Stir as required during application.
3. Do not stir surface film into the material. Remove film and, if necessary, strain coating material before using.
4. Use only the type of thinners approved by manufacturer and only within recommended limits.

D. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of coating system components. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of components being deposited on surfaces. Cover live plants and grass.

E. Coordination with Sealants: Do not apply anti-graffiti coatings until sealants for joints adjacent to surfaces receiving coatings have been installed and cured.
   1. Anti-graffiti coating work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, anti-graffiti coatings, and sealant materials identical to those used in the work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of anti-graffiti coatings and to instruct Applicator on the product and application method to be used.

B. General: Apply anti-graffiti coatings according to manufacturer's written instructions.
   1. Use applicators and techniques best suited for the material being applied.
   2. Do not apply anti-graffiti coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to forming a durable coating film.
   3. Coating surface treatments and finishes are indicated in the coating system descriptions.
   4. Provide finish coats compatible with primers used.
   5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, drinking fountains, grilles, covers for electrical equipment, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.

C. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces.
   1. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.

D. Scheduling Coating: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.

E. The number of coats and film thickness required is the same regardless of application method.
   1. Micro-Seal- one (1) coat
   2. VandlGuard TEN- two (2) coats
   3. VandlGuard Finish Coat- one (1) coat

F. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. Allow sufficient time between successive coats to permit proper drying.

G. Give special attention to edges, corners, crevices, and similar surfaces to ensure that they receive a dry film thickness equivalent to that of flat surfaces.

H. Application Procedures: Apply coatings according to manufacturer's written instructions.
   1. Spray Equipment: Use spray equipment with pressure and orifice size recommended by manufacturer for material and texture required.

I. Minimum Coating Thickness: Apply each material no thinner than manufacturers recommended spreading rate.
   1. Provide total dry film thickness of the entire system as recommended by manufacturer.

J. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by manufacturer, to material required to be coated or finished that has not been prime coated by others.

K. Recoat primed and sealed substrates immediately if there is evidence of suction spots or unsealed areas in first coat, to ensure a finish coat with no burn -through or other defects caused by insufficient sealing.

L. Completed Work: Match accepted mockups for shade and coverage. Remove, refinish, or recoat work that does not comply with specified requirements.

3.04 FIELD QUALITY CONTROL

A. Provide the services of the manufacturer's authorized field representative to verify that installed products comply with manufacturer's requirements and with the standard established by the Architect approved mockup/test panels.

B. Remove and replace work where test results indicate that it does not comply with specified requirements.

3.05 CLEANING

A. Immediately clean anti-graffiti coatings from adjoining surfaces and surfaces soiled or damaged by application as work progresses. Repair damage caused by application. Comply with manufacturer's written cleaning instructions.

B. Clean up debris and unused material and remove from site.

3.06 PROTECTION

A. Protect work of other trades, whether being coated or not, against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

END OF SECTION

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SECTION 10 1419
DIMENSIONAL LETTER SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dimensional letter signage.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's product literature for each type of dimensional letter sign, indicating style, font, colors, locations, and overall dimensions of each sign.

C. Shop Drawings:
   1. Include dimensions, locations, elevations, materials, text and graphic layout, and attachment details.

D. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

E. Manufacturer's qualification statement.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Package dimensional letter signs as required to prevent damage before installation.

B. Store under cover and elevated above grade.

PART 2 PRODUCTS

2.01 DIMENSIONAL LETTERS

A. Applications: Building identification.
   1. Use individual metal letters.
   2. Mounting Location: Exterior as indicated on drawings.

B. Acrylic and Metal Letters: Refer to Architectural drawings for configuration and materials.
   1. Mounting: Concealed screws.

2.02 ACCESSORIES

A. Concealed Screws: Noncorroding metal; stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with horizontal edges level.

END OF SECTION

SECTION 10 1423
PANEL SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Panel signage.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.
C. Shop Drawings:
   1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.
D. Verification Samples: Submit samples showing colors, materials, and finishes specified.
E. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.04 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.
B. Package signs as required to prevent damage before installation.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.02 PANEL SIGNAGE

A. Panel Signage:
   1. Application: Room and door signs.
   2. Configuration and Materials: Refer to Architectural drawings.
   3. Description: Flat signs with engraved panel media, tactile characters.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with horizontal edges level.

C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

D. Protect from damage until mm-dd-yyyy; repair or replace damaged items.

END OF SECTION

SECTION 10 2113.19
PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Solid plastic toilet compartments.

1.02 REFERENCE STANDARDS

A. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

1.03 ADMINISTRATIVE REQUIREMENTS

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on panel construction, hardware, and accessories.

C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

D. Samples: Submit two samples of partition panels, 6 by 6 inches or otherwise in manufacturer's size, illustrating panel finish, color, and sheen.

E. Manufacturer's Installation Instructions: Indicate special procedures.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.06 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Accessible Toilet Compartments: CBC Section 11B-604
   1. Wheelchair accessible compartment shall comply with CBC Section 11B-604.8.1.
   2. Toe clearance for at least one side partition of a wheelchair accessible compartment shall comply with CBC Section and Figure 11B-604.8.1.4. It shall be 9 inches high minimum above the finish floor and 6 inches deep minimum beyond the compartment side face of the partition, exclusive of partition support members. It shall be 12 inches high minimum above the finish floor for children's use. Partition components at toe clearances shall be smooth without sharp edges or abrasive surfaces. Toe clearances at the side partition is not required in a compartment greater than 66 inches wide.
   3. An ambulatory accessible compartment shall be provided where there are six or more toilet compartments, or where the combination of urinals and water closets totals six or more per CBC Section 11B-213.3.1. Such compartment shall comply with CBC Section 11B-604.8.2.
   4. Door and door hardware for accessible compartments shall be self-closing and shall comply with CBC Section 11B-404 except that pull-side clearance for ambulatory accessible compartments shall be a minimum of 44 inches clear, rather than 60 inches. CBC Figure 11B-604.8.2.
   5. A door pulll complying with CBC Seection 11B-404.2.7 shall be placed on both sides of the door near the latch.
   6. Doors shall not swing into clear floor space or clearance requied for any fixtures.
   7. Install coat hook at 48 inches maximum above finished floor.

2.02 MANUFACTURERS

A. Solid Plastic Toilet Compartments:
   1. Accurate Partitions.
   2. Ampco.
   3. Bradley.
   4. Hadrian.
   5. Inpro.
   6. Scranton Products.
   7. Substitutions: Section 01 6000 - Product Requirements.

2.03 PLASTIC TOILET COMPARTMENTS

A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286 and graffiti-resistant; floor-mounted headrail-braced.

B. Basis of Design Product:
   1. See Restroom Accessories Schedule on the Architectural drawings.
   2. Substitutions: See Section 01 2500 - Substitution Procedures.

C. Doors:
   1. Thickness: 1 inch.
   2. Width: 24 inch.
   3. Accessible Width: 36 inch, out-swinging.

4. Height: 66 inches.

D. Panels:
1. Thickness: 1 inch.
2. Height: 66 inch.

E. Pilasters:
1. Thickness: 1 inch.
2. Width: As required to fit space; minimum 3 inch.

2.04 ACCESSORIES

A. Pilaster Shoes: Stainless steel, satin finish, 3 inches high; concealing floor fastenings.

B. Head Rails: Extruded aluminum, anti-grip profile.

C. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.

D. Hinges: Stainless steel, manufacturer's standard finish.
1. Continuous-type hinge, self closing.

E. Door Hardware: Stainless steel, manufacturer's standard finish.
1. Door Latch: Slide type with exterior emergency access feature.
2. Door Strike and Keeper with Rubber Bumper: Mount on pilaster in alignment with door latch.
3. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify correct spacing of and between plumbing fixtures.

C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

3.03 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

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SECTION 10 2239
FOLDING PANEL PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Top-supported folding panel partitions, horizontally-opening.

B. Top-supported operable panel partitions, vertical opening, electrical operation.

1.02 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

D. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

E. ASTM E413 - Classification for Rating Sound Insulation; 2022.

F. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation Between Spaces Separated by Operable Partitions; 2012 (Reapproved 2020).

G. ASTM E596 - Standard Test Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures; 2022.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene at project site minimum 2 weeks before starting work of this Section.
   1. See Section Section 01 3000 - Administrative Requirements for additional information.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Delegated Design Documents: See Section 01 3000 - Administrative Requirements.
   1. Provide design documentation prepared by Contractor's Licensed Professionals.

C. Product Data: For each item to be installed.

D. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

E. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, static and dynamic loads, location and details of pass door and frame, adjacent construction and finish trim, and stacking depth.

F. Samples for Selection: Submit 3 samples of full manufacturer's color range for selection of colors.

G. Samples for Review: Submit two samples of surface finish, 4 by 4 inches size, illustrating quality, colors selected, texture, and weight.
H. Certificates: Certify that partition system meets or exceeds specified acoustic requirements.
I. Manufacturer's Instructions: Indicate special procedures.
J. Designer's qualification statement.
K. Manufacturer's qualification statement.
L. Installer's qualification statement.
M. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Designer Qualifications: Perform design under direct supervision of Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
   2. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum 5 years of documented experience.
   3. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.
B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.
C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.
D. Store products in manufacturer's unopened packaging until installation.
E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within five year period after Date of Substantial Completion.
C. Provide two year manufacturer warranty against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.01 DELEGATED DESIGN

A. Delegated Design: See Section 01 3000 - Administrative Requirements.
B. Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design folding panel partitions.

2.02 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.03 PERFORMANCE REQUIREMENTS

A. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.

B. Seismic Performance: Operable panel partitions are to withstand the effects of earthquake motions determined in accordance with ASCE 7.
   1. The term "withstand" means "the partition panels will remain in place without separation of any parts when subjected to the seismic forces specified."

C. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties in accordance with test methods indicated:
   1. Sound-Transmission (STC) Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance in accordance with ASTM E90, determined by ASTM E413, and rated for not less than the STC indicated.
   2. Noise-Reduction (NRC) Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance in accordance with ASTM C423, and rated for not less than the NRC indicated.

D. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction:
   1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.

2.04 MANUFACTURERS

A. Manufacturers:
   1. Advanced Equipment Coorporation.
   2. Hufco
   3. Kwik-Wall.
   4. Moderco.
   5. Modernfold (domakaba).
   6. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING

A. Operable Acoustical Panel Partitions: Partition system including panels, seals, finish facing, suspension system, operators, and accessories.
   1. Basis of Design Manufacturer: Modernfold.
   2. Panel Operation: Manually operated, paired.

B. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment.
   1. Frame: 16 gauge, 0.0598 inch thick formed sheet steel frame top, bottom, jambs, and intermediates; welded construction, with acoustical insulation fill.

2. Substrate: Gypsum board.
3. Hinges: Manufacturer's standard.
4. Hardware: Latching door handles of cast steel, satin chrome finish; lock cylinder keyed to building keying system.

C. Panel Finishes:
1. Facing: Vinyl coated fabric.
2. Exposed Metal Trim: Custom powder coated paint finish.

D. Panel Seals:
1. Panel to Panel Seals: Grooved and gasketed astragals, with continuous flexible ribbed vinyl seal fitted to panel edge construction; color to match panel finish.
2. Acoustic Seals: Flexible acoustic seals at jambs, meeting mullions, ceilings, retractable floor and ceiling seals, and above track to structure acoustic seal.

E. Suspension System:
1. Track: Formed steel; 1-1/4 by 1-1/4 inch size; thickness and profile designed to support loads, steel sub-channel and track connectors, and track switches.
2. Carriers: Nylon wheels on trolley carrier at top of every second panel, sized to carry imposed loads, with threaded pendant bolt for vertical adjustment.

F. Performance:
1. Acoustic Performance:
a. Noise Reduction Coefficient (NRC): ASTM E596, NRC of 0.65 minimum.
b. Sound Transmission Class (STC): 38 to 42 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft.

G. Operation: Manually operated, paired.

H. Accessories:
1. Ceiling Closure: White enameled ceiling closure; aluminum jamb and head molding, fittings and attachments, and intermediate meeting posts.
2. Pocket Enclosures: Door, frame, and trim to match adjacent walls.

1.03 OPERABLE PANEL PARTITIONS - VERTICAL OPENING

A. Operable Panel Partition: Vertical opening; individual panels stacked in drive box above ceiling; motor operated.
1. Basis of Design Product:
a. ModernFold; Skyfold Zenith 48.
b. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Panel Construction:
1. Frame: 16 gauge, 0.0598 inch thick formed sheet steel frame top, bottom, jambs, and intermediates; welded construction, with acoustical insulation fill.
2. Substrate: Gypsum board.

C. Panel Finishes:
1. Facing: Vinyl coated fabric.

D. Panel Seals:
1. Panel to Panel Seals: Tongue and groove configuration, color to match panel finish.
2. Horizontal Bottom Seal: Retractable safety sensor seal providing minimum of 2 inches floor adjustability to accommodate out-of-level floors.

E. Suspension System:
1. Guide Rails: Extruded aluminum; 6 inches wide and 6 inches deep.

2. Guide Rollers: Sealed rollers with hardened steel ball bearings.
3. Drive Box: Hardened steel construction.
    a. Supports weight of panels in stacked position.

F. Performance:
1. Acoustic Performance:
    a. Noise Reduction Coefficient (NRC): ASTM E596, NRC of 0.65 minimum.
    b. Sound Transmission Class (STC): 38 to 42 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft.
2. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.

G. Operation:
1. Electric Operator: 5 to 10 feet per minute vertical traveling speed.
    a. Drive system includes drive shafts, couplers, torque limiter, key pressure actuation control station wired in series, dual drive emergency operation and all necessary equipment for electric operation.
    b. Chain drive attaches to dual direction lead panel.
2. Control Station: One standard keyed switch (RESET-OFF-ON) and one two-position (OPEN-CLOSE, constant pressure) type rocker switch; 24 volt circuit; surface mounted.
    a. Master key switch prepared for mortise lock cylinder.
    b. Key switches alike.
3. Safety Features:
    a. Load Arrestor: Stops free fall occurrence.
    b. Entrapment Backup System: Automatically reverses downward movement when lead edge makes contact with obstruction within path of travel.
    c. Limit Switches: Automatic type, at both extremes of travel, to prevent over-travel.
    d. Emergency Release: Mechanism to disengage motor drive system and permit manual operation.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that required utilities are available, of the correct characteristics, in proper location, and ready for use.

C. Verify track supports are laterally braced and will permit track to be level within 1/4 inch of required position and parallel to the floor surface.

D. Verify floor flatness of 1/8 inch in 10 feet, non-cumulative.

E. Verify wall plumbness of 1/8 inch in 10 feet, non-cumulative.

2.02 INSTALLATION

A. Install partition in accordance with manufacturer's instructions and ASTM E557.

B. Fit and align partition assembly level and plumb.

C. Lubricate moving components.

D. Install acoustic sealant to achieve required acoustic performance.

E. Coordinate electrical connections.

2.03 ADJUSTING

A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.

B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.

C. Adjust partition assembly to achieve lightproof seal.

2.04 CLEANING

A. Clean finish surfaces and partition accessories.

2.05 CLOSEOUT ACTIVITIES

A. Demonstrate operation of partition and identify potential operational problems.

END OF SECTION

SECTION 10 2310
GLAZED INTERIOR WALL AND DOOR ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. U-channel glazed interior wall and door assemblies.

B. Framed glazed interior wall and door assemblies.

1.02 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

F. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

G. ASTM E413 - Classification for Rating Sound Insulation; 2022.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's descriptive literature for each component in partition assembly.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Shop Drawings: Drawings showing layout, dimensions, identification of components, and interface with adjacent construction.
   1. Include field measurements of openings.
   2. Include Elevations Showing:
      a. Locations and identification of manufacturer-supplied door hardware and fittings.
      b. Locations and sizes of cut-outs and drilled holes for other door hardware.
   3. Include Details Showing:
      a. Requirements for support and bracing of overhead track.
      b. Installation details.
      c. Appearance of manufacturer-supplied door hardware and fittings.

E. Selection Samples: Two sets, representing manufacturer's full range of available metal materials and finishes.

F. Verification Samples: Two samples, minimum size of 2 inch by 3 inch, representing actual material and finish of exposed metal.

G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

H. Specimen Warranty.

I. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.

J. Manufacturer's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than five years of documented experience.
      a. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
      b. Safety Glazing Certification Council (SGCC).

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Store products in manufacturer's unopened packaging until installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.06 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions by field measurement before fabrication. Show recorded measurements on shop drawings.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a one year period after Date of Substantial Completion.

C. Provide 10 year manufacturer warranty against excessive degradation of metal finishes. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

2.02 MANUFACTURERS

A. U-channel Glazed Interior Wall and Door Assemblies:
   1. Avanti Systems.
   2. C.R. Laurence.
   3. Dorma.
   4. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Framed Glazed Interior Wall and Door Assemblies:
   1. Advanced Architectural Frames.
   2. Avalon International Aluminum.
   3. C.R. Laurence.
   4. Frameworks Manufacturing.
   5. Dormakaba.
   6. Kawneer.
   7. Raco Interiors.
   8. Space Plus (Sliding Door Company).
   9. Western Integrated Materials.
   10. Wilson Partitions.
   11. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 PERFORMANCE REQUIREMENTS

A. Acoustical Performance: Provide glass partitions and door assemblies tested by qualified testing agency, calculated in accordance with ASTM E413, tested in accordance with ASTM E90, and rated for not less than Sound Transmission Class (STC) indicated.
   1. Partition STC Rating: 35, minimum, for framed partition.
   2. Door STC Rating: 18, minimum, for sliding door.

1.03 U-CHANNEL GLAZED INTERIOR WALL AND DOOR ASSEMBLIES

A. U-Channel Glazed Interior Wall Assembly: Factory fabricated assemblies consisting of full-width and height glass panels fastened with U-channel fittings on top and bottom edge of glass wall.
   1. Basis of Design Product:
      a. C.R. Laurence; Brushed Stainless Anodized Wet Glaze 1-1/2" Deep U-Channel.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. U-Channel Fittings: Extruded aluminum, brushed stainless anodized finish, wet glazed, and with matching end caps.
   3. Glass Thickness: 1/2 inch, tempered.
   4. Designed to withstand normal operation without damage, racking, sagging, or deflection.
   5. Coordinate wall and door assembly preparation and provide hardware as necessary for fully operable installation.
   6. Finished metal surfaces protected with strippable film.
   7. Factory assembled to greatest extent practical; may be disassembled to accommodate shipping constraints.

B. Pivoting Glass Doors: Dry glazed patch fittings.
   1. Door Configuration: As indicated on drawings.
   2. Glass Thickness: 1/2 inch, tempered.
      a. See Section 08 8000 - Glazing, for additional information.

3. Provide accessories as required for complete installation.

1.04 FRAMED GLAZED INTERIOR WALL AND DOOR ASSEMBLIES

A. Framed Glazed Interior Wall Assembly: Factory fabricated assemblies consisting of center-glazed rectilinear aluminum framing with screw spline or clip joinery.
   1. Basis of Design Product:
      a. Western Integrated Materials; 300 Series.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Configuration: As indicated on drawings.
   3. Profile Width: 1-1/2 inch.
   4. Frame Finish: Class II natural anodized.
   5. Provide wood blocking at sill of glazing frame to match height of floor finish.
   6. Exposed Fasteners: Stainless steel.
   7. Coordinate wall and door assembly preparation and provide hardware as necessary for fully operable installation.
   8. Design system to withstand normal operation without damage, racking, sagging, or deflection.
   9. Factory assembled to greatest extent practical; may be disassembled to accommodate shipping constraints.

B. Pivoting Glass Doors: Patch fittings at head and sill on pivot side and at lock and strike on swing side.
   1. Basis of Design Product:
      a. Western Integrated Materials; Aluminum Interior Swing Doors.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Door Configuration: As indicated on drawings.
   3. Door Stiles: Medium.
   4. Glass Thickness: 1/2 inch, tempered.
      a. See Section 08 8000 - Glazing, for additional information.
   5. Provide accessories as required for complete installation.

C. Sliding Glass Doors: Top supported from roller assembly inside head channel frame.
   1. Basis of Design Product:
      a. Western Integrated Materials; Alumaglide Sliding Door System.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Door Configuration: As indicated on drawings.
   3. Door Stiles: Medium.
   4. Glass Thickness: 1/2 inch, tempered.
      a. See Section 08 8000 - Glazing, for additional information.
   5. Provide accessories as required for complete installation.

1.05 FITTINGS AND HARDWARE

A. Glass Partition Door Hardware: Refer to Section 08 7100.

1.06 GLAZING

A. See Section 08 8000 - Glazing.

1.07 WOOD DOORS

A. See Section 08 1416 - Flush Wood Doors.

1.08 MATERIALS

A. Aluminum Components: Complying with ASTM B221 (ASTM B221M), alloy 6063, T5 temper.

B. Stainless Steel Components: Complying with ASTM A666, Type 316L alloy.

C. Sealant: One-part silicone sealant, complying with ASTM C920, clear.

1.09 FINISHES

A. Anodized Finish: See Section 05 0511 - Surface Preparation and Finishing of Metals, for additional information.

B. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils thick.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that track supports are properly braced, level within 1/4 inch of required position and parallel to the floor surface.

C. Verify floor flatness of 1/8 inch in 10 feet, non-cumulative.

D. Do not begin installation until supports and adjacent substrates have been properly prepared.

E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

2.02 PREPARATION

A. Clean substrates thoroughly prior to installation.

B. Prepare substrates using the methods recommended by the manufacturer for achieving acceptable result for the substrate under the project conditions.

2.03 INSTALLATION

A. Install in accordance with glazed interior wall and door assembly manufacturer's instructions.

B. Fit and align glazed interior wall and door assembly level and plumb.

2.04 ADJUSTING

A. Adjust glazed interior wall and door assembly to operate smoothly from sliding or pivoting positions.

B. Adjust swing door hardware for smooth operation.

2.05 CLEANING

A. Remove protective film from exposed metal surfaces.

B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.

C. Glass and Glazing: Clean glazing surfaces; remove excess glazing sealant compounds, dirt, and other substances.

2.06 PROTECTION

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements.

B. Provide barrier or other delineation to prevent damage to installed Work from subsequent construction activities.

C. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 10 2600
WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Corner guards.

B. Protective wall covering.

1.02 RELATED REQUIREMENTS

A. Section 05 5213 - Pipe and Tube Railings: Metal railings not intended to protect walls..

1.03 REFERENCE STANDARDS

A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.

B. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2021.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

D. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2023.

E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

F. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.

D. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. CDPH: Products to comply with CAL (CDPH SM) .
D. Life Cycle: Products in this section to have LCA as specified in Section 01 6000.
E. Recycled Content: Products in this Section to meet minimum recycled content thresholds specified in Section 01 6000.

2.02 MANUFACTURERS

A. Babcock-Davis.
B. Balco.
C. Construction Specialties, Inc.
D. Inpro.
E. Koroseal.
F. MDC Interior Solutions.
G. Panolam.
H. Wallguard.
I. Substitutions: See Section 01 2500 - Substitution Procedures.

2.03 PERFORMANCE CRITERIA

A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.
B. Chemical and Stain Resistance: Unless otherwise noted, provide protection products and assemblies with chemical and stain resistance complying with applicable provisions of ASTM D543.
C. Fungal Resistance: Unless otherwise noted, provide protection products and assemblies which pass ASTM G21 testing.

2.04 PRODUCT TYPES

A. Corner Guards - Flush Mounted:
   1. Material: Polyethylene terephthalate (PET or PETG); PVC-free.
   2. Width of Wings: 2 inches.
   3. Corner: Square.
   4. Color: As selected from manufacturer's standard colors.
   5. Length: One piece.
B. Protective Wall Covering:
   1. Material: Polyethylene terephthalate (PET or PETG); PVC and PBTs-free.
   2. Thickness: 0.040 inch.
   3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
   4. Color: As selected from manufacturer's standard colors.
   5. Mounting: Adhesive.
C. Adhesives and Primers: As recommended by manufacturer.
D. Mounting Brackets and Attachment Hardware: Appropriate to component and substrate.

2.05 FABRICATION

A. Fabricate components with tight joints, corners and seams.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
B. Verify that field measurements are as indicated on drawings.
C. Verify that substrate surfaces for adhered items are clean and smooth.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions and approved shop drawings.
    1. Install items level and plumb, secured rigidly in position to supporting construction.

3.03 CLEANING

A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

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SECTION 10 2800
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Under-lavatory pipe supply covers.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. CBC 1118B - Space Alowance and Reach Ranges; California Building Code.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Sanitary Facility Elements: CBC Section 11B-602 through 11B-612

1. Elements of sanitary facilities shall be mounted at locations in compliance with CBC Sections 11B-602 through 11B-612.
2. Grab bars on toilet facilities and bathing facilities shall comply with CBC Section 11B-609. Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges. The space around the grab bars shall be as follows:
   a. 1-1/2 inches between the grab bar and the wall.
   b. 1-1/2 inches minimum between the grab bar and projecting objects below and at the ends.
   c. 12 inches minimum between the grab bar and projecting objects above.
3. Toilet paper dispensers shall be continuous flow type.

2.02 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. ASI.
   2. Bobrick.
   3. Bradley.
   4. Koala Care.
   5. Substitutions: Section 01 6000 - Product Requirements.

2.03 COMMERCIAL TOILET ACCESSORIES

A. Basis of Design Products: See Restroom Accessories Schedule on the Architectural drawings.

2.04 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Under-Lavatory Pipe and Supply Covers:
   1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
   2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
   3. Construction: 1/8 inch flexible PVC.
      a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
   4. Color: White.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 4400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.
B. Fire extinguisher cabinets.
C. Accessories.

1.02 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
B. FM (AG) - FM Approval Guide; Current Edition.
C. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
D. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide extinguisher operational features.
C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Fire extinguisher cabinets must comply with CBC Sections 11B-307, 11B-308, 11B-309 and 11B-403.

2.02 MANUFACTURERS

A. Fire Extinguishers:
   1. Activar.
   2. Ansul.
   3. JL Industries.
   4. Kidde.
   5. Larsen's Manufacturing.
   6. Nystrom.
   7. Potter-Roemer.
   8. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Fire Extinguisher Cabinets and Accessories:
   1. Activar.
   2. Kidde.
   3. Larsen's Manufacturing.
   4. Nystrom.
   5. Potter-Roemer.
   6. Substitutions: See Section 01 2500 - Substitution Procedures.

1.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Class: A:B:C type.
   2. Size: 10 pound.

1.03 FIRE EXTINGUISHER CABINETS

A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

B. Fire Rated Cabinet Construction: One-hour fire rated.

C. Cabinet Configuration: Semi-recessed type.

1.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

B. Lettering: “FIRE EXTINGUISHER” decal, or vinyl self-adhering, prespaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

2.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

2.03 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION

SECTION 10 5113
METAL LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal lockers.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
D. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.
C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
D. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Lockers:
   1. ASI.
   2. Lyon.
   3. Penco.
   4. Republic.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 METAL LOCKERS

A. Accessibility: Design units indicated on drawings as 'accessible' to comply with ICC A117.1 and ADA Standards.
B. Locker Case Construction:

1. Standard-Duty, Knocked Down Construction: Made of formed sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
    a. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
        1) Unperforated Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
            (a) Zinc-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation G60/Z180.
    b. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
        1) Door Frame: 16 gauge, 0.0598 inch, minimum.
    c. Where ends or sides are exposed, provide flush panel closures.
    d. Provide filler strips where indicated, securely attached to lockers.

C. Doors: Channel edge; welded construction, manufacturer's standard stiffeners, grind and finish edges smooth.
    1. Door Thickness: 16 gauge, 0.0598 inch, minimum.
    2. Form recess for operating handle and locking device.

D. Latches and Door Handles:
    1. Latching: Manufacturer's standard for locking arrangement selected.
        a. Three-Point Lift Handle Gravity Latch: Pocket-mounted, provide for doors 18 inches or taller.
            1) Handle Pocket, Recess: Stainless steel flush-mounted cup recessed into face of door.
            2) Handle: Steel finger lift mechanism with exposed portion encased in molded plastic trigger.
                (a) Padlock Eye: Integral with lift trigger, sized for use with 9/32 inch diameter padlock shackles.
            3) Latching Mechanism: Spring activated nylon slide latch enclosed in steel latch channel allows closing of door while padlock or built-in lock is in position.
            4) Lock Hole Filler Plate: Manufacturer's standard. Provide for lockers intended to be unsecured or secured with padlocks.
            5) Rubber bumpers riveted to door stops for silent operation.

E. Hinges: Continuous piano hinge with powder coat finish to match locker color.

F. Sloped Top: 20 gauge, 0.0359 inch, with closed ends.

G. Coat Hooks: Stainless steel or zinc-plated steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared bases are in correct position and configuration.

B. Verify bases and embedded anchors are properly sized.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Place and secure on prepared base.

C. Install lockers plumb and square.

D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.

E. Install fittings if not factory installed.

F. Replace components that do not operate smoothly.

END OF SECTION

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SECTION 10 5613
METAL LIBRARY SHELVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cantilevered shelving.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Rated uniform shelf loads.
   2. Details of shelving assemblies, including reinforcement.
   3. Accessories.

C. Delegated Design Documents: See Section 01 3000 - Administrative Requirements.
   1. Provide design documentation prepared by Contractor's Licensed Professionals.

D. Test Reports: Provide independent agency test reports documenting compliance with specified structural requirements.

E. Shop Drawings: Indicate location, type, and layout of shelving, including lengths, heights, and aisle layout, and relationship to adjacent construction.

F. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and finishes.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Inspect for dents, scratches, or other damage. Replace damaged units.

C. Store in manufacturer's unopened packaging until ready for installation.

D. Store under cover and elevated above grade.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 DELEGATED DESIGN

A. Delegated Design: See Section 01 3000 - Administrative Requirements.

B. Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design metal storage shelving.
   1. Design metal storage shelving, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Submit engineered drawings to City of Inglewood for permit.

2.02 MANUFACTURERS

A. Cantilevered Shelving:
   1. Estey / Tennesco.
   2. Montel.
   3. Spacesaver.
   4. Substitutions: See Section 01 2500 - Substitution Procedures.

2.03 SHELVING - GENERAL

A. See drawings for layout and sizes.

2.04 CANTILEVERED SHELVING

A. Cantilevered Shelving: Freestanding formed steel post frame with slots for cantilevered shelving brackets, sufficiently rigid not to require sway bracing, shelving brackets, shelving surfaces, and accessories as specified. Units are modular and interchangeable.
   1. Basis of Design Product:
      a. Estey / Tennesco; Estey Cantilever Library Shelving Systems.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Unit Width: As indicated on drawings.
   3. Shelf Capacity: Uniform distributed load of 50 psf, minimum.
   4. Shelf Deflection: 1/4 inch in 36 inches, maximum, under specified uniform load.
   5. Adjustability of Shelving: At intervals of 1 inches on center, minimum.
   6. Finish: Baked enamel, medium gloss.
   7. Color: As selected by Architect from manufacturer’s standard range.
   8. Provide single-face and double-face units where indicated.

B. Frame: Formed steel members comprising posts, horizontal spreaders at top and bottom, and base brackets resisting overturning; frame configuration providing full face height and width available for adjustable shelves.
   1. Sheet Metal Thickness: 16 gauge, 0.0598 inch, minimum.
   2. Base Brackets Height from Floor: 9 inches, maximum.
   3. Connecting Hardware: Manufacturer's standard.
   4. Provide manufacturer's standard adjustable leveling devices.

C. Shelf Brackets: Combination shelf support and bookend, formed steel; full depth of shelves and minimum 6 inches height above shelf surface; rounded outer edges and corners for safety.
   1. Thickness: 16 gauge, 0.0598 inch, minimum.

2. Connection to Posts: Two hooks at top, safety lug at bottom.

D. Shelves: Formed steel, finished on all surfaces, with integral back stop.
1. Thickness: 18 gauge, 0.0478 inch, minimum.
2. Bottom Shelf Edge Profile: 1 inch with integral kickplate.
3. Integral sloping shelf at all base shelves, unless otherwise noted on the drawings.
4. Upper Shelves Edge Profile: Extending 3/4 inch, maximum, below top surface of shelf.
5. Shelf Connections: Tab interlock with brackets ; positive bolt connection between shelf and bracket.

E. End Panels and Canopy Tops: High pressure decorative laminate covered particleboard.
1. Thickness: 15/16 inch, minimum.
2. Edges: 3 mm thick edges by 18 mm width that matches laminate by Doelkin.
3. Laminate: Custom, see Architectural drawings. Laminate on both sides.
4. Provide end panels on all exposed ends of shelving runs, unless noted otherwise.
5. Provide custom end panel with book displays where noted and detailed on the drawings.
6. Canopy brackets for laminate / particle board tops at 48 inches and 66 inches high units.
7. Metal canopy tops where noted on drawings.

2.05 ACCESSORIES

A. Kick Plates: Formed sheet metal; enclose open space between bottom shelf and floor on all front sides and open ends; finished to match.

B. Sliding Wire Book Supports: 3 per single face unit.

C. Heavy duty locking, swivel castors, to support load of 66 inches high shelving and 63 inches long units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate is level and that clearances are as specified.

B. Do not begin installation until substrates have been properly prepared.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings.

B. Anchor and reinforce as specified, as indicated on drawings, and as recommended by manufacturer.

C. Install shelving with shelf surfaces level and vertical supports plumb; adjust feet and bases as required.

3.04 CLEANING

A. Clean shelving and surrounding area after installation.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 11 1313
LOADING DOCK BUMPERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Loading dock bumpers of molded rubber with attachment frame.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on unit dimensions, method of anchorage, and details of construction.

C. Manufacturer's Installation Instructions: Submit installation requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Loading Dock Bumpers:
   1. Blue Giant.
   2. Chelfant.
   3. Durable.
   4. Substitutions: See Section 01 2500 - Substitution Procedures.

2.02 COMPONENTS

A. Loading Dock Bumpers: Molded rubber, ozone resistant, Shore A Durometer of 70, minimum, and tensile strength of 950 to 1050 psi, minimum.
   1. Projection From Wall: 4 inches, minimum.
   2. Vertical Height: 10 inches, minimum.
   3. Width: 6 inches, minimum.
   4. Profile: Rectangular.

B. Attachment Hardware: 3/4 inches diameter stainless steel bolts with expansion shields.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that anchor placement is acceptable.

3.02 INSTALLATION

A. Install dock bumpers in accordance with manufacturer's instructions.

B. Set plumb and level.

END OF SECTION

SECTION 11 3013
RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Kitchen appliances.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.

C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 KITCHEN APPLIANCES

A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.

B. Basis of Design Appliances: See Equipment Schedule on the Architectural drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify utility rough-ins are provided and correctly located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.03 ADJUSTING

A. Adjust equipment to provide efficient operation.

3.04 CLEANING

A. Remove packing materials from equipment and properly discard.

B. Wash and clean equipment.

END OF SECTION

SECTION 11 5119
BOOK THEFT PROTECTION EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Library materials theft detection system.

1.02 RELATED REQUIREMENTS

A. Division 26 - Electrical: Requirements for electrical power and signal services and connections.

1.03 DEFINITIONS

A. RFID: Radio frequency identification.

1.04 REFERENCE STANDARDS

A. ISO/IEC 18046-4 - Information technology — Radio frequency identification device performance test methods - Part 4: Test methods for performance of RFID gates in libraries.; 2021.

1.05 SUBMITTALS

A. Product Data: For each item to be installed.
   1. Submit catalog data for the standard manufactured items and as applicable to shop-fabricated or shop-assembled items.

B. Shop Drawings: Showing locations of all system components and interface with electrical services.

C. Manufacturer's installation instructions.

D. Qualifications Statements: For manufacturer and installer.

E. Operation and maintenance data.

F. Warranty.

1.06 COORDINATION

A. Coordinate products with equipment provided under separate contract by Owner.

B. Coordinate requirements for concrete trenches or slab recesses, if any.

1.07 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years documented experience.
   2. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

B. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.

1. Convene minimum 2 weeks before starting work of this Section.

1.08 DELIVERY, STORAGE AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to the site in system manufacturer's original containers with the seals unbroken, factory labels intact, name of manufacturer, and date of manufacture.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.09 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with exiting and accessibility requirements of California Building Code (CBC), including Chapter 11B for accessibility.

2.02 MANUFACTURERS

A. Basis of Design Manufacturer:
   1. FE Technologies.
      a. Contact: Al Skinner.
         1) Email: AL.Skinner@fetechgroup.com .
         2) Phone: (817) 659-4708.
   2. Substitutions not permitted.

1.02 BOOK THEFT PROTECTION SYSTEM

A. General: Library book detection system, by means of exit antennas and radio signals, detects library materials containing pressure sensitive detection targets / strips. When items pass between the installed antenna system and have not been checked out correctly, the system emits an alarm signal notifying library personnel of an unauthorized removal of items.
   1. An exit aisle formed by a minimum of 2 sensing antennas, with exiting between the antennas. Aisles to be a minimum of 47 inches wide.
   2. Installation Requirements:
      a. Power is provided to antennas by installer through conduit installed in floor as specified in Division 26 - Electrical.

B. Self-Loan Stations:
   1. Installation:
      a. Freestanding, child-height.
         1) Basis of Design Product:
            (a) FE Technologies; V6 Self Loan Station.

2) Quantity: 1.

b. Desk-mounted.

1) Basis of Design Product:

(a) FE Technologies; V6 Self Loan Station.

2) Quantity: 3.

B. Security Gates: RFID reader; compliant with ISO/IEC 18046-4.

1. Basis of Design Product:
   a. FE Technologies; Standard Designer Gates (47 inches on center maximum).
2. Quantity: 3.
3. Cables: Direct mount with above grade covered cables running between each gate and continuing to wall where power / data occur.

B. Software:

1. Basis of Design Product:
   a. FE Technologies; Envoy and Library Live - Gates and Self Checks.

PART 3 - EXECUTION

2.01 EXAMINATION

A. Examine areas and conditions under which Work will be performed to determine best location for sensing unit, and to ensure prerequisite Work has been installed.

B. Manufacturer to verify job conditions and promptly report to the Owner and Architect all conditions adversely affecting proper installation of specified equipment and await further instruction. Start of the installation operations shall imply vendor or manufacturer's acceptance of job conditions.

2.02 INSTALLATION

A. Install in accordance with manufacturer's written instructions and approved shop drawings.

B. Detection System: Where indicated on Drawings, install detection panels directly mounted to concrete floor slab, with anchor plate and anchor bolts.

1. FE Technologies will provide anchor plate for GC

C. Synchronize readers to avoid interference where two systems are installed within distance of each other as specified by manufacturer.

2.03 ADJUSTING

A. Adjust operating components to proper and efficient operation, according to manufacturers' instructions.

2.04 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements.

B. Clean equipment to dust-free condition, ready for use.

2.05 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for additional submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstrate proper operation of equipment to Owner's designated representative.

D. Training: Train Owner's personnel on operation and maintenance of system.

2.06 PROTECTION

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements.

B. Provide barrier or other delineation to prevent damage to installed Work from subsequent construction activities.

END OF SECTION

SECTION 11 5133
LIBRARY MAKERSPACE EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Library makerspace equipment.

1.02 RELATED REQUIREMENTS

A. Division 26 - Electrical: Requirements for electrical power and signal services and connections.

1.03 SUBMITTALS

A. Product Data: For each item to be installed.
   1. Submit catalog data for the standard manufactured items and as applicable to shop-fabricated or shop-assembled items.

B. Shop Drawings: Showing locations of all system components and interface with electrical services.

C. Manufacturer's installation instructions.

D. Qualifications Statements: For manufacturer and installer.

E. Operation and maintenance data.

F. Warranty.

1.04 COORDINATION

A. Coordinate products with equipment provided under separate contract by Owner.

B. Coordinate requirements for concrete trenches or slab recesses, if any.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.
   1. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years documented experience.
   2. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

B. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.

1.06 DELIVERY, STORAGE AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to the site in system manufacturer's original containers with the seals unbroken, factory labels intact, name of manufacturer, and date of manufacture.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.07 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 - PRODUCTS

2.01 LIBRARY MAKERSPACE EQUIPMENT

A. Basis of Design Products:
   1. See Equipment Schedule on the Architectural drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which Work will be performed to determine best location for sensing unit, and to ensure prerequisite Work has been installed.

B. Manufacturer to verify job conditions and promptly report to the Owner and Architect all conditions adversely affecting proper installation of specified equipment and await further instruction. Start of the installation operations shall imply vendor or manufacturer's acceptance of job conditions.

3.02 INSTALLATION

A. Install in accordance with manufacturer's written instructions and approved shop drawings.

3.03 ADJUSTING

A. Adjust operating components to proper and efficient operation, according to manufacturers' instructions.

3.04 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements.

B. Clean equipment to dust-free condition, ready for use.

3.05 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for additional submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstrate proper operation of equipment to Owner's designated representative.

D. Training: Train Owner's personnel on operation and maintenance of system.

3.06 PROTECTION

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements.

B. Provide barrier or other delineation to prevent damage to installed Work from subsequent construction activities.

END OF SECTION

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SECTION 11 6133
RIGGING SYSTEMS AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rigging systems and controls.

1.02 REFERENCE STANDARDS

A. ABA Standards - ABA Accessibility Standards; 2004, with Amendments (2015).
B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
E. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal requirements.
B. Product Data: For each item to be installed.
C. Shop Drawings: Project-specific for each rigging system.
D. Certificates: Products to meet or exceed specified requirements.
E. Delegated Design Documents: See Section 01 3000 - Administrative Requirements.
    1. Provide design documentation prepared by Contractor's Licensed Professionals.
F. Structural calculations.
G. Test reports.
H. Manufacturer's installation instructions.
I. Contractor's Professional Engineer's qualification statement.
J. Qualification Statements: For manufacturer and installer.
K. Operation and maintenance data.
L. Warranty.
M. Project Record Documents: See Section 01 7800 - Closeout Submittals.
N. Maintenance materials.

1.04 COORDINATION

A. Coordinate all required items to be supported by support systems.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.

1. Contractor's Professional Engineer: Experienced in providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which the project is located.
2. Manufacturer: Regularly engaged in the manufacturer of professional theater and stage equipment, with minimum 5 years production of such equipment.
3. Installer: Minimum 5 years experience with projects of similar size, scope, and materials.

B. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
1. Convene minimum 2 weeks before starting work of this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.07 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions by field measurement before fabrication. Show recorded measurements on shop drawings.

1.08 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 DELEGATED DESIGN

A. Delegated Design: See Section 01 3000 - Administrative Requirements.

B. Engage a qualified professional engineer, as defined in Section 01 4000 - Quality Requirements, to design rigging systems and controls.

2.02 PERFORMANCE REQUIREMENTS

A. Suspension Equipment: All suspension hardware and cable to be capable of supporting design loads with a minimum safety factor of 5:1.

2.03 MANUFACTURERS

A. Manufacturers:
1. Beck Studios.

2. ETC.
3. Iweiss.
4. Protech.
5. Texas Scenic.
6. Thern Stage Equipment.
7. Wenger.
8. Substitutions: Section 01 2500 - Substitution Procedures.

B. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

1.02 RIGGING SYSTEMS, GENERAL

A. Provide all supplementary structural support necessary for safe and proper static and dynamic conditions of all systems and components required for the Work of this section.

1.03 PIPE GRID SYSTEM

A. Pipe Grid System: Fixed pipe grid for mounting of lighting, AV devices, and similar. Provide all miscellaneous steel required for proper support of the grid, including seismic bracing.
   1. Basis of Design Product:
      a. Iweiss; Steel Pipe Grid.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Physical Properties:
      a. Pipe Material: ASTM A53/A53M, 1-1/2 inches (ID) Schedule 40 black seamless steel pipe, treated to prevent corrosion. Nominal OD of 1.9 inches.
      b. Pipe Length: 21 foot lenghts and shorter to be supplied as single piece. Longer battens to have 18 inches long internal pipe sleeves.
      c. Grid Spacing: 4 feet by 4 feet.
      d. Pipe Crossovers: Secured with pipe cross clamps at all crossovers.
      e. Miscellaneous steel fabrications for system to be in conformance with ASTM A36/A36M.

PART 3 EXECUTION

2.01 EXAMINATION

A. See Section 01 7000 - Execution and Closeout Requirements.

B. Examine all attachment areas and conditions under which the rigging equipment and machinery is to be installed. Work shall not proceed until unsatisfactory conditions have been corrected. Commencement of installation indicates installer’s acceptance of existing conditions as suitable to receive the Work of this section.

2.02 INSTALLATION

A. Install in accordance with manufacturer's written instructions and approved shop drawings.

B. Install all hardware components and rigging assemblies so that all equipment is plumb and parallel, and completely free of unnecessary friction.

C. Electrical Conduit: When installed parallel to grid pipes, install minimum 6 inches above grid.

2.03 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for additional submittals.
B. See Section 01 7900 - Demonstration and Training, for additional requirements.
C. Demonstrate proper operation of equipment to Owner's designated representative.
D. Training: Train Owner's personnel on operation and maintenance of system.

END OF SECTION

SECTION 12 2400
WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior manual roller shades.

1.02 REFERENCE STANDARDS

A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

C. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

D. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.

E. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.

F. Selection Samples: Include fabric samples in full range of available colors and patterns.

G. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

H. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

I. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

J. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

K. Maintenance contracts.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum 3 years of documented experience with shading systems of similar size and type.
   1. Manufacturer's authorized representative.
   2. Factory training and demonstrated experience.

1.06 MOCK-UP

A. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams and batten pockets when applicable.
   1. Obtain Architect's approval of light and privacy characteristics of fabric prior to fabrication.
   2. Full-sized mock-up may become part of the final installation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.08 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 WARRANTY

A. See Section 01 6000 - Product Requirements.

B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
   1. Shade Hardware: One year.
   2. Fabric: One year.
   3. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior Manually Operated Roller Shades:
   1. Draper.
   2. Hunter Douglas.
   3. Levolor.
   4. MechoShade Systems.
   5. Substitutions: See Section 01 2500 - Substitution Procedures.

B. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 ROLLER SHADES

A. General:

1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
2. Provide shade system that operates smoothly when shades are raised or lowered.

B. Roller Shades - Basis of Design: MechoShade Systems LLC; Mecho/5 System; www.mechoshade.com/#sle.
   1. Description: Single roller, manually operated fabric window shades.
      a. Drop Position: Regular roll.
      b. Mounting: As indicated on drawings.
      c. Size: As indicated on drawings.
      d. Fabric: As indicated under Shade Fabric article.
   2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
      a. Material: Steel, 1/8 inch thick.
      b. Double Roller Brackets: Configured for light-filtering and room-darkening shades in one opening.
         1) Light-Filtering Fabric: Room-side of opening.
         2) Room-Darkening Fabric: Glass-side of opening.
      c. Multiple Shade Band Operation: Provide hardware as necessary to operate more than one shade band using a single clutch operator.
      d. Radiused Center Support Brackets: Provide brackets and connectors for radiused window applications.
         1) Maximum Offset: Eight degrees on each side for a 16 degree total offset.
   3. Roller Tubes:
      a. Material: Extruded aluminum.
      b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
      c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
      d. Capable of being removed and reinstalled without affecting roller shade limit adjustments.
   4. Hembars: Designed to maintain bottom of shade straight and flat.
      a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
      b. Room-Darkening Shades: Provide a slot in bottom bar with wool-pile light seal.
   5. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
      a. Provide a permanently lubricated brake assembly mounted on an oil-impregnated hub with wrapped spring clutch.
      b. Brake must withstand minimum pull force of 50 lb in the stopped position.
      c. Mount clutch/brake assembly on the support brackets, fully independent of the roller tube components.
   6. Drive Chain: Continuous loop stainless steel beaded ball chain, 95 lb minimum breaking strength. Provide upper and lower limit stops.
      a. Chain Retainer: Chain tensioning device complying with WCMA A100.1.
   7. Managed Lift: Required lifting force of 3 lb to a maximum of 8.5 lb for single-band or multi-band shades up to 5 bands and a maximum of 30 lb hanging weight.
   8. Accessories:
      a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; baked enamel finish.
         1) Color: Match aluminum storefront system.

2) Profile: Square.
3) Configuration: Captured and continuous, as indicated on drawings.

b. Ceiling Pockets: Premanufactured metal shade pocket with removable closure panel, for recess mounting in acoustical tile or drywall ceilings; size and configuration as indicated on drawings.
c. Fasteners: Noncorrosive, and as recommended by shade manufacturer.

2.03 SHADE FABRIC

A. Fabric - Type RS-1: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
1. Manufacturers:
a. MechoShade Systems LLC; EcoVeil Screens - 1550 Series (3% open): www.mechoshade.com/#sle.
b. Substitutions: See Section 01 6000 - Product Requirements.
2. Material: Vinyl coated polyester.
3. Material Certificates and Product Disclosures:
a. Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
b. Cradle to Cradle Material Health Certificate: Achievement level of Bronze.
c. Health Product Declaration (HPD): Complete, published declaration with full disclosure of known hazards.
d. Declare label.
4. Performance Requirements:
a. Flammability: Pass NFPA 701 large and small tests.
b. Fungal Resistance: No growth when tested according to ASTM G21.
5. Roll Width: To align with existing mullions.
6. Color: As indicated on drawings.
7. Fabrication:
a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
b. If height of opening requires multiple panels of railroaded fabric, use manufacturer's standard sewn seams.
c. Battens: Full width of shade, enclose in welded shade fabric pocket.

2.04 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
2. Horizontal Dimensions - Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 3/4 inch total.
3. Horizontal Dimensions - Outside Mounting: Extend shades 2 inches beyond jambs on each side.

C. Dimensional Tolerances: As recommended in writing by manufacturer.

D. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.

C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

C. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.

3.05 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

D. Training: Train Owner's personnel on operation and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours training by manufacturer's authorized personnel at location designated by the Owner.

3.06 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

3.07 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION

SECTION 12 3600
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops.

1.02 DEFINITIONS

A. See Section 06 4100 - Architectural Wood Casework, for the following definitions:
   1. High-pressure decorative laminate types.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.

B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

E. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

F. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

G. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.

H. IAPMO Z124 - Plastic Plumbing Fixtures; 2022, with Editorial Revision.

I. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

J. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

K. PS 1 - Structural Plywood; 2023.

L. WI (CSIP) - Certified Seismic Installation Program (CSIP); Current Edition.

M. WI (MCP) - Monitored Compliance Program (MCP); Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.
   2. CAL (CDPH SM) compliance data.

3. Life cycle data.
4. Sustainable wood data.
5. Regional product data.
6. Recycled content data.

D. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.

E. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

F. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.

G. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

H. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

I. Installer's qualification statement.

J. Installation Instructions: Manufacturer's installation instructions and recommendations.

K. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

A. Qualifications: See Section 01 4000 - Quality Requirements.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

C. Quality Certification:
1. Comply with AWI or WI woodwork association quality certification service / program in accordance with work specified in this Section.
2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
3. Provide designated labels on shop drawings as required by certification program.
4. Provide designated labels on installed products as required by certification program.
5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

C. Store products in manufacturer's unopened packaging until ready for installation.

D. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

E. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.08 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. CDPH: Products to comply with CAL (CDPH SM) .

D. Life Cycle: Products in this section to have LCA as specified in Section 01 6000.

E. Sustainable Wood: Products in this Section to meet sustainable wood requirements specified in Section 01 6000.

F. Recycled Content: Products in this Section to meet minimum recycled content thresholds specified in Section 01 6000.

2.02 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: As indicated on drawings.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Manufacturers:
         1) DuPont.
         2) Formica.
         3) LivingStone Surfaces.
         4) LX Hausys.
         5) Wilsonart.
         6) Substitutions: See Section 01 2500 - Substitution Procedures.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. NSF approved for food contact.

d. Sinks and Bowls: Integral castings; minimum 3/4 inch wall thickness; comply with IAPMO Z124.
e. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
f. Color/Pattern Family: Solid color, light colors.
g. Color and Pattern: As indicated on drawings.
h. Color and Pattern: As selected by Architect from manufacturer's full line.

3. Other Components Thickness: 1/2 inch, minimum.
4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
5. Exposed Edge Treatment: Hardwood nosing as indicated on drawings; natural spar varnish finish.
6. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
7. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
8. Fabricate in accordance with manufacturer's standard requirements.

1.02 MATERIALS

A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.

B. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.

C. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.

D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

E. Sealants: See 07 9200 - Joint Sealants.

F. Joint Sealant: Mildew-resistant silicone sealant, white.

1.03 ACCESSORIES

A. Concealed-Mounted Countertop Support Brackets: Verticle leg of bracket is concealed within wall cavity.
1. Finish: Manufacturer's standard, factory-applied, textured powder coat.
2. Color: As selected by Architect from manufacturer's full range.
3. Products:
a. A&M Hardware; Concealed Workstation Brackets.
b. Centerline Brackets; Floating Wall Mount Support.
c. Rakks; Concealed Series EH-FM.
d. Substitutions: See Section 01 2500 - Substitution Procedures.

1.04 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
1. Join lengths of tops using best method recommended by manufacturer.
2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
a. Rout a 1/8 inch drip groove at underside of exposed overlapping edges, set back 1/2 inch from face of edge.
3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches, unless otherwise indicated.

C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

2.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

2.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

2.03 INSTALLATION

A. Install vanities in accordance with manufacturer’s instructions and approved shop drawings

B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

C. Seal joint between back/end splashes and vertical surfaces.

2.04 CLEANING

A. Clean countertops surfaces thoroughly.

2.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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SECTION 12 4813
ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Entrance floor mats and frames.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating properties of walk-off surface, component dimensions and recessed frame characteristics.

C. Shop Drawings: Indicate dimensions and details for recessed frame.

1.03 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

E. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.04 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's standard warranty for each product.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Entrance Floor Gratings:
   1. Activar.
   2. Babcock-Davis.
   3. Balco.
   4. Construction Specialties, Inc.
   5. Nystrom.
   6. Pawling.

7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ENTRANCE FLOOR GRATINGS

A. Entrance Floor Gratings: Recessed stainless steel bar grating with longitudinal bars running perpendicular to traffic flow and perimeter frame forming sides of recess; grating hinged for access to recess.
   1. Basis of Design Product:
      a. Construction Specialties, Inc.; EFS Gridline 2 with inserts, G6PSN SlipNot stainless steel, 3/8 inch.
   2. Grating: Longitudinal bars 0.09 inch, nominal, in width, spaced at less than twice the bar width apart; cross bars set below for pronounced linear appearance.
   3. Grating Depth: 1-1/8 inches, nominal.
   4. Recess Depth Below Bottom of Grating: 1 inches.
   5. Length in Direction of Traffic Flow: 72 inches.
   6. Width Perpendicular to Traffic Flow: Full width of entrance door opening.
   7. Frame: Anodized aluminum for embedding in concrete; minimal exposed trim; stud or hook concrete anchors.

B. Mounting: Top of non-resilient members level with adjacent floor.

C. Structural Capacity: Capable of supporting rolling load of 300 lb without permanent deformation or noticeable deflection.

D. Vibration Resistant Fabrication: Welded, riveted, or bolted members; no snap or friction connections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor opening for mats are ready to receive work.

3.02 PREPARATION

A. Mats: Verify size of floor recess before fabricating mats.

B. Vacuum clean floor recess.

3.03 INSTALLATION

A. Install in accordance with manufacturer's written instructions and approved shop drawings.

B. Install frames to achieve flush plane with finished floor surface.

C. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

END OF SECTION

SECTION 13 0085
VISCOUS DAMPING DEVICES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work in this Section includes preparation of shop drawings, test reports, designing, fabricating, testing, handling and shipping to the site of Viscous Damping Devices (VDDs).

1.02 RELATED SECTIONS

A. Section 05 12 00 – Structural Steel Framing

1.03 DEFINITIONS

A. Damper Unit: The Damper Unit is the energy dissipating element, incorporating the pressure vessel, piston rods, viscous medium, seals, and housing.

B. Force-Velocity Relationship: The relationship between the VDD force and the relative velocity of the ends of the VDD, as determined by testing specified in this Section.

C. Theoretical Output Relationship: The relationship between the VDD force and relative velocity of the ends of the VDD proposed to comply with the project requirements.

D. Viscous Damping Device (VDD): The VDD is defined as the complete assembly of VDD Components, from mounting bracket to mounting bracket.

E. VDD Components: The VDD components are the individual elements comprising the VDD, including the Damper Unit, clevis plates, spherical bearings, pins and fasteners necessary to connect the individual elements in accordance with the Contract Documents.

1.04 REFERENCES

A. Conform to the current editions of the following standards:
   1. ISO 9001 Quality Management Systems - Requirements

B. Refer to Article 1.2 – Related Sections for additional references not included in this section.

1.05 SUBMITTALS

A. See Section 01 3323 – Shop Drawings, Product Data & Samples.

B. Shop Drawings: Shop drawings shall include, but not be limited to fabrication drawings, installation drawings, setting diagrams, bolting templates and schedules. Submit prior to manufacture of item, allowing adequate time for review and approval. Submit shop drawings for:
   1. Each VDD type, including any required prototypes, indicating dimensions, weights, and component material types.
   2. All VDD Components, including mounting and connection hardware.
   3. Method of corrosion protection for all VDD components.
   4. Shop drawing re-submittals shall clearly identify all revisions to previous submittals.
      a. Heavy ink, clouded outlines (revision clouds) shall be drawn around revised areas of individual sheets.

b. The City of Inglewood's Representative will not review information outside of revision clouds on resubmitted drawings.

C. Design Calculations: submit calculations bearing the seal of a Structural Engineer registered in the state of California. Calculations shall be included for all connections to the structure, considering localized effects on structural elements induced by the connection loads.

D. Product Data:
1. VDD: Product data shall include the manufacturer's product specifications, a list of production history for seismic dampers, and installation instructions. It shall also include any prototype test data used on previous projects that is being used to satisfy the requirements of Article 2.9.A – Prototype Testing.
2. Paint: Submit manufacturer's literature and data.

E. Certifications: Submit the following documents, written and signed by an approved independent testing agency.
1. Certification that all testing equipment has been checked for accuracy by appropriate standards for the purpose of this specification.
2. Certified mill test reports for all structural steel to be used within the VDDs.

F. Proposed Test Procedures: Submit annotated and drafted illustrations of proposed test apparatus and procedures for tests required by this Section. Such illustrations shall be submitted to the Engineer of Record prior to the commencement of any testing.

G. Test Reports: Submit the following reports, written and signed by an approved testing agency, for approval by the City of Inglewood's Representative.
1. Test Program Verification
2. Prototype VDD Test Reports: Submit test data for each prototype VDD tested within fourteen (14) days after completion of testing.
3. Production VDD Test Reports: Submit test data for each production VDD tested within fourteen (14) days after completion of the testing.
4. Final Test Report: Submit a final report summarizing test results for all prototype and production VDDs within fourteen (14) days after completion of all testing.

H. Operations and Maintenance Manual: Furnish the following information, at a minimum, in an Operations and Maintenance Manual:
1. Requirements contained under Article 1.09.
2. Procedure for removal and reinstallation of dampers.
3. Instructions for inspection and maintenance requirements and frequency. Inspections to be performed by a Structural Engineer registered in the State of California. Building finishes to be removed as necessary to provide adequate access to dampers for inspection and possible removal and replacement.
a. Visual inspection of dampers in areas where a fire has occurred
b. Visual inspection of dampers in an inverted chevron configuration in areas where standing water occurs to a height exceeding 2”
c. Visual inspection of 100% of dampers two years after end of construction and every five years thereafter. The inspection interval may be relaxed to every ten years after a minimum of three inspections have occurred with written permission from the City of Inglewood's Representative.
d. Visual inspection of 10% of dampers after an earthquake having a peak ground acceleration, as measured or adjusted for a rock site (Vs30 = 2500 ft/sec) within 5 miles of the building, exceeding 0.23g. The 10% of dampers selected for inspection shall be spatially distributed in both plan and elevation and shall include at least one damper of each damper type shown on the structural drawings.

e. Visual inspection of 100% of dampers after an earthquake having a peak ground acceleration, as measured or adjusted for a rock site (Vs30 = 2500 ft/sec) within 5 miles of the building, exceeding 0.45g.

1.06 MANUFACTURER

A. VDD Manufacturers:

1. Taylor Devices, Inc.
   90 Taylor Drive
   North Tonawanda, NY 14120
   (716) 694-0800
   konraderiksen@taylordevices.com
2. ITT Enidine, Inc.
   7 Center Drive
   Orchard Park, NY 14127
   (585) 313-9740
3. Maurer USA
   614 Hunters Run
   Perrysburg, OH 43551
   (716) 465-1658
   b.schneider@maurer.eu
4. Or equal.

A

1.07 QUALITY ASSURANCE

A. The VDD shall be manufactured under an established and maintained Quality Assurance Program, including written process specifications and procedures. The system must ensure that manufacturing, process, inspection and testing are accomplished in accordance with the following:

1. Manufacturing Control: Maintain a system that complies with the requirements of the International Standard Organization (ISO) 9001 model. Alternate programs may be considered acceptable after review and approval by the City of Inglewood's Representative.
2. Process Control: Maintain a system that includes, as a minimum, all of the following
   a. Specific raw material traceability
   b. Special process certification traceability
   c. Detailed manufacturing instructions that identify by operation and machine the work performed
   d. Inspection instructions
   e. In-process and final detail component inspection instructions with actual dimensions
3. Change Control: After initial design completion and approval, or initial hardware delivery, whichever occurs first, any change or substitution of material, dimensions, processes or other characteristics must be approved by the City of Inglewood's Representative prior to incorporation.
4. Calibration Control: All devices used to measure, gauge, test, inspect or otherwise examine items to determine compliance with specification and/or contractual requirements shall be calibrated to a measurement standard traceable to the National Institute of Standards and Technology (NIST), or approved equivalent.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver production VDDs to the jobsite in protective packaging for freight and handling purposes.

B. Handling: Handle VDDs and components carefully to prevent damage, breaking, denting or scoring. Do not deliver damaged VDDs or components; replace with new.

C. Storage: Store VDDs in a clean, dry place. Protect from dirt, fumes, construction debris and physical damage.

1.09 WARRANTIES AND GUARANTEES

A. Furnish to the City of Inglewood a written guarantee for the damper units against all defects in materials and workmanship for 35 years from date of acceptance. Refer to Section 01 78 00, CLOSE-OUT SUBMITTALS, for submittal form.

PART 2 PRODUCTS

2.01 PRODUCT LIFE AND MAINTENANCE

A. Damper Units: The Damper Units shall be maintenance-free and comply with Article 2.05.A - Output Tolerances when kept within the Operating Conditions specified in this Section for a life of thirty-five (35) years. Maintenance free shall mean that no refilling of viscous medium or replacement of any other parts shall be required.

B. Corrosion Protection: All materials subject to deterioration or corrosion when exposed to the environment shall be protected by means acceptable for the application. These methods shall include, but are not limited to coating, plating, or painting.

C. Installation: The VDDs shall be constructed such that installation, removal and replacement, if necessary, shall not require any special tools or methods.

2.02 VDD MATERIALS AND FABRICATION

A. Unless suitably protected against electrolytic corrosion, dissimilar materials shall not be used in contact with each other. Dissimilar metal joints shall not be permitted without a non-metallic separator or gasket of at least .06 inch thickness. The use of aluminum, aluminum alloys, magnesium, magnesium alloys, beryllium and beryllium alloys is prohibited without proper corrosion protection measures. A

B. The damper unit shall contain provisions to limit internal positive or negative pressures as may be caused by thermal expansion and/or contraction of the hydraulic medium and that would otherwise result in seal failure, leakage or damage to the VDD.

C. Non-filled cavities of the damper unit shall be sealed against external contamination and moisture or shall be constructed of materials protected against corrosion. A

D. Only non-nutrient materials shall be used in the VDD.

E. All non-metallic packings, seals, wipers or gaskets shall be of non-age sensitive materials.

2.03 VDD COMPONENTS

A. Damper Unit components: All components of the Damper Units shall comply with the requirements of this section.

1. Pressure Vessels: The pressure vessel components of the damper shall not be of tie-rod type construction, and shall not include externally supported heads or end caps.
2. Castings: Castings shall be prohibited for pressure vessel parts. A
3. Piston Rods: Base metal shall be wrought or forged steel only and shall be either stainless steel or chrome plated.

4. Viscous Medium: The viscous media used in the Damper Units shall be chemically inert, OSHA-approved, non-toxic, non-corrosive, non-flammable material. Petrochemical materials shall not be used.
5. Seals: Under the requirements of Article 2.07 - Operating Conditions specified herein, the damper unit seals shall not leak or weep.
6. Piston Rod Protection: The VDD shall be designed to prevent dusting, scratching, dinging or otherwise marring of the piston rod surface. Where a steel protective cover is used, it shall be easily removable or fitted with an inspection hatch to allow easy inspection of the Damper Unit seals and piston rod.
7. Reservoirs and Plumbing: External reservoirs, external plumbing and/or viscous medium level indicators are not permitted.

B. VDD Components other than the Damper Unit
1. Spherical bearings shall have an inner ring with a spherical outer surface and an outer ring with a spherical inner surface. Bearings shall be fabricated with stainless or high alloy steel and may be of the lined type with non-metallic liners.
2. Pins shall be machined and hardened to be compatible with design requirements of the clevis plates and spherical bearings.
3. Clevis Plates shall be ASTM A36 minimum.

C. Finish requirements:
1. The damper casing exterior surfaces shall either be nickel plated or painted with a primer coat. A finish coat of paint shall be applied on top of the nickel plating or primer coat.
   a. Primer paint: Fabricator's standard, with primer paint complying with VOC limitations of the Authority Having Jurisdiction. Coating thickness: 25 microns.
   b. Finish paint: In accordance with Section 09 9123 – Interior Painting. Coating thickness: 25 microns.

2.04 DESIGN REQUIREMENTS

A. Theoretical Output Relationship: The Damper Unit shall produce damping force output within the specified Output Tolerances, in both directions of travel, according to the following Theoretical Output Relationship:
1. $F = C*V^{\alpha}$ = damping force output from the Damper Unit (kips) C = Damper Unit damping coefficient (kip-sec/in)
2. V = relative velocity between opposite ends of the Damper Unit (in/sec) α = alpha, Damper Unit velocity exponent (unitless)

B. Design Parameters: The Design Parameters for the VDD shall establish the Theoretical Output Relationship for the Damper Unit. The Design Parameters are as shown on the structural drawings.

C. Dimensions: The overall dimensions of the VDD shall be held to a minimum consistent with the requirements of this specification and shall be coordinated with the associated steel detailing on the structural drawings.

D. Length Adjustment: The VDD shall include provisions for overall length adjustment. The minimum length adjustment provided shall be ±0.25 inch from the neutral position. Slotted bolted holes shall not be used to provide the required length adjustment.

E. Total Stroke: The VDD shall have a total stroke sufficient to allow a complete cycle of displacement as shown on the on the structural drawings. The complete cycle of displacement shall be measured from the installed, at-rest position.

F. Articulation: The end attachments of the VDD shall allow for a minimum of ±20 degrees of free articulation about an axis parallel to the mounting pins and a minimum of ±3 degrees of free articulation in all other directions.

2.05 PERFORMANCE REQUIREMENTS

A. Output Tolerances: The output developed by the Damper Unit shall be within the following tolerances, when cycled about any point:
   1. Force Output: The Damper Unit force output shall not be less than 85% nor more than 115% of the value indicated by Article 2.04.A - Theoretical Output Relationship in either direction of travel.
   2. Cyclic Force Difference: The force output developed by the Damper Unit in one direction of travel shall not be less than 90% nor more than 110% of the force developed in the opposite direction of travel for a given piston-rod position, velocity and temperature.
   3. Cyclic Energy Dissipation: The area of the measured force versus displacement hysteresis loop shall not be less than 85% of the area of the theoretical hysteresis loop. The area of the theoretical hysteresis loop shall be determined using the measured force displacement signal for the test under consideration and Article 2.04.A - Theoretical Output Relationship.

B. Performance at Articulated Limits: The Damper Unit shall be designed to operate at the maximum articulated limits according to Article 2.06 - Design Limit States.

C. No Leakage: The Damper Units shall not leak the viscous medium externally under any circumstances whether under operating or non-operating conditions. The units shall show no visible evidence of external leakage when subjected to the greatest internal pressure corresponding to application of any of the requirements in Article 2.07 - Operating Conditions for 180 seconds.

2.06 DESIGN LIMIT STATES

A. VDD components shall be proportioned such that all component stresses are at or below the yield stress under application of any of the following:
   1. Simultaneous application of 2.0 times the design velocity and a lateral acceleration of 1g, at any piston-rod position, under any of the requirements in Article 2.07 - Operating Conditions.
   2. Application of internal pressure of 200 percent of maximum operating pressure. A

2.07 OPERATING CONDITIONS

A. The VDDs shall be capable of performing according to Article 2.04.A - Theoretical Output Relationship when operating at the temperatures, installed duration, wind and seismic duty cycles, and other environmental conditions specified herein, without degradation of performance, within the requirements of Article 2.05.A - Output Tolerances.
   1. Wind duty cycles: 0 to 0.15 inches amplitude at 0.90 Hz for 30,000 cycles per year.
   2. Seismic duty cycles: 1 inch mean amplitude (2 inches peak amplitude) at 0.90 Hz for an average of 5 cycles per year.
   3. Ambient operating temperature: Maximum and minimum ambient air temperatures ranging from +20°F to +130°F.
   4. Atmospheric pressure: The unit shall operate at close to sea level pressure (760 ±50mm mercury).
   5. Humidity: Relative humidity up to 100 percent, including condensation due to temperature change.
   6. Other atmospheric elements: Any of the probable combinations of the following atmospheric elements: rain, snow, sleet, hail, ice, fog, smoke, wind, ozone, sunshine, sand and dust, and salt atmosphere.

2.08 SERIAL NUMBER ASSIGNMENT

A. Unique serial numbers shall be assigned to each VDD unit. The individual numbers shall be assigned according to the manufacturer's standard practice unless otherwise specified in the purchase order or contract.

2.09 TESTING

A. Prototype Testing
   1. The purpose of this phase of testing is to verify the ability to produce Damper Units with a measured Force-Velocity Relationship that matches the Theoretical Output Relationship for the tested damper while subjected to the requirements of Article 2.07 - Operating Conditions. The City of Inglewood's Representative shall be given sufficient notice of when prototype testing is to occur so as to arrange for on-site structural observation at testing facility, if desired.
   2. One Damper Unit for each damper type shall be tested in accordance with this Article. Tests shall be performed in the order listed.
   3. Proof Load Testing
      a. An internal pressure equal to the largest pressure due to application of any of the conditions specified in Article 2.06 - Design Limit States shall be applied and maintained for 180 seconds.
   4. Testing in accordance with Article 2.09.B.3.
   5. Life Cycle Testing
      a. Wind Load Test: The prototype Damper Unit shall be subjected to 2,000 fully reversed cycles of ±0.15 inches (or ±0.3 inches for Damper Unit spanning two levels) at a frequency of 0.90 Hz. Testing shall be permitted to consist of separate sets of multiple cycles of loading subject to approval by the Engineer of Record. A
      b. Full Stroke Test: The prototype Damper Unit shall be cycled through its full end-to-end displacement for a total of 120 cycles. The cyclic velocity is expected to be much slower than the maximum velocity and shall depend on the capacity of the approved testing apparatus. The test velocity shall be submitted to the City of Inglewood's Representative for approval prior to testing. Testing shall be permitted to consist of separate sets of multiple cycles of loading subject to approval by the Engineer of Record. A
   6. Theoretical Output Relationship Verification
      a. Testing Parameters: Tests shall be complete cycles of sinusoidal deformation for each peak test velocity and stroke. The peak velocity and displacement for each test shall be within ±10% of the required value below for each cycle of testing.
         1) Ten fully reversed cycles at 0.25 times the design velocity and 0.25 times stroke.
         2) Five fully reversed cycles at 0.5 times the design velocity and 0.5 times stroke.
         3) Five fully reversed cycles at 0.75 times the design velocity and 0.75 times stroke.
         4) Three fully reversed cycles at 1.0 times the design velocity and 0.75 times stroke.
      b. Test Temperatures: Testing shall be performed at three ambient temperatures: room temperature (60°F to 75°F), 20°F, and 130°F. Prior to commencement of testing at each ambient temperature, the damper unit shall be conditioned at the ambient temperature for at least 4 hours. All cycles of testing shall be completed within 2 hours of removing the damper from the temperature controlled environment. All practically feasible means of maintaining the conditioned temperature of the damper units shall be employed during testing. Testing in this article need only be completed for one damper prototype per project, rather than for each damper prototype, where the manufacturer can show that all damper prototypes are (i) made of identical material and similar internal construction, (ii) have similar static and dynamic internal pressures, and (iii) are fabricated with

identical processes and manufacturing quality control procedures. If only one damper prototype per project is tested in accordance with this article, all other damper prototypes need only be tested at room temperature.

7. Prototype Damper Unit used as production Damper Unit: Where a prototype Damper Unit is proposed to be used as production Damper Unit, it shall meet the requirements of Article 2.09.B following all testing described in this article. Reconditioning of the Damper Unit following testing in this article is permitted before testing in accordance with Article 2.09.B.
8. Damper units that are (i) of similar size, identical material, internal construction, and static and dynamic internal pressures and (ii) fabricated with identical internal processes and manufacturing quality control procedures and have been previously tested by an independent laboratory in the manner described above need not be tested for the above requirements provided that:
    a. All pertinent testing data are made available to, and are approved by, the City of Inglewood's Representative.
    b. The manufacturer can substantiate the similarity of the previously tested devices to the satisfaction of the design professional, and
    c. The submission of data from a previous testing program is approved in writing by the City of Inglewood's Representative.

B. Production Testing
1. The purpose of this phase of testing is to ensure quality control for the Damper Units. The City of Inglewood's Representative shall be given sufficient notice of when production testing is to occur so as to arrange for on-site structural observation at testing facility, if desired.
2. Proof Load Testing
    a. Proof Load Test: For each production Damper Unit, an internal pressure equal to the largest pressure due to application of Article 2.06.A.1 shall be applied and maintained for 180 seconds.
    b. High Level Proof Load Test: For one out of every fifty production Damper Units, or a minimum of one per damper type, an internal pressure equal to the largest pressure due to application of Article 2.06.A.2 shall be applied and maintained for 180 seconds.
3. Life Cycle Testing
    a. Full Stroke Test: One out of every fifty production Damper Units, or a minimum of two per damper type, shall be cycled through its full end-to-end displacement for a total of 30 cycles. The cyclic velocity is expected to be much slower than the maximum velocity and shall depend on the capacity of the approved testing apparatus. The test velocity shall be submitted to the Engineer of Record for approval prior to testing. Testing shall be permitted to consist of separate sets of multiple cycles of loading subject to approval by the Engineer of Record. A
4. Theoretical Output Relationship Verification: The following test shall be performed on each production Damper Unit.
    a. Testing Parameters: Tests shall be complete cycles of sinusoidal deformation for each peak test velocity and stroke. The peak velocity and displacement for each test shall be within ±10% of the required value below for each cycle of testing.
        1) Three fully reversed cycles at 0.75 times the design velocity and 0.75 times stroke.
    b. Test Temperature: Testing shall be performed at room temperature (60°F to 75°F). Prior to commencement of testing, the damper unit shall be conditioned at the ambient temperature for at least 4 hours. All cycles of testing shall be completed within 2 hours of removing the damper from the temperature controlled environment. All practically feasible means of maintaining the conditioned temperature of the damper units shall be employed during testing.

C. Test Acceptance Criteria: All of the following criteria shall be met for each tested Damper Unit for any of the Prototype or Production Tests.
   1. No evidence of external leakage before, during or after the testing program.
   2. No evidence of binding, yielding or permanent deformation in any part of the damper unit.
   3. No evidence of degradation of the seals in the damper unit.
   4. For each cycle of tests in Articles 2.09.A.5 and 2.09.B.3, the damper output shall fall within the requirements of Article 2.05.A - Output Tolerances.

D. Test Failures: The failure of any Damper Unit to satisfy the requirements of Article 2.09.C – Test Acceptance Criteria shall result in one of the following courses of action:
   1. Reject Damper Unit.
   2. Subject to approval by the City of Inglewood's Representative, repair Damper Unit and re-test.

PART 3 EXECUTION

3.01 GENERAL

A. Comply with the requirements of Section 05 12 00 – Structural Steel Framing.

END OF SECTION 13 0085

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SECTION 14 24 00
HYDRAULIC PASSENGER ELEVATORS – 2,500 LBS.

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Hydraulic passenger elevators as shown and specified. Elevator work includes:
   1. Standard pre-engineered hydraulic passenger elevators.
   2. Elevator car enclosures, hoistway entrances and signal equipment.
   3. Operation and control systems.
   4. Jack(s).
   5. Accessibility provisions for physically disabled persons.
   6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
   7. Materials and accessories as required to complete the elevator installation.

B. Related Sections:
   1. Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.
   2. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.
   3. Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.
   4. Division 5 Metals:
      a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
      b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
   5. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
   6. Division 16 Sections:
      a. Providing electrical service to elevators, including fused disconnect switches.
      b. Emergency power supply, transfer switch and auxiliary contacts.
      c. Heat and smoke sensing devices.
      d. Convenience outlets and illumination in control room, hoistway and pit.
   7. Division 22 Plumbing
      a. Sump pit and oil interceptor.
   8. Division 23 Heating, Ventilation and Air Conditioning
      a. Heating and ventilating hoistways and/or control room.

C. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Part 3 for hydraulic elevators. State or local requirements must be used if more stringent. The cost of this work is not included in the TK Elevator's proposal, since it is a part of the building construction.
   1. Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.
   2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.

3. Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point.
4. Elevator hoistways shall have barricades, as required.
5. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.
7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.
8. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.
9. Machine room to be enclosed and protected.
10. Machine Room temperature must be maintained between 55º and 90º F.
11. If machine room is remote from the elevator hoistway, clear access must be available above the ceiling or metal/concrete raceways in floor for oil line and wiring duct from machine room.
12. Access to the machinery space and machine room must be in accordance with the governing authority or code.
13. Provide an 8” x 16” cutout through machine room wall, for oil line and wiring duct, coordinated with elevator contractor at the building site.
14. All wire and conduit should run remote from the hoistways.
15. When heat, smoke or combustion sensing devices are required, connect to elevator control cabinet terminals. Contacts on the sensors should be sided for 12 volt D.C.
16. Install and furnish finished flooring in elevator cab.
17. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.
18. Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.
19. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
20. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.
21. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.
22. General Contractor shall fill and grout around entrances, as required.
23. Elevator sill supports shall be provided at each opening.
24. All walls and sill supports must be plumb where openings occur.
25. For applications with jack hole, free and clear access to the elevator pit area for the jack hole-drilling rig is required.
26. Where jack hole is required, remove all spoils from jack hole drilling.
27. When not provided by Elevator Contractor, jack hole shall accommodate the jack unit. If required the jack hole is to be provided in strict accordance with the elevator contractor's shop drawings.

28. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.
29. A light switch and fused disconnect switch for each elevator should be located inside the machine room adjacent to the door, where practical, per the National Electrical Code (NFPA No. 70).
30. For signal systems and power operated door: provide ground and branch wiring circuits, including main line switch.
31. For car light and fan: provide a feeder and branch wiring circuits, including main line switch.
32. Wall thickness may increase when fixtures are mounted in drywall. These requirements must be coordinated between the general contractor and the elevator contractor.
33. Provide supports, patching and recesses to accommodate hall button boxes, signal fixtures, etc..
34. Locate telephone and convenience outlet on control panel.

1.02 SUBMITTALS

A. Product data: When requested, the elevator contractor shall provide standard cab, entrance and signal fixture data to describe product for approval.

B. Shop drawings:
   1. Show equipment arrangement in the corridor, pit, and hoistway and/or optional control room. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
   2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
   3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
   4. Indicate electrical power requirements and branch circuit protection device recommendations.

C. Powder Coat paint selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

D. Plastic laminate selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

E. Metal Finishes: Upon request, standard metal samples provided.

F. Operation and maintenance data. Include the following:
   1. Owner's manuals and wiring diagrams.
   2. Parts list, with recommended parts inventory.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: An approved manufacturer with minimum 15 years of experience in manufacturing, installing, and servicing elevators of the type required for the project.
   1. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment.

a. The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system.
2. The manufacturer shall have a documented, on-going quality assurance program.
3. ISO-9001:2000 Manufacturer Certified
4. ISO-14001:2004 Environmental Management System Certified
5. LEED Gold certified elevator manufacturing facility.

B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.

C. Regulatory Requirements:
1. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
2. Building Code: National.
3. NFPA 70 National Electrical Code.
4. NFPA 80 Fire Doors and Windows.
5. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)
6. Section 407 in ICC A117.1, when required by local authorities
7. CAN/CSA C22.1 Canadian Electrical Code
8. CAN/CSA B44 Safety Code for Elevators and Escalators.
9. California Department of Public Health Standard Method V1.1–2010, CA Section 01350

D. Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).

E. Inspection and testing:

1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
2. Arrange for inspections and make required tests.
3. Deliver to the Owner upon completion and acceptance of elevator work.

F. Sustainable Product Qualifications:
1. Environmental Product Declaration:
a. GOOD: If Product Category Rules (PCR) are not available, produce a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate scope.
b. BEST: If Product Category Rules (PCR) are available, produce and publish an Environmental Product Declaration (EPD) based on a critically reviewed life-cycle assessment conforming to ISO 14044, with external verification recognized by the EPD program operator.
2. Material Transparency:
a. GOOD: Provide Health Product Declaration at any level

b. BETTER: Provide Health Product Declaration (HPD v2 or later). Complete, published declaration with full disclosure of known hazards, prepared using the Health Product Declaration Collaborative's "HPD builder" on-line tool.
c. BEST: Cradle to Cradle Material Health Certificate v3, Bronze level or higher.

3. LEED v4 – Provide documentation for all Building Product Disclosure AND Optimization credits in LEED v4 for product specified.
4. Living Building Challenge Projects: Provide Declare label for products specified.

1.04 DELIVERY, STORAGE AND HANDLING

A. Manufacturing shall deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

1.05 PROJECT CONDITIONS

A. Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

B. Provide the hole for the jack unit (if required by the type of jack provided), based on excavation through normal soil or clay which can be removed by manual digging or by standard truck-mounted regular drilling unit. Provide a casing if required to retain the walls of the hole. General contractor shall remove excavation spoils deposited in the elevator pit.
   1. If a physical obstruction or hindrance is encountered below the ground surface, including boulders, rock, gravel, wood, metal, pilings, sand, water, quick sand, caves, public utilities or any other foreign material, obtain written authorization to proceed with excavating using special excavation equipment.
   2. Maintain a daily log of time and material costs involved.
   3. Elevator contractor will be compensated on a time and material basis for additional costs incurred after encountering the physical obstruction or hindrance, including the cost of the special excavation equipment.

1.06 WARRANTY

A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months after final acceptance.

1.07 MAINTENANCE

A. Furnish maintenance and call back service for a period of 12 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.
   1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.

2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
3. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Design based around TK Elevator’s endura hydraulic elevator.

2.02 MATERIALS, GENERAL

A. All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD, and shall meet the California Department of Public Health Standard Method V1.1–2010, CA Section 01350 as mentioned in 1.03.9 of this specification.

B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.

C. Steel:
   1. Shapes and bars: Carbon.
   2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
   3. Finish: Factory-applied baked enamel for structural parts, powder coat for architectural parts. Color selection must be based on elevator manufacture’s standard selections.

D. Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050" thickness. Laminate selection must be based on elevator manufacture’s standard selections.

E. Flooring by others.

2.03 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.

B. Sling: Steel stiles bolted or welded to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.

C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.

D. Guides: Slide guides shall be mounted on top and bottom of the car.

E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.

F. Jack: A jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to ensure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless. Two jacks piped together, mounted one on each side of the car with a polished steel hydraulic plunger housed in a sealed steel casing having sufficient clearance space to allow for alignment during installation. Each plunger shall have a high pressure sealing system which will not allow for seal movement or displacement during the course of operation. Each Jack Assembly shall have a check valve built into the assembly to allow for automatically re-syncing the two plunger sections by moving the jack to its fully contracted position. The jack shall be designed to be mounted on the pit floor or in a recess in the pit floor. Each jack section shall have a bleeder valve to discharge any air trapped in the section..

G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.

H. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit. Provide proper viscosity grade inherently biodegradable oil as specified by the manufacturer of the power unit (see Power Unit section 2.04.G for further details)

2.04 POWER UNIT

A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit consisting of the following items:
   1. An oil reservoir with tank cover.
   2. An oil hydraulic pump.
   3. An electric motor.
   4. An oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.

B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.

C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating shall be selected for specified speed and load.

D. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
    1. Relief valve shall be adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.
    2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
    3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
    4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.
    5. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.
    6. Oil Type: Provide a zinc free, inherently biodegradable lubricant formulated with premium base stocks to provide outstanding protection for demanding hydraulic systems, especially those operating in environmentally sensitive areas.

2.05 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
    1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware specific to elevator B. Elevator A shall feature hall entrance doors at all floors with glass vision panels with code approved glass. The glass panels shall be maximized to feature full panel with code approved safety glass. .
    2. Main landing door & frame finish: ASTM A1008 steel panels, factory applied powder coat finish with factory-applied powder coat finish entrance frame.
    3. Typical door & frame finish: ASTM A366 steel panels, factory applied powder coat enamel finish with factory-applied powder coat finish entrance frame.

B. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.

C. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.
    1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
    2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
    3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

D. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide Stainless Steel.

2.06 PASSENGER ELEVATOR CAR ENCLOSURE

A. Car Enclosure:
   1. Walls: Cab type TKAP, reinforced cold-rolled steel with two coats factory applied baked enamel finish, with applied vertical wood core panels covered with 5WL Stainless Steel..
   2. Reveals and frieze: a. Reveals and frieze: Stainless steel, no. 4 brushed finish
   3. Canopy: Cold-rolled steel with hinged exit.
   4. Downlight type, metal pans with suspended LED downlights and dimmer switch. Number of downlights shall be dependent on platform size with a minimum of six. The metal pans shall be finished with a stainless steel, no. 4 brushed finish..
   5. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel
   6. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
      a. Door Finish: Stainless steel panels: No. 4 brushed finish. This finish is specific to elevator B. Elevator A shall feature code approved glass panels maximized full panel of door to match same frame banding as hoistway doors for this elevator.
      b. Cab Sills: Extruded aluminum, mill finish.
   7. Handrail: Provide 1.5' diameter cylindrical metal on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.
   8. Ventilation: Manufacturer's standard exhaust fan, mounted on the car top.
   9. Protection pads and buttons: Not required

B. Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection" switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.07 DOOR OPERATION

A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.
   1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.

2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel shall reverse and the door shall reopen to answer the other call.
4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.
5. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.
6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.
7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.
8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Door Protection Device: Provide a door protection system using microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.08 CAR OPERATING STATION

A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Wrap return shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED’s shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.

B. Emergency Communications System: Integral phone system provided.

C. Auxiliary Operating Panel:

D. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.

E. Special Equipment: Not Applicable

2.09 CONTROL SYSTEMS

A. Controller: The elevator control system shall be microprocessor based and software oriented. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.

B. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.

C. Emergency Power Operation: (Group 10-D4A) Upon loss of normal power, building-supplied standby power is available to the elevator on the same wires as the normal power. Once the loss of normal power has been detected and standby power is available, one elevator at a time from each group will be lowered to a pre-designated landing and will open the doors. After passengers have exited the elevator, the doors are closed and the car shuts down. The next available car in the group will then be selected to lower, allow passengers to exit, close the doors and shutdown. This process is repeated until all cars in the group have been lowered and parked. At this time, an elevator is automatically allowed to continue service using the building-supplied standby power. A manual selection switch is available to override the automatic selection and allow and car in the group to provide service to the building. When normal power is restored, the elevators automatically resume operation.

D. Special Operation: Not Applicable

2.10 HALL STATIONS

A. Hall Stations, General: Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction.
   1. Provide one pushbutton riser with faceplates having a brushed stainless steel finish.
      a. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.

B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

C. Hall Position Indicator: An electronic dot matrix position indicator shall be provided and mounted for optimum viewing. As the car travels, its position in the hoistway shall be indicated by the illumination of the alphanumeric character corresponding to the landing which the elevator is stopped or passing. When hall lanterns are provided, the position indicator shall be combined with the hall lanterns in the same faceplate. Faceplates shall match hall stations. Provide at main landing only.

D. Hall lanterns: Not Applicable

E. Special Equipment:
Limited access operation: Not Applicable

2.11 MISCELLANEOUS ELEVATOR COMPONENTS

A. Oil Hydraulic Silencer: Install multiple oil hydraulic silencers (muffler device) at the power unit location. The silencers shall contain pulsation absorbing material inserted in a blowout proof housing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. Install elevator systems components and coordinate installation of hoistway wall construction.
   1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
   2. Comply with the National Electrical Code for electrical work required during installation.

B. Jack unit excavation (if required by the type of jack provided): Drill or otherwise excavate below elevator pit construction as required to install the jack unit.
   1. Install casing for jack unit.
   2. Provide HDPE jack protection system for all in ground jacks.
   3. Set casing for jack unit assembly plumb, and partially fill with water set¬tled sand, eliminating voids. Back fill depth shall be sufficient to hold the bottom of the jack in place over time.

C. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.

D. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.

E. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment,

inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.

F. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.

G. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.

H. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.

I. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.

J. Lubricate operating parts of system, where recommended by manufacturer.

3.03 FIELD QUALITY CONTROL

A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.

B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.05 CLEANING

A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.

B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.
   1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

3.06 PROTECTION

A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.07 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.08 ELEVATOR SCHEDULE

A. Elevator Qty. 1
   1. Elevator Model: endura Twinpost above-ground 1-stage
   2. Elevator Type: Hydraulic Passenger
   3. Rated Capacity: 2500 lbs.
   4. Rated Speed: 110 ft./min.
   5. Operation System: TAC32H
   6. Travel: 12'-0"
   7. Landings: 2 total
   8. Openings:
      a. Front: 2
      b. Rear: 0
   9. Clear Car Inside: 6'-8" wide x 4'-3" deep
   10. Inside clear height: 7'-4" standard
   11. Door clear height: 7'-0" standard
   12. Hoistway Entrance Size: 3'-6" wide x 7'-0" high
   13. Door Type: One-speed | RH Side opening. Note doors shall be code approved glass vision panels over entire door panel framed in stainless steel.
   14. Power Characteristics: 460 volts, 3 Phase, 60 Hz.
   15. Seismic Requirements: Zone
   16. Hoistway Dimensions: 8'-4" wide x 5'-9" deep
   17. Pit Depth: 4'-0"
   18. Button & Fixture Style: Traditional Signal Fixtures
   19. Special Operations: None

END OF SECTION

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SECTION 14 24 01
HYDRAULIC PASSENGER ELEVATORS – 4,500 LBS.

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Hydraulic passenger elevators as shown and specified. Elevator work includes:
   1. Standard pre-engineered hydraulic passenger elevators.
   2. Elevator car enclosures, hoistway entrances and signal equipment.
   3. Operation and control systems.
   4. Jack(s).
   5. Accessibility provisions for physically disabled persons.
   6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
   7. Materials and accessories as required to complete the elevator installation.

B. Related Sections:
   1. Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.
   2. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.
   3. Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.
   4. Division 5 Metals:
      a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
      b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
   5. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
   6. Division 16 Sections:
      a. Providing electrical service to elevators, including fused disconnect switches.
      b. Emergency power supply, transfer switch and auxiliary contacts.
      c. Heat and smoke sensing devices.
      d. Convenience outlets and illumination in control room, hoistway and pit.
   7. Division 22 Plumbing
      a. Sump pit and oil interceptor.
   8. Division 23 Heating, Ventilation and Air Conditioning
      a. Heating and ventilating hoistways and/or control room.

C. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Part 3 for hydraulic elevators. State or local requirements must be used if more stringent. The cost of this work is not included in the TK Elevator's proposal, since it is a part of the building construction.
   1. Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.
   2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.

3. Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point.
4. Elevator hoistways shall have barricades, as required.
5. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.
7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.
8. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.
9. Machine room to be enclosed and protected.
10. Machine Room temperature must be maintained between 55º and 90º F.
11. If machine room is remote from the elevator hoistway, clear access must be available above the ceiling or metal/concrete raceways in floor for oil line and wiring duct from machine room.
12. Access to the machinery space and machine room must be in accordance with the governing authority or code.
13. Provide an 8” x 16” cutout through machine room wall, for oil line and wiring duct, coordinated with elevator contractor at the building site.
14. All wire and conduit should run remote from the hoistways.
15. When heat, smoke or combustion sensing devices are required, connect to elevator control cabinet terminals. Contacts on the sensors should be sided for 12 volt D.C.
16. Install and furnish finished flooring in elevator cab.
17. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.
18. Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.
19. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
20. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.
21. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.
22. General Contractor shall fill and grout around entrances, as required.
23. Elevator sill supports shall be provided at each opening.
24. All walls and sill supports must be plumb where openings occur.
25. For applications with jack hole, free and clear access to the elevator pit area for the jack hole-drilling rig is required.
26. Where jack hole is required, remove all spoils from jack hole drilling.
27. When not provided by Elevator Contractor, jack hole shall accommodate the jack unit. If required the jack hole is to be provided in strict accordance with the elevator contractor's shop drawings.

28. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.
29. A light switch and fused disconnect switch for each elevator should be located inside the machine room adjacent to the door, where practical, per the National Electrical Code (NFPA No. 70).
30. For signal systems and power operated door: provide ground and branch wiring circuits, including main line switch.
31. For car light and fan: provide a feeder and branch wiring circuits, including main line switch.
32. Wall thickness may increase when fixtures are mounted in drywall. These requirements must be coordinated between the general contractor and the elevator contractor.
33. Provide supports, patching and recesses to accommodate hall button boxes, signal fixtures, etc..
34. Locate telephone and convenience outlet on control panel.

1.02 SUBMITTALS

A. Product data: When requested, the elevator contractor shall provide standard cab, entrance and signal fixture data to describe product for approval.

B. Shop drawings:
   1. Show equipment arrangement in the corridor, pit, and hoistway and/or optional control room. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
   2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
   3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
   4. Indicate electrical power requirements and branch circuit protection device recommendations.

C. Powder Coat paint selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

D. Plastic laminate selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

E. Metal Finishes: Upon request, standard metal samples provided.

F. Operation and maintenance data. Include the following:
   1. Owner's manuals and wiring diagrams.
   2. Parts list, with recommended parts inventory.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: An approved manufacturer with minimum 15 years of experience in manufacturing, installing, and servicing elevators of the type required for the project.
   1. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment.

a. The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system.
2. The manufacturer shall have a documented, on-going quality assurance program.
3. ISO-9001:2000 Manufacturer Certified
4. ISO-14001:2004 Environmental Management System Certified
5. LEED Gold certified elevator manufacturing facility.

B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.

C. Regulatory Requirements:
1. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
2. Building Code: National.
3. NFPA 70 National Electrical Code.
4. NFPA 80 Fire Doors and Windows.
5. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)
6. Section 407 in ICC A117.1, when required by local authorities
7. CAN/CSA C22.1 Canadian Electrical Code
8. CAN/CSA B44 Safety Code for Elevators and Escalators.
9. California Department of Public Health Standard Method V1.1–2010, CA Section 01350

D. Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).

E. Inspection and testing:

1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
2. Arrange for inspections and make required tests.
3. Deliver to the Owner upon completion and acceptance of elevator work.

F. Sustainable Product Qualifications:
1. Environmental Product Declaration:
a. GOOD: If Product Category Rules (PCR) are not available, produce a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate scope.
b. BEST: If Product Category Rules (PCR) are available, produce and publish an Environmental Product Declaration (EPD) based on a critically reviewed life-cycle assessment conforming to ISO 14044, with external verification recognized by the EPD program operator.
2. Material Transparency:
a. GOOD: Provide Health Product Declaration at any level

b. BETTER: Provide Health Product Declaration (HPD v2 or later). Complete, published declaration with full disclosure of known hazards, prepared using the Health Product Declaration Collaborative's "HPD builder" on-line tool.
c. BEST: Cradle to Cradle Material Health Certificate v3, Bronze level or higher.

3. LEED v4 – Provide documentation for all Building Product Disclosure AND Optimization credits in LEED v4 for product specified.
4. Living Building Challenge Projects: Provide Declare label for products specified.

1.04 DELIVERY, STORAGE AND HANDLING

A. Manufacturing shall deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

1.05 PROJECT CONDITIONS

A. Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

B. Provide the hole for the jack unit (if required by the type of jack provided), based on excavation through normal soil or clay which can be removed by manual digging or by standard truck-mounted regular drilling unit. Provide a casing if required to retain the walls of the hole. General contractor shall remove excavation spoils deposited in the elevator pit.
   1. If a physical obstruction or hindrance is encountered below the ground surface, including boulders, rock, gravel, wood, metal, pilings, sand, water, quick sand, caves, public utilities or any other foreign material, obtain written authorization to proceed with excavating using special excavation equipment.
   2. Maintain a daily log of time and material costs involved.
   3. Elevator contractor will be compensated on a time and material basis for additional costs incurred after encountering the physical obstruction or hindrance, including the cost of the special excavation equipment.

1.06 WARRANTY

A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months after final acceptance.

1.07 MAINTENANCE

A. Furnish maintenance and call back service for a period of 12 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.
   1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.

2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
3. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Design based around TK Elevator’s endura hydraulic elevator.

2.02 MATERIALS, GENERAL

A. All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD, and shall meet the California Department of Public Health Standard Method V1.1–2010, CA Section 01350 as mentioned in 1.03.9 of this specification.

B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.

C. Steel:
   1. Shapes and bars: Carbon.
   2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
   3. Finish: Factory-applied baked enamel for structural parts, powder coat for architectural parts. Color selection must be based on elevator manufacture’s standard selections.

D. Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050" thickness. Laminate selection must be based on elevator manufacture’s standard selections.

E. Flooring by others.

2.03 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.

B. Sling: Steel stiles bolted or welded to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.

C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.

D. Guides: Slide guides shall be mounted on top and bottom of the car.

E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.

F. Jack: A jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to ensure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless telescopic 2-stage. Two jacks piped together, mounted one on each side of the car with each having two telescopic sections designed to extend in a synchronized manner when oil is pumped into the Assembly. Each jack section will be guided from within the casing or the plunger assembly used to house the section. Each plunger shall have a high pressure sealing system which will not allow for seal movement or displacement during the course of operation. Each Jack Assembly shall have a check valve built into the assembly to allow for automatically re-syncing the two plunger sections by moving the jack to its fully contracted position. The jack shall be designed to be mounted on the pit floor or in a recess in the pit floor. Each jack section shall have a bleeder valve to discharge any air trapped in the section..

G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.

H. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit. Provide proper viscosity grade inherently biodegradable oil as specified by the manufacturer of the power unit (see Power Unit section 2.04.G for further details)

2.04 POWER UNIT

A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit consisting of the following items:
   1. An oil reservoir with tank cover.
   2. An oil hydraulic pump.
   3. An electric motor.
   4. An oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.

B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.

C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating shall be selected for specified speed and load.

D. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
    1. Relief valve shall be adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.
    2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
    3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
    4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.
    5. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.
    6. Oil Type: Provide a zinc free, inherently biodegradable lubricant formulated with premium base stocks to provide outstanding protection for demanding hydraulic systems, especially those operating in environmentally sensitive areas.

2.05 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
    1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware.
    2. Main landing door & frame finish: ASTM A1008 steel panels, factory applied powder coat finish with factory-applied powder coat finish entrance frame.
    3. Typical door & frame finish: ASTM A366 steel panels, factory applied powder coat enamel finish with factory-applied powder coat finish entrance frame.

B. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.

C. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.
    1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
    2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
    3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

D. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish Provide Stainless Steel.

2.06 PASSENGER ELEVATOR CAR ENCLOSURE

A. Car Enclosure:
    1. Walls: Cab type TKAP, reinforced cold-rolled steel with two coats factory applied baked enamel finish, with applied vertical wood core panels covered with 5WL Stainless Steel..
    2. Reveals and frieze: a. Reveals and frieze: Powder Coated
    3. Canopy: Cold-rolled steel with hinged exit.
    4. Ceiling: Downlight type, metal pans with suspended LED downlights and dimmer switch. Number of downlights shall be dependent on platform size with a minimum of six. The metal pans shall be finished with a stainless steel, no. 4 brushed finish.
    5. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel
    6. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
        a. Door Finish: Stainless steel panels: No. 4 brushed finish.
        b. Cab Sills: Extruded aluminum, mill finish.
    7. Handrail: Provide 1.5' diameter cylindrical metal on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.
    8. Ventilation: Manufacturer's standard exhaust fan, mounted on the car top.
    9. Protection pads and buttons: Not required

B. Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection" switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.07 DOOR OPERATION

A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.
    1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
    2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
    3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the

hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel shall reverse and the door shall reopen to answer the other call.

4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.
5. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.
6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.
7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.
8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Door Protection Device: Provide a door protection system using microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.08 CAR OPERATING STATION

A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Wrap return shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED’s shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.

B. Emergency Communications System: Integral phone system provided.

C. Auxiliary Operating Panel:

D. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.

E. Special Equipment: Not Applicable

2.09 CONTROL SYSTEMS

A. Controller: The elevator control system shall be microprocessor based and software oriented. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.

B. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.

C. Emergency Power Operation: Full automatic operation (Simplex 10D-4A) Upon loss of the normal power supply, building-supplied standby power is available to the elevator on the same wires as the normal power. Once the loss of normal power has been detected and standby power is available, the elevator is lowered to a pre-designated landing and will open the doors. After passengers have exited the elevator, the doors are closed. At this time the elevator is automatically allowed to continue service using the building-supplied standby power.

D. Special Operation: Not Applicable

2.10 HALL STATIONS

A. Hall Stations, General: Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction.
   1. Provide one pushbutton riser with faceplates having a brushed stainless steel finish.
      a. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.

B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

C. Hall Position Indicator: Not Applicable

D. Hall lanterns: Not Applicable

E. Special Equipment:
Limited access operation: Not Applicable

2.11 MISCELLANEOUS ELEVATOR COMPONENTS

A. Oil Hydraulic Silencer: Install multiple oil hydraulic silencers (muffler device) at the power unit location. The silencers shall contain pulsation absorbing material inserted in a blowout proof housing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. Install elevator systems components and coordinate installation of hoistway wall construction.
   1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
   2. Comply with the National Electrical Code for electrical work required during installation.

B. Jack unit excavation (if required by the type of jack provided): Drill or otherwise excavate below elevator pit construction as required to install the jack unit.
   1. Install casing for jack unit.
   2. Provide HDPE jack protection system for all in ground jacks.
   3. Set casing for jack unit assembly plumb, and partially fill with water set¬tled sand, eliminating voids. Back fill depth shall be sufficient to hold the bottom of the jack in place over time.

C. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.

D. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.

E. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.

F. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.

G. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.

H. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.

I. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.

J. Lubricate operating parts of system, where recommended by manufacturer.

3.03 FIELD QUALITY CONTROL

A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.

B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.05 CLEANING

A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.

B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.
    1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

3.06 PROTECTION

A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.07 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at

time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.08 ELEVATOR SCHEDULE

A. Elevator Qty. 1
   1. Elevator Model: endura Twinpost above-ground 2-stage
   2. Elevator Type: Hydraulic Passenger
   3. Rated Capacity: 4500 lbs.
   4. Rated Speed: 150 ft./min.
   5. Operation System: TAC32H
   6. Travel: 25'-0"
   7. Landings: 3 total
   8. Openings:
      a. Front: 3
      b. Rear: 0
   9. Clear Car Inside: 5'-8" wide x 7'-9 1/2" deep
   10. Inside clear height: 7'-4" standard
   11. Door clear height: 7'-0" standard
   12. Hoistway Entrance Size: 4'-0" wide x 7'-0" high
   13. Door Type: Two-speed | RH Side opening
   14. Power Characteristics: 460 volts, 3 Phase, 60 Hz.
   15. Seismic Requirements: Zone
   16. Hoistway Dimensions: 7'-4" wide x 9'-6 1/2" deep
   17. Pit Depth: 4'-0"
   18. Button & Fixture Style: Traditional Signal Fixtures
   19. Special Operations: None

END OF SECTION

SECTION 21 0500
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Above Ground Piping
B. Pipe Sleeve
C. Pipe Hanger and Supports
D. Mechanical Coupling

1.02 REFERENCE STANDARDS

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.
B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
D. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.
E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
G. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.
H. AWWA C606 - Grooved and Shouldered Joints; 2022.
I. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.
C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
D. Project Record Documents: Record actual locations of components and tag numbering.
E. Operation and Maintenance Data: Include installation instructions and spare parts lists.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified this section.
   1. Minimum three years experience.
   2. Approved by manufacturer.

C. Comply with FM (AG) requirements.

D. Valves: Bear FM (AG), UL (DIR), and ITS (DIR) or Warnock Hersey product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.

E. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

1.07 FLOW TEST

A. If flow test information provided below has been conducted less than 12 months prior to working plan submittal, utilize for design of NFPA 13 fire sprinkler and NFPA 14 standpipe systems.

B. If flow test information provided below has been conducted less than 12 months prior to working plan submittal, the information provided is advisory only and not to be used for design. Provide materials and labor for a new water supply test on the closest nearby fire hydrants per NFPA 13 and NFPA 291. Utilize new flow test results for design of NFPA 13 fire sprinkler and NFPA 14 standpipe systems.

1.08 SYSTEM IMPAIRMENT

A. When returning a water -based fire protection system to service after impairment or control valve closure, verify the system is in working order by performing a main drain test per NFPA 25.

PART 2 PRODUCTS

2.01 FIRE PROTECTION SYSTEMS

A. Sprinkler Systems: Comply with NFPA 13.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

2.02 ABOVE GROUND PIPING

A. Steel Pipe 2.5 inches and larger: ASTM A53 Schedule 40 or ASTM A795 Schedule 40, black. Weight Class STD (Standard), Type E or Type S, Grade A.

1. Steel Fittings: ASME B16.9, wrought steel, buttwelded, ASME B16.25, buttweld ends, ASTM A234/A234M, wrought carbon steel or alloy steel, ASME B16.5, steel flanges and fittings, or ASME B16.11, forged steel socket welded and threaded; with double layer, half-lapped polyethylene tape.
2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
3. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

B. Steel Pipe 2 inches and smaller: ASTM A53 Schedule 40, ASTM A795 Schedule 40, black. Weight Class STD (Standard), Type E or Type S, Grade A.
1. Steel Fittings: ASME B16.39, Class 150, cast or ductile iron threaded fittings.
2. Post-chlorinated Poly Vinyl Chloride (CPVC) shall not be acceptable.

2.03 PIPE SLEEVES

A. Vertical Piping:
1. Sleeve Length: 1 inch above finished floor.
2. Provide sealant for watertight joint.

B. Pipe Passing Through Below Grade Exterior Walls:
1. Zinc coated or cast iron pipe.
2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

2.04 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.

C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

D. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.

E. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.

F. Vertical Support: Steel riser clamp.

G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

H. Seismic Hangers and Couplings:

2.05 MECHANICAL COUPLINGS

A. Manufacturers:
1. Apollo Valves: www.apollovalves.com/#sle.
2. Tyco Fire Protection Products; Grinnell G-Fire Figure 705 Grooved Flexible Couplings: www.tyco-fire.com/#sle.
3. Victaulic Company; FireLock Style 009H: www.victaulic.com/#sle.
4. Viega LLC; MegaPress: www.viega.com/#sle.

B. Rigid Mechanical Couplings for Grooved Joints:
1. Dimensions and Testing: Comply with AWWA C606.
2. Minimum Working Pressure: 300 psig.
3. Housing Material: Fabricate of ductile iron complying with ASTM A536.

4. Housing Coating: Factory applied orange enamel.
5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
6. Bolts and Nuts: Hot dipped galvanized or zinc electroplated steel.
7. Product:
   a. Victaulic Company; FireLock Style 009H: www.victaulic.com.
   b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.

B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

C. Install piping to conserve building space, to not interfere with use of space and other work.

D. Group piping whenever practical at common elevations.

E. Sleeve pipes passing through partitions, walls, and floors.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

H. Pipe Hangers and Supports:
   1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   2. Place hangers within 12 inches of each horizontal elbow.
   3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

I. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

J. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Do not penetrate building structural members unless indicated.

L. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

M. Escutcheons:
   1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
   2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
   3. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.

N. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

O. Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.

P. Provide drain valves at main shut-off valves, low points of piping and apparatus.

END OF SECTION

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SECTION 21 1300
FIRE-SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wet-pipe sprinkler system.

B. System design, installation, and certification.

1.02 RELATED REQUIREMENTS

A. Section 21 0500 - Common Work Results for Fire Suppression: Pipe and fittings.

B. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

C. Section 22 0553 - Identification for Plumbing Piping and Equipment.

D. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide; Current Edition.

B. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).

C. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).

D. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).

E. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.

F. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL (DIR) - Online Certifications Directory; Current Edition.

H. UL 405 - Standard for Safety Fire Department Connection Devices; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Shop Drawings:

1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
3. Submit shop drawings to Authorities Having Jurisdiction for approval. Submit proof of approval to Architect.

D. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Sprinklers: Type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
3. Sprinkler Wrenches: For each sprinkler type.

1.06 QUALITY ASSURANCE

A. Comply with FM (AG) requirements.

B. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

D. Equipment and Components: Provide products that bear FM (AG) label or marking.

E. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sprinklers, Valves, and Equipment:
1. Tyco Fire Protection Products: www.tyco-fire.com/#sle.
2. Viking Corporation: www.vikinggroupinc.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SPRINKLER SYSTEM

A. Sprinkler System: Provide coverage for entire building.

B. Occupancy: Light hazard; comply with NFPA 13.

C. Occupancy: Ordinary hazard, Group 1; comply with NFPA 13

D. Water Supply: Determine volume and pressure from water flow test data.

E. Provide fire department connections where indicated.

F. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

G. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
   5. Other Types: As required.

2.03 SPRINKLERS

A. Suspended Ceiling Type: Semi-recessed pendant type with matching push on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Escutcheon Plate Finish: Enamel, color white.
   4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

B. Exposed Area Type: Pendant type with guard.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

C. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Escutcheon Plate Finish: Enamel, color white .
   4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

D. Window Type: Listed to provide complete wetting and coverage for heat strengthened, tempered, or ceramic glass windows using closed sprinklers.
   1. Response Type: Fast.
   2. Coverage Type: Standard.
   3. Finish: Natural Brass.
   4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
   5. Mounting: Horizontal, vertical, or pendant, as required.
   6. Tyco Model WS, or approved equal.
      a. Install per manufactuer's instructions.

E. Flexible Drop System: Stainless steel, multiple use, open gate type.
   1. Application: Use to properly locate sprinkler heads.
   2. Include all supports and bracing.
   3. Provide braided type tube as required for the application.
   4. Manufacturers:
      a. Victaulic Company; Vic-Flex: www.victaulic.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.04 PIPING SPECIALTIES

A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
   1. Activate electric alarm.

2. Test and drain valve.
3. Replaceable internal components without removing valve from installed position.

B. Flooding Deluge Valve: Gate type valve with rubber faced disc actuated manually with water motor alarm and electric alarm, with alarm testing trim.

C. Backflow Preventer: Reduced pressure principle valve assembly backflow preventer with drain and OS & Y gate valve on each end.
1. Manufacturers:
a. Tyco Fire Protection Products[<>]: www.tyco-fire.com/#sle.
b. Watts: www.watts.com/
c. Substitutions: See Section 01 6000 - Product Requirements.

D. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy chrome plated gong and motor housing, nylon bearings, and inlet strainer.

E. Electric Alarm: Electrically operated chrome plated gong with pressure alarm switch.

F. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.

G. Fire Department Connections:
1. Type: Free standing made of corrosion resistant metal complying with UL 405.
a. Sleeve: Brass, 18 inches height.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with referenced NFPA design and installation standard.

B. Install equipment in accordance with manufacturer's instructions.

C. Locate outside alarm gong on building wall as indicated.

D. Place pipe runs to minimize obstruction to other work.

E. Place piping in concealed spaces above finished ceilings.

F. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.

G. Flush entire piping system of foreign matter.

H. Hydrostatically test entire system.

I. Require test be witnessed by Fire Marshal.

3.02 INTERFACE WITH OTHER PRODUCTS

A. Ensure required devices are installed and connected as required to fire alarm system.

END OF SECTION

SECTION 22 0130
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Piping tube and fitting materials.
   2. Pipe joining materials.
   3. Transition fittings.
   4. Dielectric fittings.
   5. Mechanical sleeve seals.
   6. Sleeves.
   7. Escutcheons.
   8. Grout.
   9. Demolition.
   10. Equipment installation requirements common to equipment sections.
   11. Painting and finishing.
   12. Concrete bases.
   13. Supports and anchorages.

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.03 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

1.04 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.06 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS MATERIALS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.02 PIPE JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:
   1. ABS Piping: ASTM D 2235.
   2. CPVC Piping: ASTM F 493.
   3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
   4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.03 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
   1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
   2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
   3. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.04 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Refer to individual Division 23 piping Sections for dielectric fittings not listed below.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.05 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Stainless steel. Include two for each sealing element.
   3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.06 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms for concrete foundation walls below grade.

F. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.07 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw. Polished chrome-plated and rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw. Polished chrome-plated and rough brass.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.08 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi 28-day compressive strength, unless otherwise indicated in the structural drawings.
   3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
   1. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
   2. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
   3. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
   4. Install piping to permit valve servicing.
   5. Install piping at indicated slopes.
   6. Install piping free of sags and bends.
   7. Install fittings for changes in direction and branch connections.
   8. Install piping to allow application of insulation.

C. Select system components with pressure rating equal to or greater than system operating pressure.

3.02 **ESCUTCHEONS**

A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

3.03 PENETRATIONS AND SLEEVES

A. Sleeves are not required for core-drilled holes.

B. Permanent sleeves are not required for holes formed by removable PE sleeves.

C. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
d. Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

D. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

E. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

G. Verify final equipment locations for roughing-in.

H. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.04 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   5. PVC Nonpressure Piping: Join according to ASTM D 2855.
   6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.05 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.06 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Grease fittings shall be installed in accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.07 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 9.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.08 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic requirements as indicated in the California Building Code.
   1. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit, vibration isolator, or seismic restraint. Verify requirements with equipment anchor bolt edge distances.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section; unless otherwise indicated in structural drawings.

3.09 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.10 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Grout Installation:
   1. Clean surfaces that will come into contact with grout.
   2. Provide forms as required for placement of grout.
   3. Avoid air entrapment during placement of grout.
   4. Place grout, completely filling equipment bases.
   5. Place grout on concrete bases and provide smooth bearing surface for equipment.
   6. Place grout around anchors.
   7. Cure placed grout.

3.11 **PLUMBING DEMOLITION**

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Equipment to Be Removed: Disconnect and cap services and remove equipment.

C. Owner shall have first right-of refusal for salvage of all items to be removed. All items accepted for salvage by the Owner shall be protected from damage and delivered to the Owner's Representative. All items refused by Owner shall be properly dispose of by the Contractor.

D. For piping to remain, Contractor shall submit samples of existing piping to remain from locations as determined by the Engineer. Based on the results of destructive testing replacement of piping may be considered.

E. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

F. If suspected asbestos, lead or other toxic materials are discovered during the demolition process, work shall be halted and the owner's representative shall be notified.

END OF SECTION 230130

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SECTION 22 0516
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flexible pipe connectors.

B. Expansion joints and compensators.

C. Pipe loops, offsets, and swing joints.

1.02 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping.

1.03 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide; Current Edition.

B. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Maintenance Data: Include adjustment instructions.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Packing for Packed Expansion Joints: One set for each joint.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with UL (DIR) requirements.

2.02 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

A. Manufacturers:

1. Flex-Weld, Inc: www.kelcoind.com/#sle.
2. Mercer Rubber Company: www.mercer-rubber.com/#sle.
3. The Metraflex Company: www.metraflex.com/#sle.
4. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.

B. Inner Hose: Stainless steel.

C. Exterior Sleeve: Single braided, stainless steel.
D. Pressure Rating: 125 psi up to 12 inch.
E. Maximum Service Temperature: 250 degrees F.
F. End Connections: As specified for pipe joints.
G. Size: Use pipe sized units.
H. Maximum offset: 3/4 inch on each side of installed center line.

2.03 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

A. Manufacturers:
1. Flex-Weld, Inc: www.kelcoind.com/#sle.
2. Mercer Rubber Company: www.mercer-rubber.com/#sle.
3. The Metraflex Company: www.metraflex.com/#sle.
4. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.
B. Inner Hose: Bronze.
C. Exterior Sleeve: Braided bronze.
D. Pressure Rating: 125 psi up to 2 inch.
E. Maximum Service Temperature: 250 degrees F.
F. End Connections: As specified for pipe joints.
G. Size: Use pipe sized units.
H. Maximum offset: 3/4 inch on each side of installed center line.
I. Application: Copper piping.

2.04 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE

A. Manufacturers:
1. Flex-Weld, Inc: www.kelcoind.com/#sle.
2. Mercer Rubber Company: www.mercer-rubber.com/#sle.
B. Pressure Rating: 125 psi and 400 degrees F.
C. Maximum Compression: 1-3/4 inches.
D. Maximum Extension: 1/4 inch.
E. Joint Type: Externally pressurized with flanged ends.
F. Size: Use pipe sized units.
G. Application: Steel piping 4 inches and under.

2.05 EXPANSION JOINTS - EXTERNAL RING CONTROLLED STAINLESS STEEL BELLOWS TYPE

A. Manufacturers:
1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
B. Pressure Rating: 125 psi and 400 degrees F.
C. Maximum Compression: 15/16 inch.
D. Maximum Extension: 5/16 inch.
E. Maximum Offset: 1/8 inch.
F. End Connections: Flanged.

G. Size: Use pipe sized units.

H. Application: Steel piping over 2 inches.

2.06 EXPANSION JOINTS - COMPENSATORS

A. Manufacturers:
   1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
   2. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.

B. Type: Two-ply 304 stainless steel bellows with carbon steel shroud.

C. Maximum Working Pressure: 200 psi.

D. Maximum Working Temperature: 400 degrees F.

E. Maximum Compression: 1/2 inch.

F. Maximum Extension: 5/32 inch.

G. End Connections: Female copper sweat.

H. Application: Copper piping up to 3 inches in size or steel piping up to 4 inches in size.

2.07 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

A. Manufacturers:
   1. Flex-Weld, Inc: www.kelcoind.com/#sle.
   2. The Metraflex Company: www.metraflex.com/#sle.
   3. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.

B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets and plugged drain port for steam service.

C. Maximum Allowable Motion: 2 inch in the x, y, and z planes with no thrust loads to the building structure.

D. Maximum Working Pressure: 150 psi at 800 degrees F.

E. Construction: Class 150, schedule 40, stainless steel hose and braid assembly with carbon steel fittings, including elbows and flanged end connections sized to match pipe segment.
   1. Selected Product to Accommodate:
      a. Angular Rotation: 15 degrees.
      b. Force developed by 1.5 times specified maximum allowable operating pressure.
   2. Provide necessary accessories including, but not limited to, swivel joints.

2.08 EXPANSION JOINTS - EXTERNALLY PRESSURIZED

A. Manufacturers:
   1. Flex-Weld, Inc: www.kelcoind.com/#sle.
   2. The Metraflex Company: www.metraflex.com/#sle.
   3. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.

B. Bellows Type: Two-ply, single bellows constructed of 304 stainless steel.

C. Internal Liner: Carbon steel with internal and external guides.

D. Specialty: Carbon steel anchor base, lifting lugs, and drain port with tapered plug.

E. End Connections: Class 150, carbon steel, welded flange.

F. Maximum Axial Compression: 4 inches.

G. Maximum Working Pressure: 150 psi at 700 degrees F.

H. Application: Steel piping 2 inches and over.

2.09 ACCESSORIES

A. Pipe Alignment Guides:
   1. Manufacturers:
      a. Flex-Weld, Inc: www.kelcoind.com/#sle.
      b. The Metraflex Company: www.metraflex.com/#sle.
   2. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.

B. Swivel Joints:
   1. Fabricated steel body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

D. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

E. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION

SECTION 22 0517
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe sleeves.

B. Pipe sleeve-seals.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 09 9113 - Exterior Painting: Preparation and painting of exterior piping systems.

C. Section 09 9123 - Interior Painting: Preparation and painting of interior piping systems.

D. Section 22 0719 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

C. FM (AG) - FM Approval Guide; Current Edition.

D. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Valve Stem Packings: Two for each type and size of valve.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified this section.
   1. Minimum three years experience.

C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

A. Manufacturers:
   1. Flexicraft Industries: www.flexicraft.com.

B. Vertical Piping:
   1. Sleeve Length: 1 inch above finished floor.
   2. Provide sealant for watertight joint.
   3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
   4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

C. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

D. Pipe Passing Through Below Grade Exterior Walls:
   1. Zinc coated or cast iron pipe.
   2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

E. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
   1. Galvanized steel pipe or black iron pipe with asphalt coating.
   2. Connect sleeve with floor plate except in mechanical rooms.

F. Clearances:
   1. Provide allowance for insulated piping.
   2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
   3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.

2.02 PIPE-SLEEVE SEALS

A. Manufacturers:
   1. Advance Products & Systems, LLC: www.apsonline.com/#sle.
   2. American Polywater Corporation: www.polywater-haufftechnik.com/#sle.
   3. Flexicraft Industries: www.flexicraft.com/#sle.

B. Modular Mechanical Sleeve-Seal:

1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
3. Size and select seal component materials in accordance with service requirements.
4. Service Requirements:
   a. Corrosion resistant.
   b. Oil, fuel, gas, and solvent resistant.
   c. Underground, buried, and wet conditions.
   d. Fire Resistant: 1 hour, UL (DIR) approved.
5. Glass-reinforced plastic pressure end plates.

C. Sealing Compounds:
1. Provide packing and sealing compound to fill pipe to sleeve thickness.
2. Combined packing and sealing compounding to match partition fire-resistance hourly rating.

D. Pipe Sleeve Material:
1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
2. Masonry Structures: Sheet metal or fiber.

E. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.

F. Sleeve-Forming Disk: Non-conductive plastic-based material, 3 inch thick.

G. Pipeline-Casing Seals:
1. End Seals: 1/8 inch, pull-on type, rubber or synthetic rubber based.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

E. Structural Considerations: Do not penetrate building structural members unless indicated.

F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
2. Aboveground Piping:
   a. Pack solid using mineral fiber complying with ASTM C592.
   b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
3. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.
4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

G. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
3. Locate piping in center of sleeve or penetration.
4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
5. Tighten bolting for a water-tight seal.
6. Install in accordance with manufacturer's recommendations.

H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 22 0519
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flow meters.
B. Pressure gauges.
C. Thermometers.
D. Pressure-temperature test plugs.

1.02 REFERENCE STANDARDS

A. AGA/ANSI B109 Set - INCLUDES ANSI B109.1, ANSI B109.2, ANSI B109.3, ANSI B109.4; 2000.
B. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata (2023).
C. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
D. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2020).
E. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
F. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2020.
G. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service; 2019.
H. AWWA C702 - Cold-Water Meters -- Compound Type; 2019.
I. AWWA C703 - Cold-Water Meters -- Fire-Service Type; 2019.
J. AWWA C704 - Propeller-Type Meters for Waterworks Applications; 2019.
K. AWWA C707 - Encoder-Type Remote-Registration Systems for Cold-Water Meters; 2022.
L. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).
M. FM (AG) - FM Approval Guide; Current Edition.
N. IEEE 802.3 - IEEE Standard for Ethernet; 2022, with Amendments (2023).
O. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
P. NSF 61 - Drinking Water System Components - Health Effects; 2023.
Q. NSF 372 - Drinking Water System Components - Lead Content; 2022.
R. UL (DIR) - Online Certifications Directory; Current Edition.
S. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Utility Service Metering: Coordinate and apply Utility Service Provider requirements in terms of meter type, size, physical location, pipe size, upstream/downstream pipe lengths required, and other installation details.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide red-marked product data sheets for each furnished item with associated components and accessories.

C. Project Record Documents: Record actual locations of components and instrumentation.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements. for additional provisions.

PART 2 PRODUCTS

2.01 FLOWMETERS

A. In-Line Monitor:
   1. Accuracy: Plus or minus five percent full scale.
   2. Flow: Water, flow-range as indicated on drawings.
   3. Connection Size: 1 inch NPT female.
   4. Maximum Service Pressure: 200 psi.
   5. Range marks to bear metric and English (dual) scale with gpm units.

B. Flow Sensing Element.
   1. In-Line Averaging Measuring Station: Type 316 stainless steel pitot type flow element inserted through welded threaded couplet, with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.
      a. Pressure rating: 275 psi.
      b. Maximum temperature: 400 degrees F.
      c. Accuracy: Plus 0.55 percent to minus 2.30 percent.

2.02 PRESSURE GAUGES

A. Bourdon Tube for Liquids and Gases:
   1. Dial Size and Cover: 4-1/2 inch diameter scale with polycarbonate window.
   2. Dial Text and Markings: Black color on white background with scaled kPa and psi units.
   3. Accuracy: ASME B40.100, adjustable commercial grade (D) with 5 percent of span.
   4. Process Connection: Lower-back, 1/4 inch NPT male except where noted.

B. Diaphragm Actuated for Gases:
   1. Dial Size and Cover: 3-1/2 inch diameter scale with polycarbonate window.
   2. Dial Text and Markings: Black color on white background with scaled cm (cm wg) and inch (in wg) units.

3. Accuracy: ASME B40.100, adjustable commercial grade (B) with 2 percent at mid-range of span.
4. Process Connection: Lower-back, 1/4 inch NPT male except where noted.

2.03 THERMOMETERS

A. General:
   1. Product Compliance: ASTM E1.
   2. Lens: Clear glass, except where stated.
   3. Accuracy: One percent, when tested in accordance with ASTM E77, except where stated.
   4. Scale: Black markings depicting single scale in degrees F where expected process value falls half-span of standard temperature range.

B. Thermometers - Straight: 5 inch v-shape lead-free brass case with clear glass window scale, 2 inch NPT stem, 3-1/4 inch NPT thermowell, and red or blue non-toxic organic liquid filled glass tube.

C. Thermometers - Adjustable Angle: 7 inch v-shape aluminum case with clear glass window scale, 6 inch NPT stem, red or blue organic non-toxic liquid filled glass tube, and adjustable joint with positive locking device allowing 360 degrees in horizontal plane or 180 degrees in vertical plane adjustments.

D. Thermometers - Dial Type:
   1. Fixed: 5 inch diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch NPT stem.
   2. Adjustable Angle: 5 inch diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch NPT stem.
   3. Vapor (Gas) Actuated: 4-1/2 inch glass-reinforced phenolic case, aluminum dial with black pointer, recalibrating screw, 2 inch brass thermowell, adjustable joint with positive locking device allowing 180 degrees in vertical plane adjustment and capillary.

2.04 PRESSURE-TEMPERATURE TEST PLUGS:

A. Size: 500 psi capacity; 1/2 inch MPT brass fitting with gasket, cap, and retaining strap for 1/8 inch pressure gauge or temperature probe.

B. Wetted Materials per Temperature Range:
   1. Up to 200 degrees F: Brass probe with neoprene core.

C. Test Kit: Internally padded carrying case fitted with two 2-1/2 inch diameter pressure gauges, adapters, two 1/8 inch probes, and 1 inch dual-scale dial thermometers.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify Utility Service Provider piping readiness to receive meter.

B. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports, and test plugs.

3.02 INSTALLATION

A. Install metering products in accordance with manufacturer's instructions for intended fluid type and service.

B. Install water meters with inlet and outlet isolation valves in compliance with AWWA M6.

C. Install gas meters in accordance with Utility Service Provider instructions with required appurtenances.

D. Install rotameters (flowmeters) between 4 to 6 ft above finished floor unless instructed otherwise to allow easy readability.

E. Install pressure gauges as follows:
   1. At Pumps: Place single gauge before strainer, suction side and discharge side.
   2. Include gauge cock to isolate each gauge and extend nipples for insulation clearance.
   3. Adjust gauges to selected viewing angle, clean thoroughly, and calibrate to zero.

F. Install thermometers as follows:
   1. Hot Water Heaters: Place upstream and downstream of heater. Add one on the inlet end when using steam as the water heating medium.

END OF SECTION

SECTION 22 0523
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Angle valves.
B. Ball valves.
C. Butterfly valves.
D. Check valves.
E. Gate valves.
F. Globe valves.
G. Lubricated plug valves.

1.02 RELATED REQUIREMENTS

A. Section 08 3100 - Access Doors and Panels.
B. Section 22 0553 - Identification for Plumbing Piping and Equipment.
C. Section 22 0719 - Plumbing Piping Insulation.
D. Section 22 1005 - Plumbing Piping.
E. Section 22 1500 - General-Service Compressed-Air Systems.

1.03 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Non-rising stem.
E. PTFE: Polytetrafluoroethylene.
F. WOG: Water, oil, and gas.
G. WSP: Working steam pressure.

1.04 REFERENCE STANDARDS

A. API STD 594 - Check Valves: Flanged, Lug, Wafer, and Butt-Welding; 2022.
B. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
D. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022.
F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
G. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.

H. ASME B31.9 - Building Services Piping; 2020.
I. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.
J. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
K. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
L. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
M. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015 (Reapproved 2021).
N. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
O. MSS SP-45 - Drain and Bypass Connections; 2020.
P. MSS SP-67 - Butterfly Valves; 2022.
Q. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.
R. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
S. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
T. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.
U. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
V. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
W. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided; 2018.
X. NSF 61 - Drinking Water System Components - Health Effects; 2023.
Y. NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
D. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
    1. See Section 01 6000 - Product Requirements for additional provisions.

1.06 QUALITY ASSURANCE

A. Manufacturer:
    1. Obtain valves for each valve type from single manufacturer.
    2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
   2. Protect valve parts exposed to piped medium against rust and corrosion.
   3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
   4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
   5. Secure check valves in either the closed position or open position.
   6. Adjust butterfly valves to closed or partially closed position.

B. Use the following precautions during storage:
   1. Maintain valve end protection and protect flanges and specialties from dirt.
      a. Provide temporary inlet and outlet caps.
      b. Maintain caps in place until installation.
   2. Store valves in shipping containers and maintain in place until installation.
      a. Store valves indoors in dry environment.
      b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

1.08 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

A. Handle large valves with sling, modified to avoid damage to exposed parts.

B. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. See drawings for specific valve locations.

B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

C. Provide the following valves for the applications if not indicated on drawings:
   1. Shutoff: Ball, butterfly, gate or plug.
   2. Throttling: Provide globe, ball, or butterfly.
   3. Swing Check (Pump Outlet):
      a. 2 inch and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
      b. 2-1/2 inch and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.

D. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.

E. Required Valve End Connections for Non-Wafer Types:
   1. Steel Pipe:
      a. 2 inch and Smaller: Threaded ends.
      b. 2-1/2 inch to 4 inch: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
   2. Copper Tube:
      a. 2 inch and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

b. 2-1/2 inch to 4 inch: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.

F. Domestic, Hot and Cold Water Valves:
1. 2 inch and Smaller:
a. Bronze: Provide with threaded or Viega ProPress ends.
b. Bronze Angle: Class 125, bronze disc.
c. Ball: Two piece, full port, brass with brass trim.
d. Bronze Swing Check: Class 125, bronze disc.
e. Bronze Gate: Class 125, NRS.
f. Bronze Globe: Class 125, bronze disc.
2. 2-1/2 inch and Larger:
a. Iron, 2-1/2 inch to 4 inch: Provide with threaded or flanged ends.
b. Iron Ball: Class 150.
c. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.
d. Iron Swing Check: Class 125, metal seats.
e. Iron Swing Check with Closure Control: Class 125, lever and spring.
f. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
g. Iron Plate-Type Check: Class 125; single plate; metal seat.
h. Iron Gate: Class 125, NRS.

2.02 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
1. Gear Actuator: Quarter-turn valves 8 inch and larger.
2. Handwheel: Valves other than quarter-turn types.
3. Hand Lever: Quarter-turn valves 2 inch and smaller except plug valves.
4. Wrench: Plug valves with square heads.

D. Insulated Piping Valves: With 2 inch stem extensions and the following features:
1. Gate Valves: Rising stem.
2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: Extended neck.
4. Memory Stops: Fully adjustable after insulation is installed.

E. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
4. Solder Joint Connections: ASME B16.18.

F. General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
2. Solder-joint Connections: ASME B16.18.
3. Building Services Piping Valves: ASME B31.9.

G. Potable Water Use:
1. Certified: Approved for use in compliance with NSF 61 and NSF 372.

2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.

H. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRASS, BALL VALVES

A. Two Piece, Full Port with Brass Trim and Female Thread Connections:
1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. WOG Rating: 600 psi.
4. Body: Forged brass.
5. Seats: PTFE.
6. Ball: Chrome-plated brass.
7. Operator: Lockable handle and memory stop.

B. Two Piece, Full Port with Press Connections:
1. WOG Rating: 250 psi.
2. Body: Forged brass.
3. Seats: EPDM.
4. Ball: Chrome-plated brass.
5. Blow-out Proof Stem: Forged brass.
6. Operator: Provide lockable handle.
7. Maximum Service Temperature: 250 degrees F.

2.04 BRONZE, BALL VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Bronze Trim:
1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. WOG Rating: 600 psi.
4. Body: Forged bronze or dezincified-brass alloy.
5. Ends Connections: Pipe thread or solder.
6. Seats: PTFE.
7. Stem: Bronze, blowout proof.
8. Ball: Chrome plated brass.
9. Operator: Provide lockable handle and stem extension.

2.05 IRON, BALL VALVES

A. Class 125, Full Port, Stainless Steel Trim:
1. Comply with MSS SP-72.
2. CWP Rating: 200 psi.
3. Body: ASTM A536 Grade 65-45-12, ductile iron.
4. End Connections: Flanged.
5. Seats: PTFE.
6. Operator: Lever with locking handle.

2.06 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Lug Style; Bi-directional dead-end service without use of downstream flange:
   1. Class 125 or Class 150 flanges.
   2. Comply with MSS SP-67, Type I.
   3. Lug Style, Service Pressure Ratings:
      a. 100 psi for sizes 14 to 24 inch.
      b. 150 psi for sizes 2 to 12 inch.
      c. Vacuum down to 29.9 in-Hg.
   4. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
   5. Stem: One or two-piece stainless steel.
   6. Seat: EPDM.
   7. Disc: Stainless steel.
   8. Finish: Epoxy coated.
   9. Operator: Gear operator with handwheel over direct-mount actuator base.

2.07 BRONZE, LIFT CHECK VALVES

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125:
   1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
   2. CWP Rating: 200 psi.
   3. Design: Vertical flow.
   4. Body: Comply with ASTM B61 or ASTM B62, bronze.
   5. End Connections: Threaded.
   6. Disc (Type 1): Bronze.

2.08 BRASS, HORIZONTAL SWING CHECK VALVES

A. Class 125, Threaded End Connections:
   1. WOG Rating: 200 psi.
   2. Body: Forged brass.
   3. Disc: Forged brass.
   4. Hinge-Pin, Screw, and Cap: Forged brass.

B. Class 125, Press End Connections:
   1. WOG Rating: 200 psi.
   2. Body: Forged brass.
   3. Disc: Forged brass.
   4. Hinge-Pin, Screw, and Cap: Forged brass.

2.09 BRONZE, SWING CHECK VALVES

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125:

1. Pressure and Temperature Rating: MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.
3. WOG Rating: 200 psi.
4. Body: Bronze, ASTM B62.
5. End Connections: Threaded.
6. Disc: Bronze.

2.10 FLOW LIMITING VALVES

A. Size: As indicated on drawings, female threaded.

B. Flow Accuracy: Plus or minus 5 percent.

C. Body and Cap: Lead-free brass.

D. Cap and Plug: Lead-free brass.

E. Cartridge: Stainless steel with replaceable EPDM seal.

F. Maximum Service Pressure: 600 psi, WOG.

G. Maximum Service Temperature: 250 degrees F.

2.11 BRONZE, GATE VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Non-Rising Stem or NRS
1. Pressure-Temperature Range: MSS SP-80, Type I.
2. Class 125:
3. Class 150: CWP Rating; 300 psi.
4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
5. Ends Connections: Threaded.
6. Stem: Bronze.
7. Disc: Solid wedge; bronze.
8. Packing: Asbestos free.
9. Handwheel Operator: Malleable iron.

2.12 IRON, GATE VALVES

A. Bolted Bonnet: OS&Y; Rising Stem:
1. Pressure and Temperature Rating: MSS SP-70, Type I.
2. Class 125: WOG Rating; 200 psi.
3. Body: ASTM A126, gray iron with bolted bonnet.
4. End Connections: Flanged.
5. Trim: Bronze.
6. Disc: Solid wedge.
7. Packing and Gasket: Asbestos free.

2.13 BRONZE, GLOBE VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125 and Class 250:
   1. Class 125:
      a. WOG Rating: 200 psi.
      b. WSP Rating: 125 psi, saturated.
   2. Class 250: WOG Rating; 300 psi.
   3. Comply with MSS SP-80, Type 1.
   4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
   5. End Connections: Threaded or solder.
   6. Bonnet: NRS; Non-rising Stem.
   7. Non-Rising Stem: Bronze.
   8. Disc: PTFE.
   9. Packing: Asbestos free.
   10. Handwheel Operator: Malleable iron.

2.14 LUBRICATED PLUG VALVES

A. Regular Gland with Threaded Ends:
   1. Comply with MSS SP-78, Type II.
   2. Class 125: CWP Rating: 200 psi.
   3. Body: ASTM A48/A48M or ASTM A126, cast iron with lubrication sealing system.
   4. Pattern: Regular or short.
   5. Plug: Cast iron or bronze with sealant groove.

PART 3 EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

END OF SECTION

SECTION 22 0529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prefabricated trapeze-framed systems.
B. Strut systems for pipe or equipment support.
C. Beam clamps.
D. Pipe hangers.
E. Pipe rollers and roller supports.
F. Pipe supports, guides, shields, and saddles.
G. Seismic bracing hardware.
H. Nonpenetrating rooftop supports for low-slope roofs.
I. Anchors and fasteners.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
B. Section 05 5000 - Metal Fabrications.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2023.
D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
K. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
M. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
N. FM (AG) - FM Approval Guide; Current Edition.
O. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
P. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
Q. UL (DIR) - Online Certifications Directory; Current Edition.
R. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
   1. Fiberglass Strut Channel Framing Systems: Include requirements for strength derating according to ambient temperature.

1.06 QUALITY ASSURANCE

A. Comply with applicable building code.
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.

B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.

C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.

D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

E. Fire Resistance: Provide hardware rated for 60 minutes resistance unless specifically indicated by the authority having jurisdiction.

F. Materials for Metal Fabricated Supports: Comply with Section 05 5000.
   1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
   2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.

G. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.
   1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
   2. Outdoor, Damp, or Wet-Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

2.02 PREFABRICATED TRAPEZE-FRAMED SYSTEMS

A. Prefabricated Trapeze-Framed Metal Strut Systems:
   1. Manufacturers:
      a. Anvil International, LLC: www.asc-es.com/#sle.
      b. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
      c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
   2. Strut Channel or Bracket Material:
      a. Indoor Dry Locations: Use zinc-plated steel or galvanized steel.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
   3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
   4. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
   5. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

B. Prefabricated Trapeze-Framed Fiberglass Strut Systems:
   1. Manufacturers:

a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. MSS SP-58 type 59, prefabricated continuous-slot fiberglass strut channel, associated fittings, and related accessories.
3. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.

2.03 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

A. Strut Channels:
   1. Manufacturers:
      a. ABB Installation Products: electrification.us.abb.com/#sle.
      b. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
      c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
   2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
   3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.

B. Hanger Rods:
   1. Threaded zinc-plated steel unless otherwise indicated.
   2. Minimum Size, Unless Otherwise Indicated or Required:
      a. Equipment Supports: 1/2 inch diameter.
      b. Piping up to 1 inch: 1/4 inch diameter.
      c. Piping larger than 1 inch: 3/8 inch diameter.
      d. Trapeze Support for Multiple Pipes: 3/8 inch in length.

C. Channel Nuts:
   1. Manufacturers:
      a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
      b. FNW: www.fnw.com/#sle.
      c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
      d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
   2. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

2.04 BEAM CLAMPS

A. Manufacturers:
   1. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
   2. FNW: www.fnw.com/#sle.
   3. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
   4. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

B. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.

C. C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.

D. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).

E. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.

F. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.

G. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish.

H. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

I. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.05 PIPE HANGERS

A. Band Hangers, Adjustable:
   1. Manufacturers:
      a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
      b. Gripple, Inc: www.gripple.com/#sle.
      c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
   2. MSS SP-58 type 7 or 9, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.

B. J-Hangers, Adjustable:
   1. Manufacturers:
      a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
      b. FNW: www.fnw.com/#sle.
      c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
      d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
   2. MSS SP-58 type 5, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
   3. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.

C. Swivel Ring Hangers, Adjustable:
   1. Manufacturers:
      a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
      b. FNW: www.fnw.com/#sle.
      c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
   2. MSS SP-58 type 10, epoxy-painted, zinc-colored.
   3. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
   4. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
   5. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.

D. Clevis Hangers, Adjustable:
   1. Manufacturers:
      a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
      b. FNW: www.fnw.com/#sle.
      c. nVent Caddy, a brand of nVent: www.erico.com/#sle.

d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
3. Felt-Lined: MSS SP-58 type 1, zinc-plated, silicone-free carbon steel.
4. Light-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
5. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
6. UL (DIR) listed: Pipe sizes 2-1/2 to 8 inch.
7. FM (AG) listed: Pipe sizes 2-1/2 to 8 inch.

2.06 PIPE CLAMPS

A. Riser Clamps:
1. Manufacturers:
a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
b. FNW: www.fnw.com/#sle.
c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
3. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.

B. Extension Split Pipe Clamp:
1. Manufacturers:
a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
b. FNW; 7001: www.fnw.com/#sle.
c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MSS SP-58 type 12, hinged split ring and yoke roller hanger with epoxy copper or plain finish.
3. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
4. Provide hanger rod and nuts of the same type and material for a given pipe run.
5. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

C. Strut Clamps:
1. Manufacturers:
a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
3. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil.
4. Service Temperature Range: Minus 65 to 275 degrees F.

D. Insulation Coupling:
1. Manufacturers:

a. FNW: www.fnw.com/#sle.
b. nVent Caddy, a brand of nVent: www.erico.com/#sle.
c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. Two bolt-type clamps designed for installation under insulation.
3. Material: Carbon steel with epoxy copper or zinc finish.

2.07 PIPE ROLLERS AND ROLLER SUPPORTS

A. Manufacturers:
1. ASC Engineered Solutions: www.asc-es.com/#sle.
2. FNW: www.fnw.com/#sle.
3. nVent Caddy, a brand of nVent: www.erico.com/#sle.
4. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

B. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.

C. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

2.08 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

B. Stanchions:
1. Manufacturers:
a. Anvil International: www.anvilintl.com/#sle.
b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
3. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
4. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.

C. U-Bolts:
1. Manufacturers:
a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
b. FNW: www.fnw.com/#sle.
c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MSS SP-58 type 24, carbon steel u-bolt for pipe support or anchoring.

D. Intermediate Anchors and Pipe Alignment Guides:
1. Manufacturers:
a. Anvil International, LLC: www.anvilintl.com/#sle.
b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
c. Gregory Industries, Inc: www.gregorycorp.com/#sle.

d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. Pipe Sizes 6 inch and Smaller: Minimum clearance of 0.16 inch.
3. Pipe Size 8 inch: 0.625 inch U-bolt with double nuts providing minimum clearance of 0.28 inch.
4. Pipe Size 10 inch: 0.75 inch U-bolt.
5. Pipe Sizes 12 to 16 inch: 0.875 inch U-bolt.
6. Pipe Sizes 18 to 30 inches: 1 inch U-bolt.
7. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.

E. Pipe Alignment Guides, Galvanized steel:
1. Manufacturers:
a. Anvil International: www.anvilintl.com/#sle.
b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
c. Gregory Industries, Inc: www.gregorycorp.com/#sle.
d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.

F. Pipe Shields for Insulated Piping:
1. Manufacturers:
a. Anvil International: www.anvilintl.com/#sle.
b. FNW: www.fnw.com/#sle.
c. Gregory Industries, Inc: www.gregorycorp.com/#sle.
d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
3. General Construction and Requirements:
a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
b. Shields Material: UV-resistant polypropylene with glass fill.
c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
d. Service Temperature: Minus 40 to 178 degrees F.
e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

G. Pipe Supports:
1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
2. Liquid Temperatures Up to 122 degrees F:
a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
b. Support From Below: MSS SP-58 types 35 through 38.

H. Pipe Supports, Thermal Insulated:
1. Manufacturers:
a. Buckaroos, Inc: www.buckaroos.com/#sle.
b. KB Enterprises: www.snappitz.com/#sle.
2. General Requirements:
a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.

c. Provide pipe supports for 1/2 to 30 inch iron pipes.
d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.

3. PVC Jacket:
a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
c. Minimum Thickness: 60 mil, 0.06 inch.

I. Copper Pipe Supports:
1. Manufacturers:
a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
c. Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by single manufacturer.

J. Thermal Insulated, Surface-Mounted Pipe Supports:
1. Manufacturers:
a. FNW: www.fnw.com/#sle.
b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Material: Carbon steel with epoxy copper or zinc finish.
3. Weather and UV light resistant foam, plastic, or rubber material with built-in strut. Maximum Load: 50 lb for single pipe or multiple landed on top strut.

K. Overhead Pipe Supports:
1. Manufacturers:
a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
b. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

L. Plenum Pipe Supports:
1. Manufacturers:
a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
b. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2.09 SEISMIC BRACING HARDWARE

A. Cable Suspension Systems:
1. Manufacturers:
a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
b. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Strut channel or bracket-fitted fitting with locking mechanism for pipe or equipment suspension using cable wires extended to surface-mounted end-fixing fittings.
3. Provide cable wire and end-fixing as required to hold minimum weight of 120 lb.

B. Cable Sway Bracing Systems:
1. Manufacturers:
a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.

b. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. Cable wire hanger with fix and release spring mechanism enclosed using zinc housing with 302 stainless steel components for pipe or equipment suspension to surface-mounted end-fixing fittings.
3. Provide cable wire and end-fixing as required to hold minimum weight of 25 lb.

2.10 NONPENETRATING ROOFTOP SUPPORTS FOR LOW-SLOPE ROOFS

A. Manufacturers:
1. Anvil International: www.anvilintl.com/#sle.
2. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
3. MIFAB MFG: www.mifab.com.
4. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
5. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

B. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.

C. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.

D. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

E. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

2.11 ANCHORS AND FASTENERS

A. Manufacturers - Mechanical Anchors:
1. Hilti, Inc: www.us.hilti.com/#sle.
2. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
3. Powers Fasteners, Inc: www.powers.com/#sle.
4. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.

B. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

C. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.

D. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.

E. Hollow Masonry: Use toggle bolts.

F. Hollow Stud Walls: Use toggle bolts.

G. Steel: Use beam ceiling clamps, beam clamps, machine bolts, or welded threaded studs.

H. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.

I. Sheet Metal: Use sheet metal screws.

J. Wood: Use wood screws.

K. Plastic and lead anchors are not permitted.

L. Powder-actuated fasteners are not permitted.

M. Hammer-driven anchors and fasteners are not permitted.

N. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

O. Preset Concrete Inserts: Continuous metal strut channel and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
   1. Channel Material: Use galvanized steel.
   2. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
   3. Manufacturer: Same as manufacturer of metal strut channel framing system.

P. Concrete Inserts:
   1. Manufacturers:
      a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
      b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
      c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
      d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

H. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.

J. Secure fasteners according to manufacturer's recommended torque settings.

K. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 22 0548
VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vibration isolation requirements.
B. Seismic control requirements.
C. Vibration-isolated equipment support bases.
D. Vibration isolators.
E. Seismic restraint systems.

1.02 DEFINITIONS

A. Plumbing Component: Where referenced in this section in regards to seismic controls, applies to any portion of the plumbing system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).
B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
C. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.
D. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
E. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
G. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
H. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2020).
I. MFMA-4 - Metal Framing Standards Publication; 2004.
J. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.

2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Seismic Controls:
    a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
    b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

1.06 QUALITY ASSURANCE

A. Comply with applicable building code.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing plumbing equipment and/or plumbing connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:
1. Select vibration isolators to provide required static deflection.
2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.

D. Piping Isolation:
1. Provide vibration isolators for piping supports:
    a. Located in equipment rooms.
    b. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
    c. For piping over 2 inch located below or within 50 feet of noise-sensitive areas indicated.

2.02 SEISMIC CONTROL REQUIREMENTS

A. Design and provide plumbing component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor plumbing components.

B. Seismic Design Criteria: Obtain from project Structural Engineer of Record.

C. Premanufactured Modular Plumbing Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.

D. Seismic Restraints:
   1. Provide seismic restraints for plumbing components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
   2. Seismic Restraint Exemptions:
      a. Exemptions for Seismic Design Category C:
         1) Plumbing components where either of the following apply:
            (a) The component importance factor (Ip) is 1.0 and the component is positively attached to the structure.
            (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
         2) Plumbing piping with component importance factor (Ip) of 1.5 and nominal pipe size of 2 inch or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
      b. Plumbing Piping Exemptions, All Seismic Design Categories:
         1) Plumbing piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:
            (a) Trapeze supported piping weighing less than 10 pounds per foot, where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.
            (b) Trapeze supported piping with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.
            (c) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds or less.

(d) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.

(e) Hanger supported piping with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, where pipe has a component importance factor (Ip) of 1.0 and meets size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds or less.

3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
   a. FEMA 412.
   b. FEMA 413.
   c. FEMA 414.
   d. FEMA E-74.
   e. SMACNA (SRM).
4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
5. Seismic Restraint Systems:
   a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
   b. Use only cable restraints to restrain vibration-isolated plumbing components, including distributed systems.
   c. Use only one restraint system type for a given plumbing component or distributed system (e.g., piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
   d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain plumbing component in all lateral directions; consider bracket geometry in anchor load calculations.
   e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported plumbing component weight.
   f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported plumbing component weight.
   g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
   h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
   i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.

E. Seismic Attachments:
   1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.

2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use power-actuated fasteners except where permitted by applicable code.
4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads) except where permitted by applicable code. Beam clamps may be used for supporting sustained loads where provided with restraining straps.
5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
6. Concrete Housekeeping Pads:
   a. Increase size of pad as required to comply with anchor requirements.
   b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

F. Seismic Interactions:
1. Include provisions to prevent seismic impact between plumbing components and other structural or nonstructural components.
2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.

G. Seismic Relative Displacement Provisions:
1. Use suitable fittings or flexible connections to accommodate:
   a. Relative displacements at connections between components, including distributed systems (e.g., piping); do not exceed load limits for equipment utility connections.
   b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
   c. Design displacements at seismic separations.
   d. Anticipated drifts between floors.

2.03 SEISMIC RESTRAINT SYSTEMS

A. Manufacturers:
1. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.

B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

C. Cable Restraints:
1. Comply with ASCE 19.
2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
4. Use protective thimbles for cable loops where potential for cable damage exists.

D. Rigid Restraints: Use MFMA-4 steel channel (strut) for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Secure fasteners according to manufacturer's recommended torque settings.

D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

E. Vibration Isolation Systems:
   1. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
   2. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
   3. Adjust isolators to be free of isolation short circuits during normal operation.
   4. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

F. Seismic Controls:
   1. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
   2. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
   3. Equipment with Sheet Metal Housings:
      a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
      b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
      c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
   4. Concrete Housekeeping Pads:
      a. Size in accordance with seismic design to meet anchor requirements.
      b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
   5. Seismic Restraint Systems:
      a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
      b. Install restraints within permissible angles in accordance with seismic design.
      c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
      d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
      e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.02 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Vibration Isolation Systems:
   1. Verify isolator static deflections.
   2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

D. Seismic Controls:
   1. Verify snubbing element air gaps.

E. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION

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SECTION 22 0553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 **RELATED DOCUMENTS**

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 **SUMMARY**

A. SECTION INCLUDES
   1. Equipment Labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Valve tags.
   5. Underground warning tape.
   6. Ceiling tacks.
   7. Warning tags.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: For each type of product indicated.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedule: For each piping system to include in maintenance manuals.

F. Schedules:
   1. Submit plumbing component identification schedule listing equipment, piping, and valves.
   2. Detail proposed component identification data in terms of of wording, symbols, letter size, and color coding to be applied to corresponding product.
   3. Valve Data Format: Include id-number, location, function, and model number.

1.05 **COORDINATION**

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

A. Nameplates:
   1. Heat exchangers, water heaters, and other heat transfer products.
   2. Control panels, transducers, and other related control equipment products.
   3. Pumps, tanks, filters, water treatment devices, and other plumbing equipment products.

B. Tags:
   1. Piping: 3/4 inch diameter and smaller.
   2. Manual operated and automated control valves.
   3. Ceiling tacks placed on lay-in ceiling surface to reference plumbing components.

C. Pipe Markers: 3/4 inch diameter and higher.

2.02 **EQUIPMENT LABLES**

A. Metal Labels for Equipment:
   1. Material and Thickness: Brass, 0.032 inch (0.8 mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
   3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   4. Fasteners: Stainless steel rivets or self-tapping screws.
   5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
   1. Material and Thickness Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
   2. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
   3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
   4. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   5. Fasteners: Stainless steel rivets or self-tapping screws.
   6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: Fore each item of equipment to be labeled, on 8-1/2 by 11 inch (A4) bond paper. Tabulate equipment identification number and identify drawing numbers where equipment is indicated (plans, details, and schedules), plus Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.03 **WARNING SIGNS AND LABELS**

A. Material and Thickness Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

D. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

E. Fasteners: Stainless steel rivets or self-tapping screws.

F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

G. Label Content: Include caution and warning information, plus emergency notification instructions.

2.04 **PIPE LABELS**

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference fo pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.05 **VALVE TAGS**

A. Valve Tags: Stamped or engraved with 1/4 inch (6.4 mm) letters for piping system abbreviation and 1/2 inch (13 mm) numbers.
   1. Tag Material: Brass, 0.032 inch (0.8 mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Bras wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2 by 11 inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve tag schedule shall be included in operation and maintenance data.

2.06 **WARNING TAGS**

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7 inches (100 by 178 mm).
   2. Fasteners: Brass grommet and wire.

3. Nomenclature: Large-size primary caption such as "DANGER", "CAUTION", or "DO NOT OPERATE".
4. Color: Yellow background with black lettering.

2.07 TAGS

A. Manufacturers:
   1. Advanced Graphic Engraving: www.advancedgraphicengraving.com/#sle.
   2. Brady Corporation: www.bradycorp.com/#sle.
   3. Brimar Industries, Inc: www.pipemarker.com/#sle.
   4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
   5. Seton Identification Products: www.seton.com/#sle.

B. Metal: Brass, 19 gauge 1-1/2 inch in diameter with smooth edges, blank, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.

C. Valve Tag Chart: Typewritten 12-point letter size list in anodized aluminum frame.

D. Piping: 3/4 inch diameter and smaller. Include corrosion resistant chain. Identify service, flow direction, and pressure.

2.08 PIPE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradycorp.com/#sle.
   2. Brimar Industries, Inc: www.pipemarker.com/#sle.
   3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
   4. Seton Identification Products: www.seton.com/#sle.

B. Comply with ASME A13.1.

C. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.

D. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

E. Underground Flexible Marker: Bright-colored continuously printed ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

F. Identification Scheme, ASME A13.1:
   1. Primary: External Pipe Diameter, Uninsulated or Insulated.
      a. 3/4 to 1-1/4 inches: Use 8 inch field-length with 1/2 inch text height.
      b. 1-1/2 to 2 inches: Use 8 inch field-length with 3/4 inch text height.
      c. 2-1/2 to 6 inches: Use 12 inch field-length with 1-1/4 inch text height.
      d. 8 to 10 inches: Use 24 inch field-length with 2-1/2 inch text height.
   2. Secondary: Color scheme per fluid service.
      a. Compressed Air: White text on blue background.
      b. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.
   3. Tertiary: Other Details.
      a. Directional flow arrow.

2.09 UNDERGROUND WARNING TAPE

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com/#sle.
   2. Brimar Industries, Inc: www.brimar.com/#sle.

3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
4. Seton Identification Products: www.seton.com/#sle.

B. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

C. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil, 0.004 inch.

D. Legend: Type of service, continuously repeated over full length of tape.

2.10 CEILING TACKS

A. Manufacturers:
1. Craftmark: www.craftmarkid.com/#sle.

B. Description: Steel with 3/4 inch diameter color coded head.

C. Color code as follows:
1. Plumbing Equipment: Yellow.
2. Plumbing Valves: Green.
3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

B. Degrease and clean surfaces to receive identification products.

3.02 **EQUIPMENT LABEL INSTALLATION**

A. Install or permanently fasten labels on each major item of mechanical equiment.

B. Locate equipment labels where accessible and visible.

3.03 **PIPE LABEL INSTALLATION**

A. Piping Color-Coding: Painting of piping is specified in other sections.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces, machine rooms, accessible maintenance spaces such as shafts, tunnels, and plenums, and exterior exposed locations as follows:
1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately space labels.

3.04 **VALVE-TAG INSTALLATION**

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similiar rough-in connections on end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similiar to those indicated in the following subparagraphs:
   1. Valve-Tag Size and Shape:
      a. Cold Water: 2 inches (50 mm) round.
      b. Hot Water: 2 inches (50 mm) round.

3.05 **WARNING-TAG INSTALLATION**

A. Write required message on, and attach warning tags to equipment and other items where required.

3.06 INSTALLATION

A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags in clear view and align with axis of piping

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Apply ASME A13.1 Pipe Marking Rules:
   1. Place pipe marker adjacent to changes in direction.
   2. Place pipe marker adjacent each valve port and flange end.
   3. Place pipe marker at both sides of floor and wall penetrations.
   4. Place pipe marker every 25 to 50 feet interval of straight run.

G. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 22 0719
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 **RELATED DOCUMENTS**

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 **SUMMARY**

A. Section Includes:
   1. Insulation Materials:
   2. Flexible elastomeric cellular insulation.
   3. Flexible elastomeric.
   4. Glass fiber insulation.
   5. Polyethylene insulation.
   6. Mineral fiber.
   7. Adhesives.
   8. Sealants.

1.03 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.

B. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.04 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).

B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.

C. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.

D. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).

E. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

C. Qualification Data: For qualified installer.

1.06 **QUALITY ASSURANCE**

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicted, as directed by Architect. Use materials indicted for the completed work.

1.07 **DELIVERY, STORAGE, AND HANDLING**

A. Packaging: Insulation material containers shall be marked by mnufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.08 **COORDINATION**

A. Coordinate clearance requirements with piping installer for piping insulation application and equipment installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.09 **SCHEDULING**

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.10 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 **INSULATION MATERIALS**

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Foam insulation materials shall not use CFC of HCFC blowing agents in the manufacturing process.

C. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class 1.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA Inc; Aerocel.
      b. Armacell LLC; 520 Adhesive.
      c. Foster Products Corporation, H.B. Fuller Company; 85-75.
   2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-82.
      b. Foster Products Corporation, H.B. Fuller Company; 85-20.
      c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. PVC Jacket Adhesive: Compatible with PVC Jacket:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Chemical Company (The); 739, Dow Silicone.
      b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
      c. P.I.C. Plastics, Inc; Welding Adhesive.
      d. Speedline Corporation; Speedine Vinyl Adhesive.
   2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.03 SEALANTS

A. Joint Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Permanently flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
   4. Color: White or gray.
   5. For indoor applications, use sealants that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products, Division of ITW; CP-76-8.
   b. Foster Products Corporation, H.B. Fuller Company; 95-44.
   c. Marathon Industries, Inc; 405.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire and water resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, use sealants that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire and water resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, use sealants that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.05 GLASS FIBER INSULATION

A. Insulation: ASTM C547and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
1. K Value: ASTM C177, 0.23 at 75 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

2.06 POLYETHYLENE INSULATION

A. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.
1. K Value: ASTM C177; 0.25 at 75 degrees F.
2. Maximum Service Temperature: 200 degrees F.
3. Density: 2 pcf.
4. Maximum Moisture Absorption: 1.0 percent by volume.
5. Moisture Vapor Permeability: 0.05 perm inch, when tested in accordance with ASTM E96/E96M.
6. Connection: Contact adhesive.

2.07 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
   1. Minimum Service Temperature: Minus 40 degrees F.
   2. Maximum Service Temperature: 220 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.

2.08 JACKETING AND ACCESSORIES

A. PVC Plastic Jacket:

B. PVC Jacket: One piece molded type fitting covers and sheet material, off-white color.
   1. Minimum Service Temperature: 0 degrees F.
   2. Maximum Service Temperature: 150 degrees F.
   3. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
   4. Thickness: 10 mil, 0.010 inch.
   5. Connections: Brush on welding adhesive.
   6. Covering Adhesive Mastic: Compatible with insulation.

C. Aluminum Jacket:
   1. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
   1. Verify that system and equipment to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry, with foreign material removed.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **PREPARATION**

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation apprlication.

B. Surface Preparation: Clean and dry surfaces to receive insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
   2. Carbon Steel: Coat carbon steel operating at a service temperature range between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces, free of voids throughout the legth of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thickness required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatiable with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with lonitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachments devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install sheilds over jacket, arranged to protectjcaket from tear or puncture by hanger, support, and shield.

K. Apply adhesive, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3 inch (75 mm) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) O.C.
   3. Overlap jacket lonitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to recieve self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) O.C.
   4. For below ambient services, apply vapor-barrier mastic over staples.
   5. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
   6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut instulation in a manner to avoid compressing insulation more than 75 percent of it's nominal thickness.

N. Finish installation with systems at operating conditions. Repair separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Name plates and data plates.
   4. Manholes.
   5. Handholes.
   6. Cleanouts.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetration.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant,. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications thighly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applicaitons requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulations, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations for fire-rated walls and partitions.
   1. Comply with requirements for firestopping and fire-resistive joint sealers listed in other sections.

F. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements for firestopping and fire-resistive joint sealers listed in other sections.
   3. General pipe insulation installation.

G. Requirements in this artical generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

H. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
   2. Insulated pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves with preformed fitting insulation or sectional pipe insulation fo same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less that two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers with preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
   6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
   7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mech. Trowel the mastic to a smooth and well-shaped contour.
   8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
   9. Stencil or label the outside insulation jacket of each union with the word "UNION". Match size and color of pipe lables.

I. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating ceement and finish with finishing cement, mastic, and flashing sealant.

J. Install removable insulation covers at locations indicted. Installation shall conform to the following:
   1. Make removable flange and union insulation form sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of the flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removeable valveinsulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.05 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flange and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allows passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allows passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allows passage of air to surface being insulated.

3.06 **MINERAL-FIBER INSULATION INSTALLATION**

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of performed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) O.C.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circuference of flange insulation and outer circumference of adjacent straight piping segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm) and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install performed sections fo same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When performed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without distrubing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.07 **FINISHES**

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
1. Flat Acrylic Finish: Two finish coats over a primer that is compatiable with jacket material and finish coat paint. Add Fungicidal agent to render fabric mildew proof.
a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.08 **FIELD QUALITY CONTROL**

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform test and inspections.

C. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations fo threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Pipe Insulation Schedule, General" Article.

3.09 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more that one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personal injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water:
   1. NPS 1/2" (DN 15) and NPS 3/4" (DN 20): Insulation shall be one of the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
   2. NPS 1" (DN 25), NPS 1-1/4" (DN 32) and NPS 1-1/2" (DN 40): Insulation shall be one of the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch (38 mm) thick.
   3. NPS 2" (DN 50) and larger: Insulation shall be one of the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inch (51 mm) thick.

B. Condensate and Equipment Drain Waer below 60 Deg F (16 deg C):
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch (25 mm) thick.

3.11 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

G. Glass fiber insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

H. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 8400.

J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with aluminum jacket.

K. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

END OF SECTION

SECTION 22 1005
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sanitary waste piping, buried within 5 feet of building.
B. Sanitary waste piping, above grade.
C. Domestic water piping, buried within 5 feet of building.
D. Domestic water piping, above grade.
E. Storm drainage piping, buried within 5 feet of building.
F. Storm drainage piping, above grade.
G. Sanitary Vent.
H. Natural gas piping, above grade.
I. Pipe flanges, unions, and couplings.
J. Pipe hangers and supports.
K. Pipe sleeve-seal systems.
L. Ball valves.
M. Butterfly valves.
N. Balancing valves.
O. Pressure reducing valves.
    1. Pressure relief valves.
P. Pressure-temperature valves.
Q. Strainers.
R. Indirect and Condensate

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.
B. Section 08 3100 - Access Doors and Panels.
C. Section 22 0516 - Expansion Fittings and Loops for Plumbing Piping.
D. Section 22 0529 - Hangers and Supports for Plumbing Piping and Equipment.
E. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
F. Section 22 0553 - Identification for Plumbing Piping and Equipment.
G. Section 22 0719 - Plumbing Piping Insulation.
H. Section 31 2316 - Excavation.

1.03 REFERENCE STANDARDS

A. ANSI LC 1/CSA 6.26 - Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing; 2019.

B. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).
C. ANSI Z223.1 - National Fuel Gas Code; 2024.
D. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
F. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
G. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.
H. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV; 2022.
I. ASME B31.9 - Building Services Piping; 2020.
J. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.
K. ASSE 1003 - Water Pressure Reducing Valves for Potable Water Distribution Systems; 2023.
L. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
M. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.
N. ASTM B32 - Standard Specification for Solder Metal; 2020.
O. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.
P. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2020.
Q. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
R. ASTM D2321- Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
S. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2020.
T. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.
U. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.
V. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2020.
W. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
X. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2023.
Y. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
Z. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014 (Reapproved 2021).
AA. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2017.
BB. AWWA C651 - Disinfecting Water Mains; 2014, with Addendum (2020).

CC. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.

DD. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.

EE. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).

FF. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).

GG. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

HH. NSF 61 - Drinking Water System Components - Health Effects; 2023.

II. NSF 372 - Drinking Water System Components - Lead Content; 2022.

JJ. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Product Origin: Each pipe and fitting shall be marked with the following: Manufacturer’s name or registered trademark, Country of Origin, date of manufacture (pipe materials only).

1.05 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.

E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

F. Made in USA: All piping products shall be manufactured and fabricated in the United States and produced from materials that is made and melted in the United States.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

B. Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

2.02 **SANITARY SEWER AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING**

A. Hubless Cast Iron Pipe and Fittings:
   1. Pipe Fittings: ASTM A 888 or CISPI 301.
   2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
   3. Shielded Couplings: ASTM C 1540 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.
      a. Sanitary Sewer And Vent Piping - Heavy-Duty, 4-band shielded, stainless-steel couplings, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

B. DWV Copper Pipe And Fittings - Forced Main:
   1. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
   2. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

2.03 **SANITARY SEWER AND VENT PIPING, ABOVE GRADE**

A. Hubless Cast Iron Pipe and Fittings:
   1. Pipe Fittings: ASTM A 888 or CISPI 301.
   2. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.
      a. Vent Piping - Standard, 2-band or 4-band shielded, stainless-steel couplings, CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
   3. Shielded Couplings: ASTM C 1540 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.
      a. Sanitary Sewer Piping - Heavy-Duty, 4-band shielded, stainless-steel couplings, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

B. Copper Tube And Fittings - Forced Main:
   1. Hard Drawn Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
   2. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Tube and Fittings:
   1. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
   2. Wrought-Copper Solder-Joint Fittings: ASME B 16.22, wrought-copper pressure fittings.
   3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Soft Copper Tube: ASTM B88, Type K water tube, annealed temper.
1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube and Fittings:
1. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
2. Wrought-Copper Solder-Joint Fittings: ASME B 16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.06 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Hubless Cast Iron Pipe and Fittings:
1. Pipe Fittings: ASTM A 888 or CISPI 301.
2. Shielded Couplings: ASTM C 1540 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.
a. Heavy-Duty, 4-band shielded, stainless-steel couplings, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

2.07 STORM DRAINAGE PIPING, ABOVE GRADE

A. Hubless Cast Iron Pipe and Fittings:
1. Pipe Fittings: ASTM A 888 or CISPI 301.
2. Shielded Couplings: ASTM C 1540 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.
a. Heavy-Duty, 4-band shielded, stainless-steel couplings, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

2.08 NATURAL GAS PIPING, ABOVE GRADE

A. Pipe And Fittings - Interior:
1. ASTM A53, Type F, Grade A, Black Steel, Schedule 40
a. Thread pipe with tapered pipe threads complying with ASME B1.20.1
2. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
a. Material Group: 1.1.
b. End Connections: Threaded or butt welding to match pipe.
c. Lapped Face: Not permitted underground.
d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground adn stainless steel underground.

B. Pipe And Fittings - Exterior:
   1. ASTM A53, Type F, Grade A, Hot-Dip Galvanized , Schedule 40
      a. Thread pipe with tapered pipe threads complying with ASME B1.20.1
      b. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
         1) Alkyd System: MPI EXT 5.1D.
            (a) Prime Coat: Alkyd anticorrosive metal primer.
            (b) Intermediate Coat: Exterior alkyd enamel matching topcoat.
            (c) Topcoat: Exterior alkyd enamel (semigloss).
            (d) Color: Gray.
   2. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
   3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
   4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      a. Material Group: 1.1.
      b. End Connections: Threaded or butt welding to match pipe.
      c. Lapped Face: Not permitted underground.
      d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
      e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

C. Flexible Gas Piping:
   1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
   2. Comply with ASTM E84.
   3. Fittings: Provided by piping system manufacturer.

2.09 **ENCASEMENT FOR UNDERGROUND PIPING**

A. High density cross laminated polyethylene film intended for encasement of underground piping for protection against corrosion.
   1. ASTM 1674 or AWWA C105
   2. Minimum thickness: 0.004-inch
   3. Form: Tube
   4. Color: Natural

2.10 **CONDENSATE PIPING**

A. Copper Tube And Fittings:
   1. Hard Drawn Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
   2. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

2.11 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.

3. Trapeze Hangers: Welded steel channel frames attached to structure.
4. Vertical Pipe Support: Steel riser clamp.
5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.

B. Plumbing Piping - Drain, Waste, and Vent:
1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
2. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
3. Wall Support for Pipe Sizes to 3 inch: Cast iron hook.
4. Wall Support for Pipe Sizes 4 inch and Over: Welded steel bracket and wrought steel clamp.
5. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water:
1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
2. Hangers for Cold Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
3. Hangers for Hot Pipe Sizes 2 to 4 inch: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 6 inch and Larger: Adjustable steel yoke, cast iron pipe roll, double hanger.
5. Wall Support for Pipe Sizes Up to 3 inch: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inch and Larger: Welded steel bracket and wrought steel clamp.
7. Wall Support for Hot Pipe Sizes 6 inch and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Floor Support for Hot Pipe Sizes to 4 inch: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
10. Floor Support for Hot Pipe Sizes 6 inch and Larger: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
11. Copper Pipe Support: Carbon steel ring, adjustable, copper plated, plastic-coated, or felt-lined for non-insulated copper pipe.

D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
1. Concrete Wedge Expansion Anchors: Comply with ICC-ES AC193.
2. Masonry Wedge Expansion Anchors: Comply with ICC-ES AC01.
3. Concrete Screw Type Anchors: Comply with ICC-ES AC193.
4. Masonry Screw Type Anchors: Comply with ICC-ES AC106.

2.12 **BRONZE GATE VALVES**

A. Bronze Gate Valve, General: MSS SP-80, with ferrous-alloy handwheel.

B. Type 2, Class 200, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet.

2.13 **BRONZE GLOBE VALVES**

A. Bronze Globe Valve, General: MSS SP-80, with ferrous-alloy handwheel.

B. Type 1, Class 200, Bronze Globe Valves: Bronze body with bronze disc and union-ring bonnet.

C. Type 2, Class 200, Bronze Gate Valves: Bronze body with PTFE or TFE disc and union-ring bonnet.

2.14 BALL VALVES

A. General Duty: Copper-Alloy Ball Valves:
   1. Copper-Alloy Ball Valves, General: MSS SP-110
   2. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball, PTFE or TFE seats, and 600 psig (4140 kPa) minimum CWP rating and blowout-proof stem.
   3. Threaded end connection for NPS 2 inch and smaller.
   4. Flanged end connection for NPS 2-1/2 inch and larger.

B. General Duty: Ferrous-Alloy Ball Valves:
   1. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flange ends.
   2. Ferrous-Alloy Ball Valves: Class 300, full or regular port.
   3. Threaded end connection for NPS 2 inch and smaller.
   4. Flanged end connection for NPS 2-1/2 inch and larger.

C. Gas Service: Bronze Ball Valves, NPS 2 inch and smaller:
   1. Two-Piece, Full-Port, Bonze Ball Valves with Bronze Trim: MSS SP-110
   2. Body: Bronze, complying with ASTM B 584.
   3. Ball: Chrome-plated bronze.
   4. Stem: Bronze, blowout proof.
   5. Seats: Reinforced TFE, blowout proof.
   6. Ends: Threaded, NPS 2 inch and smaller.
   7. CWP Rating: 600 psig (4140 kPa).
   8. Listing: Valves NPS 1 inch and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
   9. Service for aboveground: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Gas Service: PE Ball Valve, complying with ASME B16.40.
   1. Body: PE
   2. Ball: PE
   3. Stem: Acetal.
   4. Seats and Seals: Nitrile.
   5. Ends: Plain or fusible to match piping.
   6. CWP Rating: 80 psig (552 kPa).
   7. Operating Temperature: Minus 20 to plus 140 deg F (Minus 29 to plus 60 deg C).
   8. Operator: Nut or flat head for key operation.
   9. Include plastic valve extentsion.
   10. Include tamperproof locking feature for valves where indicated on Drawings.
   11. Service for underground.

2.15 PLUG VALVES

A. General Duty: Cast-Iron Plug Valves:
   1. Cast-Iron Plug Valves, General: MSS SP-78.
   2. Class 250 or 300, lubricated-type, cast-iron plug valves.
   3. Class 250, nonlubricated-type, cast-iron plug valves.

B. Gas Service: Bronze Plug Valves: MSS SP-78, NPS 2-1/2 inch and larger.
   1. Body: Bronze, complying with ASTM B 584.
   2. Plug: Bronze.

3. Ends: Threaded, socket, or flanged.
4. Operator: Square head or lug type with tamperproof feature where indicated.
5. Pressure Class: 125 psig (862 kPa).
6. Listing: Valves NPS 1 inch and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
7. Service for aboveground: Suitable for natural-gas service with "WOG" indicated on valve body.

2.16 FERROUS-ALLOY BUTTERFLY VALVES

A. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc adn lining suitable for potable water, unless otherwise indicated.

B. Flangeless, 250-psig (1725 kPa) CWP Rating, Ferrous-Alloy Butterfly Valve: Wafer type with one or two piece stem.

C. Single-Flange, 300-psig (2070 kPa) CWP Rating, Ferrous-Alloy Butterfly Valve: Wafer-lug type with one or two piece stem.

D. Flanged, 300-psig (2070 kPa) CWP Rating, Ferrous-Alloy Butterfly Valve: Flanged-end type with one or two piece stem

2.17 SPRING LOADED, LIFT-DISC CHECK VALVES

A. Lift-Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.

B. Type II, Class 250, Compact Wafer, Lift-Disc Check Valves: Compact-wafer style with cast-iron shell with diameter made to fit within bolt circle.

C. Type III, Class 250, Globe Lift-Disc Check Valves: Globe Style with cast iron shell and flanged ends.

D. Type IV, Class 150, Threaded Lift-Disc Check Valves: Threaded style with bronze shell and threaded ends.

2.18 PRESSURE REDUCING VALVES

A. 2 inch and Smaller:
   1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.
   2. Pressure Reducing Pilot-Operator:
      a. Operating Range: 5 to 50 psi.
      b. Connected into brass or bronze pilot piping and fittings.
      c. Fixed flow restrictor, pressure gauges, and isolation valves.

B. 2 inch and Larger:
   1. ASSE 1003, cast iron body with interior lining complying with AWWA C550, bronze fitted, elastomeric diaphragm and seat disc, flanged.
   2. Pressure Reducing Pilot-Operator:
      a. Operating Range: 5 to 50 psi.
      b. Connected into brass or bronze pilot piping and fittings.
      c. Fixed flow restrictor, strainer, pressure gauges, and isolation valves.

2.19 PRESSURE RELIEF VALVES

A. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

2.20 **STRAINERS FOR DOMESTIC WATER PIPING**

A. Y-Pattern Strainers:
   1. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
   2. Body: Bronze for NPS 2 inch and smaller. Cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating for NPS 2-1/2 inch and larger.
   3. End Connections: Threaded for NPS 2 inch and smaller. Flanged for NPS 2-1/2 inch and larger.
   4. Screen: Stainless steel with round perforations, unless otherwise noted.
   5. Perforation Size:
      a. Strainers NPS 2 inch and Smaller: 0.062 inch (157 mm)
      b. Strainers NPS 2-1/2 inch to NPS 4 inch: 0.125 inch (3.18 mm).
      c. Strainers NPS 5 inch and Larger: 0.25 inch (6.35 mm)
   6. Drain: Factory-installed, hose-end drain valve.

2.21 **BALANCING VALVES**

A. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Memory-Stop Balancing Valves:
   1. Standard: MSS SP-110 for two-piece copper alloy ball valve or MSS SP-80 for bronze straight pattern globe valves.
   2. Pressure Rating: 125 psig minimum CWP.
   3. Size: NPS 2 inch or smaller.
   4. Body: Copper Alloy or Brass.
   5. Ports: Standard or full test ports for differential pressure measurement.
   6. Seats and Seals: Replaceable.
   7. End Connections: Threaded.
   8. Handle: Vinyl-covered steel or heavy duty plastic with memory-setting device.

2.22 **VACUUM BREAKERS**

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
   1. Standard: ASSE 1001.
   2. Size: NPS 1/4 to NPS 3 inch, as required to match connected piping.
   3. Body: Bronze.
   4. Inlet and Outlet Connections: Threaded.
   5. Finish: Chrome Plated.

B. Pressure Vacuum Breakers:
   1. Standard: ASSE 1020.
   2. Operation: Continuous-pressure Applications.
   3. Accessories:
      a. Valves: Ball Type, on inlet and outlet.

2.23 **PIPING SPECIALTIES**

A. Appliance Flexible Connectors:
   1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
   2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
   3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
   4. Operating-Pressure Rating: 0.5 psig.
   5. End Fittings: Zinc-coated steel.
   6. Threaded Ends: Comply with ASME B1.20.1.
   7. Maximum Length: 72 inches

B. Y-Pattern Strainers:
   1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
   3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
   4. CWP Rating: 125 psig

C. Basket Strainers:
   1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
   3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
   4. CWP Rating: 125 psig

D. T-Pattern Strainers:
   1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
   2. End Connections: Grooved ends.
   3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
   4. CWP Rating: 750 psig

E. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 **TRENCHING FOR UNDERGROUND PIPING**

A. Comply with requirements of Division 31.

B. Comply with recommendations of available geotechnical report

C. Installation and Construction: Trench excavation shall comply with AST D2321.
   1. Fill material shall be free of roots, rocks, debris, and organic materials. Fill material shall swell less than 3% when compacted.
   2. Sand bedding material shall be natural river or bank sand free of silt, clay, loam, friable or soluable materials, and organic materials. Graded in accordnace with ANSI/ASTM C136.
   3. Trench backfill in layers.
   4. Compact bedding before placing pipe.
   5. Hand place fill material to six inches above top of pipe and compact fill without damaging piping.
   6. Reaminder of fill may be placed in trench by gravity from height not exceeding 12-inches above trench.

3.04 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed.

I. Establish elevations of buried piping outside the building to ensure not less than 2 ft of cover.

J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly;

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.

L. Provide support for utility meters in accordance with requirements of utility companies.

M. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.

N. Excavate in accordance with Section 31 2316.

O. Install bell and spigot pipe with bell end upstream.

P. Install valves with stems upright or horizontal, not inverted. See Section 22 0523.

Q. Install water piping to ASME B31.9.

R. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

S. Sleeve pipes passing through partitions, walls, and floors.

T. Inserts:
   1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

U. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9.
2. Support horizontal piping as indicated.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Provide hangers adjacent to motor-driven equipment with vibration isolation; see Section 22 0548.
11. Support cast iron drainage piping at every joint.

3.05 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

D. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Install globe valves for throttling, bypass, or manual flow control services.

F. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

G. Provide spring-loaded check valves on discharge of water pumps.

H. Provide flow controls in water recirculating systems where indicated.

3.06 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.

B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.07 FIELD TESTS AND INSPECTIONS

A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.

B. Domestic Water Systems:

1. Perform hydrostatic testing for leakage prior to system disinfection.
2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
3. General:
   a. Fill the system with water and raise static head to 10 psi above service pressure. Minimum static head of 50 to 150 psi. As an exception, certain codes allow a maximum static pressure of 80 psi.
4. Metal Piping Systems Subject to Freezing Conditions:
   a. Inject 40 psi of compressed air into piping to spot check for leaks with liquid soap. Document and repair leaks as necessary.
   b. Raise injected compressed air pressure to 1.5 times rated service pressure or minimum pressure of 100 psi for a duration of 2 hours and verify with a gauge that no perceptible pressure drop is measured.

C. Gas Distribution Systems:
1. Test Preparation: Close each appliance valve or disconnect and cap each connected appliance.
2. General Systems:
   a. Inject a minimum of 10 psi of compressed air into the piping system for a duration of 15 minutes and verify with a gauge that no perceptible pressure drop is measured.
   b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound.
3. Welded Pipes or Systems with Service Pressures Above 14 in-wc:
   a. Inject a minimum of 60 psi of compressed air into the piping system for a duration of 30 minutes and verify with a gauge that no perceptible pressure drop is measured.
   b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound with 1 psi increments.

D. Test Results: Document and certify successful results, otherwise repair, document, and retest.

3.08 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with Division 31.

B. Prior to starting work, verify system is complete, flushed, and clean.

C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.09 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
   1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
   2. Provide 18 gauge, 0.0478-inch galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

3.10 SCHEDULES

A. Pipe Hanger Spacing:
   1. Metal Piping:
      a. Pipe Size: 1/2 inch to 1-1/4 inch:
         1) Maximum Hanger Spacing: 6.5 ft.
         2) Hanger Rod Diameter: 3/8 inches.
      b. Pipe Size: 1-1/2 inch to 2 inch:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 3/8 inch.
      c. Pipe Size: 2-1/2 inch to 3 inch:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 1/2 inch.
      d. Pipe Size: 4 inch to 6 inch:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 5/8 inch.
      e. Pipe Size: 8 inch to 12 inch:
         1) Maximum hanger spacing: 14 ft.
         2) Hanger Rod Diameter: 7/8 inch.
      f. Pipe Size: 14 inch and Over:
         1) Maximum Hanger Spacing: 20 ft.
         2) Hanger Rod Diameter: 1 inch.
   2. Plastic Piping:
      a. All Sizes:
         1) Maximum Hanger Spacing: 6 ft.
         2) Hanger Rod Diameter: 3/8 inch.

END OF SECTION

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SECTION 22 1006
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Drains.
B. Cleanouts.
C. Hose bibbs.
D. Ice maker outlet boxes.
E. Backflow preventers.
F. Double check valve assemblies.
G. Water hammer arrestors.
H. Mixing valves.
I. Electronic trap-seal primers.

1.02 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping.
B. Section 22 4000 - Plumbing Fixtures.

1.03 REFERENCE STANDARDS

A. ASME A112.6.3 - Floor Drains; 2022.
B. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2022.
C. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2023.
D. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2021.
E. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies; 2021.
F. NSF 61 - Drinking Water System Components - Health Effects; 2023.
G. NSF 372 - Drinking Water System Components - Lead Content; 2022.
H. PDI-WH 201 - Water Hammer Arresters; 2017.
I. NSF 61, "Drinking Water System Components."
J. California Health & Safety Code 116875 for lead free content.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
D. Operation Data: Indicate frequency of treatment required for interceptors.

E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
   2. Josam Company: www.josam.com/#sle.
   3. MIFAB, Inc: www.mifab.com/#sle.
   4. Zurn Industries, LLC: www.zurn.com/#sle.

B. Roof and Overflow Drains:
   1. Assembly: ASME A112.6.4.
   2. Body: Lacquered cast iron with sump.
   3. Strainer: Removable cast iron dome with vandal proof screws.
   4. Accessories: Coordinate with roofing type.
      a. Membrane flange and membrane clamp with integral gravel stop.
      b. Adjustable under deck clamp.
      c. Roof sump receiver.
      d. Waterproofing flange.
      e. Controlled flow weir.
      f. Leveling frame.
      g. Adjustable extension sleeve for roof insulation.

C. Downspout Nozzles:
   1. Bronze round with straight bottom section.

D. Area Drains:
   1. Assembly: ASME A112.6.4.
   2. Body: Lacquered cast iron with sump.
   3. Strainer: Round nickel-bronze.
   4. Accessories: Membrane flange and membrane clamp with integral gravel stop, with adjustable under deck clamp.

E. Floor Drain:
   1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

F. Floor Drain (FD-2):
   1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and square, adjustable nickel bronze strainer.

G. Floor Sink:
   1. Lacquered cast iron body with dome strainer and seepage flange.

2.03 CLEANOUTS

A. Exposed Metal Cleanouts :
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
      a. MIFAB, Inc.
      b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      c. Watts Drainage Products Inc.
      d. Zurn Plumbing Products Group; Specification Drainage Operation
   2. Standard: ASME A112.3.1 for stainless steel for cleanout test tee.
   3. Size: Same as connected drainage piping
   4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
   5. Closure: Countersunk, brass plug.
   6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts :
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      b. Watts Drainage Products Inc.
      c. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule cleanout.
   3. Size: Same as connected branch.
   4. Type: Cast-iron soil pipe with cast-iron ferrule.
   5. Body or Ferrule:
   6. Clamping Device: Required.
   7. Outlet Connection: Inside calk.
   8. Closure: Brass plug with tapered threads.
   9. Adjustable Housing Material: Cast iron with threads.
   10. Frame and Cover Material and Finish: Stainless steel.
   11. Frame and Cover Shape: Round.
   12. Top Loading Classification: Heavy Duty.
   13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
   14. Standard: ASME A112.3.1.
   15. Size: Same as connected branch.
   16. Housing: Stainless steel.
   17. Closure: Stainless steel with seal.
   18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts :
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. MIFAB, Inc.
      b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      c. Watts Drainage Products Inc.
      d. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Standard: ASME A112.36.2M. Include wall access.

3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.04 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies :
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Acorn Engineering Company; Elmdor/Stoneman Div.
      b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm-) thick, lead flashing collar and skirt extending at least 6 inches (150 mm) from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

2.05 **VANDAL-PROOF VENT CAPS**

A. Description: Low-silhouette vandal-proof hooded vent cap for roof terminations of sanitary vent lines.
   1. Cast iron body.
   2. Vandal-proof securing device.

B. Provide vandal-proof vent caps at all roof vent terminations.

2.06 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
   1. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
   2. Size: Same as connected soil, waste, or vent stack.
   3. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
   4. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
   5. Special Coating: Corrosion resistant on interior of fittings

2.07 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings :
   1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
   2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

B. Air-Gap Fittings:
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.

5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device :
   1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches (51 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings :
   1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
   2. Size: Same as connected stack vent or vent stack.

E. Vent Caps :
   1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
   2. Size: Same as connected stack vent or vent stack.

2.08 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
   2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
   3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Solder: ASTM B 32, lead-free alloy.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic

2.09 HOSE BIBBS

A. Interior Hose Bibbs:
   1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome-plated where exposed with handwheel, integral vacuum breaker in compliance with ASSE 1011.

2.10 ICE MAKER OUTLET BOXES

A. Description: Plastic preformed square or round rough-in box with brass quarter-turn ball valve, and slip-in finishing cover.

2.11 BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventer Assembly:
   1. ASSE 1013; cast bronze body and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure, and non-threaded vent outlet.
   2. Size: _____ inch assembly with threaded gate valves.

2.12 DOUBLE CHECK-VALVE ASSEMBLIES

A. Double Check Valve Assembly:
   1. ASSE 1012; cast bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.
   2. Size: 3/4 to 2 inch, NPS assembly with threaded full port ball valves.

2.13 WATER HAMMER ARRESTORS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
   2. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com/#sle.
   3. Zurn Industries, LLC: www.zurn.com/#sle.

B. Water Hammer Arrestors:
   1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.14 MIXING VALVES

A. Thermostatic Master Mixing Valves:
   1. Valve: Chrome plated cast brass or glass-filled polysulfonebody, stainless steel or copper alloy bellows or thermoplastic polmer cartridge, with integral temperature adjustment.
   2. Quality Assurance
      a. Maximum Working Pressure: 125 psig (860 kPa), unless otherwise indicated.
      b. Comply with NSF 61, "Drinking Water System Components."
      c. Comply with California Health & Safety Code 116875 for lead free content.
   3. Accessories:
      a. Strainer stop checks on inlets.
      b. Shut-off valve on outlet.
   4. Cabinet: 16 gauge, 0.0598 inch prime-coated steel, for recessed mounting with keyed lock.

B. ELECTRONIC TRAP-SEAL PRIMERS

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor.

E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

F. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories sinks and washing machine outlets .

END OF SECTION

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SECTION 22 3000
PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water Heaters:
   1. Commercial gas fired, tank-type.
B. In-line circulator pumps.
C. Cooling condensate removal pumps.

1.02 RELATED REQUIREMENTS

A. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. ANSI Z21.10.1 - Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less; 2019, with Errata (2020).
B. ANSI Z21.10.3 - Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous; 2019.
C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.
D. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.
E. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.
F. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
B. Product Data:
   1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
   2. Indicate pump type, capacity, power requirements.
   3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
   4. Provide electrical characteristics and connection requirements.
C. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Certifications:
   1. Water Heaters: NSF approved.
   2. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1, as applicable.
   3. Gas Water Heaters: Comply with SCAQMD Rule 1146.2 requirements for ultra low-NOx emissions.
   4. Electric Water Heaters: UL listed and labeled to UL 174.
   5. Water Tanks: ASME labeled to ASME BPVC-VIII-1.
   6. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

C. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide three year manufacturer warranty for domestic water heaters.

C. Provide five year manufacturer warranty for booster pumps, sewage ejectors, and sump pumps.

PART 2 PRODUCTS

2.01 WATER HEATERS

A. Manufacturers:
   1. A.O. Smith Water Products Co: www.hotwater.com/#sle.
   2. Bock Water Heaters, Inc: www.bockwaterheaters.com/#sle.
   3. Rheem Manufacturing Company: www.rheem.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Commercial Gas Fired, Tank-type:
   1. Type: Automatic, natural gas-fired, vertical storage.
   2. Performance: Refer to Drawings
   3. Tank: Glass lined welded steel ASME labeled; multiple flue passages, 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
   4. Accessories:
      a. Water Connections: Brass.
      b. Dip Tube: Brass.

c. Drain valve.
d. Anode: Magnesium.
e. Temperature and Pressure Relief Valve: CSA-certified and ASME-rated.

5. Controls: Automatic water thermostat with temperature range adjustable from 90 to 180 degrees F, automatic reset high temperature limiting thermostat factory set at 195 degrees F, gas pressure regulator, multi-ribbon or tubular burner, 100 percent safety shut-off pilot and thermocouple, flue baffle and draft hood.

2.02 IN-LINE CIRCULATOR PUMPS

A. Manufacturers:
1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.
2. Bell & Gossett, a xylem brand: www.bellgossett.com/#sle.
3. Grundfos
4. Taco
5. Substitutions: See Section 01 6000 - Product Requirements.

B. Casing: Bronze or Cast Iron, rated for 125 psig working pressure.

C. Impeller: Bronze or Composite.

D. Shaft: Steel or ceramic.

E. Motor: Integral to pump.

F. Performance: Refer to Drawings.

2.03 COOLING CONDENSATE REMOVAL PUMPS

A. Manufacturers:
1. Aspen Pumps
2. Little Giant / Franklin Electric
3. Zoeller Company[<>]: www.zoeller.com
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Construction: Commercial grade, nonferrous pump with stainless steel shaft, integral discharge check valve, integral float switch, safety switch, thermoplastic reservoir, motor assembly, and power cord with ground.

C. Safety: UL 778.

D. Performance: Refer to Drawings

2.04 ELECTRICAL WORK

A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring.

B. Electrical characteristics to be as specified or indicated.

C. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.

D. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.

C. Pumps:
   1. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
   2. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
   3. Align and verify alignment of base mounted pumps prior to start-up
   4. Provide electrical interlocking from cooling condensate pump safety switch to associated HVAC unit(s) furnished under other Sections.

3.02 SCHEDULES

A. Refer to Drawings.

END OF SECTION

SECTION 22 4000
PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water closets.
B. Urinals.
C. Lavatories.
D. Sinks.
E. Service sinks.
F. Electric water coolers.
G. Drinking fountains.
H. Hose Bibbs
I. Icemaker Supply Boxes
J. Trap Primers
K. Water Hammer Arrestors
L. Thermostatic Mixing Valves

1.02 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping.
B. Section 22 1006 - Plumbing Piping Specialties.
C. Section 22 3000 - Plumbing Equipment.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.
C. ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2018.
D. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures; The American Society of Mechanical Engineers; 2008 (R2011).
E. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2022.
F. NSF 61 - Drinking Water System Components - Health Effects; 2023.
G. NSF 372 - Drinking Water System Components - Lead Content; 2022.
H. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

C. Accessible Plumbing Fixtures:
   1. Accessible Plumbing Fixtures, plumbing fixtures intended for people with disabilities, shall comply with requirements contained in:
      a. ICC A117.1, "Accessible and Usable Buildings and Facilities"
      b. Public Law 90-480, "Architectural Barriers Act"
      c. Public Law 101-336, "Americans with Disabilities Act"
   2. Plumbing fixtures and accessories in toilet rooms shall comply with CBC Section 11B-213.2 and Section 11B-213.3.
   3. Accessible plumbing fixtures shall comply with all requirements of CBC Section 11B, Division 6.
      a. Clearance around accesible water closets shall be minimum 60 inches measured perpendicular from side wall and 56 inches measured perpendicular from rear wall per CBC Section 11B-604.3.1
      b. Heights and location of accessible plumbing fixtures shall comply with CBC Sections 11B-602 through 11B-612.
      c. Fixture controls for accessible plumbing fixtures shall comply with the following:
         1) CBC Section 11B-602.3 for drinking fountains
         2) CBC Section 11B-604.6 for water closets
         3) CBC Section 11B-604.9.5 for children's water closets
         4) CBC Section 11B-605.4 for urinals
         5) CBC Section 11B-606.4 for lavatories and sinks
         6) CBC Section 11B-607.5 for bath tubs
         7) CBC Section 11B-608.5 for showers
         8) CBC Section 11B-611.3 for washing machines and clothes dryers
   4. Accessible sinks shall be mounted with the front of the counter or rim no higher and 34” above the finished floor.
   5. Depth of lavatories or sinks shall not interfere with knee or toe clearance provided in accordance with CBC Section 11B-306 when a forward approach is required.
   6. Water supply and drain pipes under lavatories and sinks shall be insualted or otherwise configured to protect against contact. There shall be no sharp or abrsive surfaces under lavatories and sinks. Refer to CBC Section 11B-605.5.
   7. Accessible sinks shall be a maximum of 6-1/2” deep.
   8. Heights and location of plumbing fixtures shall comply with DSA Checklist Figure 15-A.

D. Plumbing Fixture Water Flow Rates:
   1. Comply with requirements in Public Law 102-486, "Energy Policy Act," regarding water flow and consumption rates for plumbing fixtures.
   2. Comply with requirements of California CCF Title 24, Part 11 "California Green Building Standards", Section 5.303 Indoor Water Use, regarding plumbing fixture maximum flow rates.

E. NSF Standards: Comply with NSF 61, "Drinking Water System Components--Health Effects," and NSF 372 "Lead Content Compliance" for fixture materials that will be in contact with potable water. Provide pipe and fittings with NSF certification marks demonstrating complaince.

F. Lead Content Restrictions: Domestic water piping, valves, and components shall conform to California AB 1953 Legislation as applicable for maximum allowable lead content.

G. Gender Neutral Restrooms: All single-user restrooms shall be designated as gender neutral facilities by a door symbol and signage that complies with CBC Section 11B-216.8 and 11B-703.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for electric water cooler.

PART 2 PRODUCTS

2.01 **GENERAL**

A. Refer to schedules in Plumbing drawings for plumbing fixture specifications and additional information.

2.02 HOSE BIBBS

A. Manufacturers:
   1. Acorn
   2. Jay R. Smith
   3. Woodford
   4. Substitutions: See Section 016000 - Product Requirements.

2.03 TRAP PRIMERS

A. Manufacturers:
   1. Jay R Smith
   2. Precision Plumbing Products
   3. Substitutions: See Section 016000 - Product Requirements

2.04 **WATER HAMMER ARRESTORS**

A. Manufacturers:
   1. Jay R Smith
   2. Precision Plumbing Products
   3. Substitutions: See Section 016000 - Product Requirements

2.05 THERMOSTATIC MIXING VALVES

A. Manufacturers:
   1. Bradley
   2. Apollo Valve
   3. Watts
   4. Substitutions: See Section 016000 - Product Requirements

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
B. Verify that electric power is available and of the correct characteristics.
C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.
B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
C. Install components level and plumb.
D. Install and secure fixtures in place with wall carriers or wall supports and bolts.
E. Seal fixtures to wall and floor surfaces with sealant. Color to match fixture.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

A. Clean plumbing fixtures and equipment.

3.07 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.
B. Do not permit use of fixtures by construction personnel.

C. Repair or replace damaged products before Date of Substantial Completion.

3.08 SCHEDULES

A. Refer to Drawings.

B. Fixture Heights: Install fixtures to heights above finished floor as indicated.
   1. Water Closet:
      a. Standard: 15 inches to top of bowl rim.
      b. Accessible: 18 inches to top of seat.
   2. Water Closet Flush Valves:
      a. Standard: 11 inches min. above bowl rim.
      b. Recessed: 10 inches min. above bowl rim.
   3. Urinal:
      a. Standard: 22 inches to top of bowl rim.
      b. Accessible: 17 inches to top of bowl rim.
   4. Lavatory:
      a. Standard: 31 inches to top of basin rim.
      b. Accessible: 34 inches to top of basin rim.
   5. Drinking Fountain:
      a. Child: 30 inches to top of basin rim.
      b. Standard Adult: 40 inches to top of basin rim.
      c. Accessible: 36 inches to top of spout.

END OF SECTION

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SECTION 23 0500
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Piping tube and fitting materials.
   2. Pipe joining materials.
   3. Transition fittings.
   4. Dielectric fittings.
   5. Mechanical sleeve seals.
   6. Sleeves.
   7. Escutcheons.
   8. Grout.
   9. Mechanical demolition.
   10. Equipment installation requirements common to equipment sections.
   11. Painting and finishing.
   12. Concrete bases.
   13. Supports and anchorages.

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.03 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

1.04 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.06 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS MATERIALS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.02 PIPE JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:
   1. ABS Piping: ASTM D 2235.
   2. CPVC Piping: ASTM F 493.
   3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
   4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.03 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
   1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
   2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
   3. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.04 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Refer to individual Division 22 piping Sections for dielectric fittings not listed below.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.05 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Reinforced Nylon Polymer or Stainless steel. Include two for each sealing element.
   3. Connecting Bolts and Nuts: Steel with corrosion inhibiting coating or stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.06 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms for concrete foundation walls below grade.

F. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.07 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
C. One-Piece, Cast-Brass Type: With set screw. Polished chrome-plated and rough brass.
D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw. Polished chrome-plated and rough brass.
E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.08 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi 28-day compressive strength, unless otherwise indicated in the structural drawings.
   3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
   1. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
   2. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
   3. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
   4. Install piping to permit valve servicing.
   5. Install piping at indicated slopes.
   6. Install piping free of sags and bends.
   7. Install fittings for changes in direction and branch connections.
   8. Install piping to allow application of insulation.
C. Select system components with pressure rating equal to or greater than system operating pressure.

3.02 **ESCUTCHEONS**

A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.

d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

3.03 PENETRATIONS AND SLEEVES

A. Sleeves are not required for core-drilled holes.

B. Permanent sleeves are not required for holes formed by removable PE sleeves.

C. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
d. Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

D. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

E. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

G. Verify final equipment locations for roughing-in.

H. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.04 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   5. PVC Nonpressure Piping: Join according to ASTM D 2855.
   6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.05 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.06 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Grease fittings shall be installed in accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.07 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 9.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.08 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic requirements as indicated in the California Building Code.
   1. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit, vibration isolator, or seismic restraint. Verify requirements with equipment anchor bolt edge distances.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section; unless otherwise indicated in structural drawings.

3.09 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.10 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Grout Installation:
1. Clean surfaces that will come into contact with grout.
2. Provide forms as required for placement of grout.
3. Avoid air entrapment during placement of grout.
4. Place grout, completely filling equipment bases.
5. Place grout on concrete bases and provide smooth bearing surface for equipment.
6. Place grout around anchors.
7. Cure placed grout.

3.11 MECHANICAL DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Ducts to Be Removed: Remove portion of ducts indicated to be removed and cap or plug remaining ducts with same or compatible ductwork material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.

C. Owner shall have first right-of refusal for salvage of all items to be removed. All items accepted for salvage by the Owner shall be protected from damage and delivered to the Owner's Representative. All items refused for salvage by the Owner shall be properly dispose dof by the Contractor.

D. For piping to remain, Contractor shall submit samples of existing piping to remain from locations as determined by the Engineer. Based on the results of destructive testing replacement of piping may be considered.

E. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

END OF SECTION

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SECTION 23 0516
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flexible pipe connectors.
B. Expansion joints and compensators.
C. Pipe loops, offsets, and swing joints.

1.02 REFERENCE STANDARDS

A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
B. EJMA (STDS) - EJMA Standards; Tenth Edition.

1.03 SUBMITTALS

A. See Division 01 for submittal procedures.
B. Product Data:
   1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
   2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
C. Delegated-Design Submittal: For each anchor and alignment guide required to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
   2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
   3. Alignment Guide Details: Detail field assembly and attachment to building structure.
   4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

PART 2 PRODUCTS

2.01 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

A. Inner Hose: Bronze.
B. Exterior Sleeve: Single braided, stainless steel.
C. Pressure Rating: 125 psi up to 12 inch.
D. End Connections: Flanged.
E. Size: Use pipe sized units.

F. Maximum offset: 3/4 inch on each side of installed center line.

2.02 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

A. Inner Hose: Bronze.
B. Exterior Sleeve: Braided bronze.
C. Pressure Rating: 125 psi up to 2 inch.
D. End Connections: Flanged.
E. Size: Use pipe sized units.
F. Maximum offset: 3/4 inch on each side of installed center line.
G. Application: Copper piping.

2.03 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

A. Manufacturers:
   1. The Metraflex Company; Metraloop: www.metraflex.com/#sle.
B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets, air release valve, and plugged drain port.
C. Flexible loop shall be manufactured. Field fabricated loops shall not be acceptable.
D. Fitting materials of construction and end fitting type shall be consistent with pipe material and equipment / pipe connection fittings. Copper fittings shall not be attached to stainless steel hose.
E. Flexible hose expansion loops shall have factory supplied hanger / support lug located at the bottom of the 180 degree return.
F. Maximum Allowable Motion: 2 inch in the x, y, and z planes with no thrust loads to the building structure
G. Maximum Working Pressure: 150 psi at 800 degrees F.
H. Construction: Class 150, schedule 40, 304 stainless steel hose and braid assembly with carbon steel fittings, including elbows and flanged end connections sized to match pipe segment
   1. Provide necessary accessories including, but not limited to, swivel joints.

2.04 ACCESSORIES

A. Pipe Alignment Guides:
   1. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.
B. Engineered Riser Anchor Clamps:
   1. Provide one clamp above and one clamp below the slab to anchor pipe.
      a. Coordinate with the structural engineer to determine the maximum thrust loading calculated for the slab or floor structure. Use the maximum thrust loading calculations to verify the clamps will be a safety factor of one less than the maximum loading of clamp per the manufacturer's instructions.
C. Swivel Joints:
   1. Fabricated steel body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.

C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

G. Substitute grooved piping for vibration isolated equipment instead of flexible connectors. Grooved piping need not be anchored.

END OF SECTION

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SECTION 23 0517
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe sleeves.

B. Pipe-sleeve seals.

1.02 REFERENCE STANDARDS

A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

1.03 SUBMITTALS

A. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Valve Stem Packings: Two for each type and size of valve.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

A. Vertical Piping:

1. Sleeve Length: 1 inch above finished floor.
2. Provide sealant for watertight joint.

B. Pipe Passing Through Interior Walls and Partitions
1. Sheet metal
2. Provide sealant for watertight joint.

C. Pipe Passing Through Below Grade Exterior Walls:
1. Zinc coated or cast iron pipe.
2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

D. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect.

E. Clearances:
1. Provide allowance for insulated piping.
2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.

2.02 PIPE-SLEEVE SEALS

A. Modular Mechanical Sleeve-Seal:
1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
3. Size and select seal component materials in accordance with service requirements.
4. Glass-reinforced plastic pressure end plates.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

E. Structural Considerations:
   1. Do not penetrate building structural members unless indicated.

F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
   1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
   2. Aboveground Piping:
      a. Pack solid using mineral fiber in compliance with ASTM C592.
      b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
   3. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.

G. Manufactured Sleeve-Seal Systems:
   1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
   2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
   3. Locate piping in center of sleeve or penetration.
   4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
   5. Tighten bolting for a water-tight seal.
   6. Install in accordance with manufacturer's recommendations.

H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

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SECTION 23 0519
METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flow meters.
B. Electromagnetic flow meters.
C. Pressure gauges and pressure gauge taps.
D. Thermometers and thermometer wells.
E. Static pressure gauges.

1.02 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi; 2004 (Reaffirmed 2017).
C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2020).
D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
E. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2020.
F. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).
G. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
B. Project Record Documents: Record actual locations of components and instrumentation.

1.04 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 POSITIVE DISPLACEMENT METERS (LIQUID)

A. AWWA C700, positive displacement disc type suitable for fluid with metal alloy main case and cast iron frost-proof, breakaway bottom cap, hermetically sealed register, remote reading.

B. Meter: Brass body turbine meter with magnetic drive register.
   1. Service: Cold water, 122 degrees F.
   2. Service: Hot water, 200 degrees F.
   3. Accuracy: 1-1/2 percent.
   4. Size: 3/4 inch, or as indicated on plans.

2.02 LIQUID FLOW METERS

A. CalibratedASME MFC-3M Venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gauge in case.

B. Annular element flow stations with meter set.
   1. Measuring Station: Type 316 stainless steel pitot type flow element installed in threaded nipple pipe section, with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.
      a. Pressure rating: 275 psi.
      b. Maximum temperature: 400 degrees F.
      c. Accuracy: Plus 0.55 percent to minus 2.30 percent.

2.03 PRESSURE GAUGES

A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
   1. Case: Steel with brass bourdon tube.
   2. Size: 4-1/2 inch diameter.
   3. Mid-Scale Accuracy: One percent.
   4. Scale: Psi.

2.04 PRESSURE GAUGE TAPPINGS

A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.

B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.

D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.05 STEM TYPE THERMOMETERS

A. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
   1. Size: 9 inch scale.
   2. Window: Clear glass.
   3. Stem: 3/4 inch NPT brass.
   4. Accuracy: 2 percentper ASTM E77.
   5. Calibration: Degrees F.

2.06 DIAL THERMOMETERS

A. Thermometer: ASTM E1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
   1. Size: 3 inch diameter dial.
   2. Lens: Clear glass.
   3. Accuracy: 1 percent.
   4. Calibration: Degrees F.

2.07 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

C. Thermometer Wells: Thermometers and temperature sensors installed in fluid piping shall include separable socket thermometer well. Provide with extension necks where thermometers are installed in insulation 2 inches thick or greater. Well insertion length shall be minimum one-third of pipe diameter. Stainless steel thermowells shall be used in steel piping. Copper-nickel thermowells shall be used in copper piping.

2.08 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gauges, one gauge adapters with 1/8 inch probes, two 1 inch dial thermometers.

2.09 STATIC PRESSURE GAUGES

A. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

B. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.

C. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install positive displacement meters with isolating valves on inlet and outletto AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.

C. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

D. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Provide siphon on gauges in steam systems. Extend nipples and siphons to allow clearance from insulation.

E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

F. Install thermometers in air duct systems on flanges.

G. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets.

H. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.

I. Coil and conceal excess capillary on remote element instruments.

J. Provide instruments with scale ranges selected according to service with largest appropriate scale.

K. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

L. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

M. Locate test plugs adjacent thermometers and thermometer sockets.

N. Temperature wells are to be filled with a thermal gel to eiminate void between well wall and sensor element.

END OF SECTION

SECTION 23 0523
VALVES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Angle valves.
B. Globe valves.
C. Ball valves.
D. Butterfly valves.
E. Check valves.
F. Chainwheels.

1.02 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Nonrising stem.
E. OS&Y: Outside screw and yoke.
F. PTFE: Polytetrafluoroethylene.
G. RS: Rising stem.
H. TFE: Tetrafluoroethylene.
I. WOG: Water, oil, and gas.

1.03 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022.
E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
F. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.
G. ASME B31.9 - Building Services Piping; 2020.
H. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.
I. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
J. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).

K. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
L. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
M. MSS SP-67 - Butterfly Valves; 2022.
N. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
O. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends; 2011.
P. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
Q. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided; 2018.

1.04 SUBMITTALS

A. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
B. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
D. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
    1. See Section 01 6000 - Product Requirements for additional provisions.

1.05 QUALITY ASSURANCE

A. Manufacturer:
    1. Obtain valves for each valve type from single manufacturer.
    2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
    1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
    2. Protect valve parts exposed to piped medium against rust and corrosion.
    3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
    4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
    5. Secure check valves in either the closed position or open position.
    6. Adjust butterfly valves to closed or partially closed position.
B. Use the following precautions during storage:
    1. Maintain valve end protection and protect flanges and specialties from dirt.
        a. Provide temporary inlet and outlet caps.
        b. Maintain caps in place until installation.
    2. Store valves in shipping containers and maintain in place until installation.
        a. Store valves indoors in dry environment.
        b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

C. Exercise the following precautions for handling:
   1. Handle large valves with sling, modified to avoid damage to exposed parts.
   2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. See drawings for specific valve locations.

B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

C. Provide the following valves for the applications if not indicated on drawings:
   1. Throttling (Hydronic): Butterfly and Ball.
   2. Isolation (Shutoff): Gate and Ball.
   3. Swing Check (Pump Outlet):
      a. Size 2 inch and Smaller: Bronze with bronze disc.
      b. 2-1/2 NPS and Larger: Iron with center-guided with resilient seat.
   4. Dead-End: Butterfly, single-flange (lug) type.

D. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.

E. Required Valve End Connections for Non-Wafer Types:
   1. Steel Pipe:
      a. Size 2 inch and Smaller: Threaded ends.
      b. 2-1/2 NPS and Larger: Flanged ends.
   2. Copper Tube:
      a. 2 NPS and Smaller: Solder-joint valve-ends
      b. 2-1/2 NPS and Larger: Flanged ends.

2.02 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
   1. Gear Actuator: Quarter-turn valves 8 inch and larger.
   2. Handwheel: Valves other than quarter-turn types.
   3. Hand Lever: Quarter-turn valves 6 NPS and smaller except plug valves.
   4. Wrench: Plug valves with square heads.

D. Valves in Insulated Piping: Provide 2 inch stem extensions and the following features:
   1. Gate Valves: Rising stem.
   2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
   3. Butterfly Valves: Extended neck.

E. Memory Stops: Fully adjustable after insulation is installed.

F. Valve-End Connections:
   1. Threaded End Valves: ASME B1.20.1.
   2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.

3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
4. Solder Joint Connections: ASME B16.18.

G. General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
2. Building Services Piping Valves: ASME B31.9.

H. Bronze Valves:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

I. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, ANGLE VALVES

A. CWP Rating: Class 125: 200 psi and Class 150: 300 psi:
1. Comply with MSS SP-80, Type 1.
2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
3. Ends: Threaded.
4. Stem: Bronze.
5. Disc: Bronze, PTFE, or TFE.
6. Packing: Asbestos free.
7. Handwheel: Bronze or aluminum.

2.04 BRONZE, GLOBE VALVES

A. CWP Rating: Class 125: 200 psi:
1. Comply with MSS SP-80, Type 1.
2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
3. Ends: Threaded or solder joint.
4. Stem and Disc: Bronze or PTFE.
5. Packing: Asbestos free.
a. Handwheel: Malleable iron.

2.05 IRON, GLOBE VALVES

A. CWP Ratings: Class 125: 200 psi and Class 250: 500 psi:
1. Comply with MSS SP-85, Type I.
2. Body: Gray iron; ASTM A126, with bolted bonnet.
3. Ends: Flanged.
4. Trim: Bronze.
5. Packing and Gasket: Asbestos free.
6. Operator: Handwheel or chainwheel.

2.06 BRASS, BALL VALVES

A. Two Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psi.
3. WOG Rating: 600 psi.
4. Body: Forged brass.
5. Stem: Stainless Steel.
6. Ball: Chrome-plated brass.

2.07 BRONZE, BALL VALVES

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Bronze or Brass Trim:
   1. Comply with MSS SP-110.
   2. WSP Rating: 150 psi.
   3. WOG Rating: 400 psi.
   4. Body: Forged bronze or dezincified-brass alloy.
   5. End Connections: Pipe thread or solder.
   6. Seats: PTFE.
   7. Stem: Bronze or brass.
   8. Ball: Chrome plated brass.

2.08 CARBON STEEL, BALL VALVES

   1. WSP Rating: 150 psi.
   2. Size: 1/2 to 12 inches.

2.09 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Wafer Style:
   1. Comply with MSS SP-67, Type I.
   2. Wafer Style, CWP Ratings:
      a. Sizes 2 to 12 inch: 200 psi.
      b. Sizes 14 to 24 inch: 150 psi.
      c. Vacuum Service: Down to 29.9 in-Hg.
   3. Stem: One or two-piece stainless steel.
   4. Seat: NBR.
   5. Disc: Aluminum-bronze.

2.10 BRONZE, LIFT CHECK VALVES

A. Class 125:
   1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat.
   2. CWP Rating: 200 psi.
   3. Design: Vertical flow.
   4. Body: Bronze.
   5. Ends: Threaded.
   6. Disc (Type 1): Bronze.

2.11 BRONZE, SWING CHECK VALVES

2.12 IRON, FLANGED END SWING CHECK VALVES

2.13 IRON, CENTER-GUIDED CHECK VALVES

A. Class 150, Compact-Wafer:
   1. Comply with MSS SP-125.

2. Sizes 2-1/2 to 12 inch: CWP Rating; 300 psi.
3. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
4. Metal Seat: Bronze.
5. Resilient Seat: EPDM or NBR.

2.14 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
   1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
   2. Sprocket Rim with Chain Guides: Ductile iron include zinc coating.
   3. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

PART 3 EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.
B. Verify valve parts to be fully operational in all positions from closed to fully open.
C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.
D. Install check valves where necessary to maintain direction of flow as follows:
   1. Lift Check: Install with stem plumb and vertical.
   2. Swing Check: Install horizontal maintaining hinge pin level.
   3. Orient center-guided into horizontal or vertical position, between flanges.
E. Provide chainwheels on operators for valves 4 NPS and larger where located 96 NPS or more above finished floor, terminating 60 NPS above finished floor.

END OF SECTION

SECTION 23 0529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components.

1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2023.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).

H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

M. FM (AG) - FM Approval Guide; Current Edition.

N. MFMA-4 - Metal Framing Standards Publication; 2004.

O. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

P. UL (DIR) - Online Certifications Directory; Current Edition.

Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.04 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.

C. Installer Qualifications for Field-Welding: As specified in Section 05 5000.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.

3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
4. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Prefabricated Trapeze-Framed Metal Strut Systems:
1. Manufacturers:
    a. ABB Installation Products: electrification.us.abb.com/#sle.
    b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
    c. Gripple, Inc; Fast Track - Standard: www.gripple.com/#sle.
    d. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
2. MFMA-4 compliant, pre-fabricated, MSS SP-58 type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.

C. Strut Channels:
1. Manufacturers:
    a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
    b. Gripple, Inc; Universal Bracket: www.gripple.com/#sle.
    c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.

D. Hanger Rods:
1. Threaded zinc-plated steel unless otherwise indicated.
2. Minimum Size, Unless Otherwise Indicated or Required:
    a. Equipment Supports: 1/2 inch diameter.
    b. Piping up to 1 inch: 1/4 inch diameter.
    c. Piping larger than 1 inch: 3/8 inch diameter.
    d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

E. Thermal Insulated Pipe Supports:
1. General Requirements:
    a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
    c. Pipe supports to be provided for nominally sized, 1/2 to 30 inch iron pipes.

d. Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by a 360 degree, PVC jacketing.

2. PVC Jacket:
   a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
   b. Minimum Service Temperature: Minus 40 degrees F.
   c. Maximum Service Temperature: 180 degrees F.
   d. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
   e. Thickness: 60 mil.
3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

F. Pipe Supports:
1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
2. Liquid Temperatures Up To 122 degrees F:
   a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
   b. Support From Below: MSS SP-58 Types 35 through 38.
3. Operating Temperatures from 122 to 446 degrees F:
   a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
   b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
   c. Sliding Support: MSS SP-58 Types 35 through 38.

G. Roller Chairs:
1. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.
2. Steel Yoke Type: MSS SP-58 type 44, vertically adjustable, nonconductive, and corrosion resistant.
3. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

H. Pipe Stanchions:
1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
3. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.

I. Beam Clamps:
1. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
2. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
3. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
4. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
5. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
6. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish,
7. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

8. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

J. Riser Clamps:
1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
3. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.

K. U-Bolts:
1. MSS SP-58 Type 24, carbon steel u-bolt for pipe support or anchoring.

L. Strut Clamps:
1. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.

M. Insulation Clamps:
1. Two bolt-type clamps designed for installation under insulation.
2. Material: Carbon steel with epoxy copper or zinc finish.

N. Pipe Hangers:
1. Split Ring Hangers:
   a. Provide hinged split ring and yoke roller hanger with epoxy copper or plain finish.
   b. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
   c. Provide hanger rod and nuts of the same type and material for a given pipe run.
   d. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
2. Band Hangers, Adjustable:
   a. MSS SP-58 Type 7 or 9, Zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
3. J-Hangers, Adjustable:
   a. MSS SP-58 Type 5, Zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
4. Swivel Ring Hangers, Adjustable:
   a. MSS SP-58 Type 10, epoxy-painted, zinc-colored.
   b. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
   c. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
5. Clevis Hangers, Adjustable:
   a. Copper Tube: MSS SP-58 Type 1, epoxy-plated copper.
   b. Felt-Lined: MSS SP-58 Type 1, zinc-plated, silicone-free carbon steel.
   c. Light-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.
   d. Standard-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.

O. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

P. Nonpenetrating Rooftop Supports for Low-Slope Roofs:

1. Manufacturers:
   a. PHP Systems/Design: www.phpsd.com/#sle.
   b. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

Q. Pipe Shields for Insulated Piping:
1. MSS SP-58 Type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel
2. General Construction and Requirements:
   a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
   b. Shields Material: UV-resistant polypropylene with glass fill.
   c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
   d. Minimum Service Temperature: Minus 40 degrees F.
   e. Maximum Service Temperature: 178 degrees F.
   f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

R. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam-ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
7. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.
8. Sheet Metal: Use sheet metal screws.
9. Wood: Use wood screws.
10. Plastic and lead anchors are not permitted.
11. Powder-actuated fasteners are not permitted.
12. Hammer-driven anchors and fasteners are not permitted.
13. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
   a. Comply with MFMA-4.
   b. Channel Material: Use galvanized steel.
   c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

S. Pipe Installation Accessories:
1. Seismic Bracing Hardware:
   a. Cable Suspension Systems:
      1) Strut channel or bracket-fitted fitting with locking mechanism for pipe or equipment suspension using cable wires extended to surface-mounted end-fixing fittings.
      2) Provide cable wire and end-fixing as required to hold minimum weight of 120 lb.
   b. Cable Sway Bracing Systems:

1) Cable wire hanger with fix and release spring mechanism enclosed using zinc housing with 302 stainless steel components for pipe or equipment suspension to surface-mounted end-fixing fittings.
2) Provide cable wire and end-fixing as required to hold minimum weight of 25 lb.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

G. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.

I. Secure fasteners according to manufacturer's recommended torque settings.

J. Remove temporary supports.

3.02 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

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SECTION 23 0548
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vibration isolation requirements.
B. Seismic control requirements.
C. Vibration-isolated equipment support bases.
D. Seismic restraint systems.
E. Vibration-isolated and/or seismically engineered roof curbs.

1.02 DEFINITIONS

A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).
B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
D. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.
E. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.05 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
   1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.

C. Shop Drawings - Vibration Isolation Systems:
   1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
   2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

1.06 QUALITY ASSURANCE

A. Comply with applicable building code.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:
   1. Select vibration isolators to provide required static deflection.
   2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.

2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

2.03 SEISMIC RESTRAINT SYSTEMS

A. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

B. Cable Restraints:
   1. Comply with ASCE 19.
   2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
   3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
   4. Use protective thimbles for cable loops where potential for cable damage exists.

C. Rigid Restraints: Use MFMA-4 steel channel (strut) for structural element; suitable for both compressive and tensile design loads.

2.04 VIBRATION-ISOLATED AND/OR SEISMICALLY ENGINEERED ROOF CURBS

A. Seismic Type:
   1. Non-isolated Curb and Fabricated Equipment Piers:
      a. Location: Between structure and rooftop equipment.
      b. Construction: Steel.
      c. Weather exposed components consist of corrosion resistant materials.
   2. Vibration Isolation Curb:
      a. Location: Between structure and rooftop equipment.
      b. Construction: Steel.
      c. Integral vibration isolation to conform to requirements of this section.
      d. Snubbers consist of minimum 0.25 inch thick resilient pads to avoid metal-to-metal contact without compromising vibration isolating capabilities.
      e. Weather exposed components consist of corrosion resistant materials.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Secure fasteners according to manufacturer's recommended torque settings.

D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

E. Vibration Isolation Systems:
   1. Vibration-Isolated Equipment Support Bases:
      a. Provide specified minimum clearance beneath base.
   2. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
   3. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
   4. Adjust isolators to be free of isolation short circuits during normal operation.
   5. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.02 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Vibration Isolation Systems:
   1. Verify isolator static deflections.
   2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

1. Refer to Drawings.

END OF SECTION

SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.
B. Tags.
C. Duct markers.
D. Pipe markers.
E. Ceiling tacks.

1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.03 SUBMITTALS

A. See Division 01 for submittal procedures.
B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
D. Product Data: Provide manufacturers catalog literature for each product required.
E. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.
B. Air Terminal Units: Nameplates.
C. Automatic Controls: Tags. Key to control schematic.
D. Control Panels: Nameplates.
E. Ductwork: Duct Markers.
F. Heat Transfer Equipment: Nameplates.
G. Instrumentation: Tags.
H. Major Control Components: Nameplates.
I. Piping: Pipe markers.
J. Pumps: Nameplates.
K. Relays: Tags.

L. Small-sized Equipment: Tags.
M. Tanks: Nameplates.
N. Thermostats: Adhesive backed abel.
O. Valves: Tags and ceiling tacks where located above lay-in ceiling.
P. Water Treatment Devices: Nameplates.

2.02 NAMEPLATES

A. Content: Minimum information indicating unique equipment tag.
B. Multi-layered metalized polyester with permanent adhesive.
   1. Letter Color: White.
   2. Letter Height: 2 inch, minimum.
   3. Background Color: Black.
   4. Plastic: Comply with ASTM D709.

2.03 TAGS

A. Content: Minimum information indicating unique valve or insturment tag
B. Metal Tags: Stainless Steel with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

2.04 DUCT MARKERS

A. Material: High gloss acrylic adhesive-backed vinyl film; printed with UV and chemical resistant inks.
B. Style: Multiple Markers on a Roll.
C. Content: Minimum information indicating flow direction arrow and identification of air service.
D. Color: Yellow/Black for concealed ductwork.
E. Size: 12 inch long color field (minimum), 2-1/2 inch high letters.

2.05 PIPE MARKERS

A. Color: Comply with ASME A13.1.
B. Content: Minimum information indicating flow direction arrow and identification of fluid being conveyed.
C. Size:
   1. Up to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
   2. Over 2 inch Outside Diameter of Insualtion or Pipe: 12 inch long color field, 1-1/4 inch high letters.
D. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering.
E. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
F. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

2.06 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
   1. HVAC Equipment: Yellow.
   2. Fire Dampers and Smoke Dampers: Red.
   3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install valve tags with corrosion resistant chain.

C. Install plastic pipe markers or plastic tape pipe markers in accordance with manufacturer's instructions.

D. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

E. Install ductwork with duct labels.

F. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

G. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

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SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic systems.

1.02 SUBMITTALS

A. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Submit to Architect.
   2. Submit six weeks prior to starting the testing, adjusting, and balancing work.
   3. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
   4. Include at least the following in the plan:
      a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
      c. Identification and types of measurement instruments to be used and their most recent calibration date.
      d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      e. Final test report forms to be used.
      f. Details of how TOTAL flow will be determined; for example:
         1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
         2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
      g. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
      h. Confirmation of understanding of the outside air ventilation criteria under all conditions.
      i. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
      j. Method of checking building static and exhaust fan and/or relief damper capacity.
      k. Procedures for formal deficiency reports, including scope, frequency and distribution.

B. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Revise TAB plan to reflect actual procedures and submit as part of final report.
   2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.

3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
5. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
   1. AABC (NSTSB), AABC National Standards for Total System Balance.
B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
D. TAB Agency Qualifications:
   1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
   2. Having minimum of three years documented experience.
   3. Certified by one of the following:
      a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place and open.
   8. Air coil fins are cleaned and combed.
   9. Access doors are closed and duct end caps are in place.
   10. Air outlets are installed and connected.
   11. Duct system leakage is minimized.
   12. Hydronic systems are flushed, filled, and vented.
   13. Pumps are rotating correctly.
   14. Proper strainer baskets are clean and in place.
   15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
   1. Running log of events and issues.
   2. Discrepancies, deficient or uncompleted work by others.
   3. Contract interpretation requests.
   4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.06 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.07 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

END OF SECTION

SECTION 23 0713
HVAC DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.
B. Duct liner.
C. Jacketing and accessories.

1.02 REFERENCE STANDARDS

A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
E. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.
F. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
G. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2016 (Reapproved 2021).
H. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2019 (Reapproved 2022).
I. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers; 2015 (Reapproved 2022).
J. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
M. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
N. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
O. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
P. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.
Q. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors; Current Edition, Including All Revisions.

R. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Johns Manville: www.jm.com.
   3. Knauf Insulation: www.knaufinsulation.com/#sle.
   4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

B. Insulation: ASTM C553; flexible, noncombustible blanket.
   1. 'K' value (maximum): 0.27 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Density: 0.75 lbs/cu. ft. (nominal)
   3. Maximum Service Temperature: 1,200 degrees F.
   4. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film ('FSK') or White kraft paper with glass fiber yarn ('PSK').

2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure-sensitive tape.

D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

E. Indoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

F. Outdoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

G. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

2.03 GLASS FIBER, RIGID

A. Manufacturer:
1. CertainTeed Corporation: www.certainteed.com/#sle.
2. Johns Manville: www.jm.com.
3. Knauf Insulation: www.knaufinsulation.com/#sle.
4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

B. Insulation: ASTM C612; rigid, noncombustible blanket.
1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 450 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent.
4. Maximum Density: 8.0 pcf.

C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure-sensitive tape.

D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

E. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.04 JACKETING AND ACCESSORIES

A. Aluminum Jacket:
1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
2. Thickness: 0.016 inch sheet.
3. Finish: Embossed.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
6. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

B. Flexible Weather-Proofing Outdoor Jacket: Self-healing, field-applied outdoor cladding.

1. Material: Aluminum foil/polymer laminate with rubberized asphalt layer and acrylic adhesive.
2. Thickness: 34 mil, 0.034 inch.
3. Finish: Embossed.
4. Color: Silver.
5. Water Vapor Transmission: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
6. Mold Resistance: Pass when tested in accordance with ASTM C1338.
7. Emissivity: 0.30 when tested in accordance with ASTM C1371.

C. Reinforced Tape:
1. FSK tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.
2. Comply with UL 723 or ASTM E84.
3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
4. Finish: Match insulation.

D. UL181 Tape for Rigid and Flexible Ductwork:
1. Comply with UL 181A for rigid ductwork.
2. Comply with UL 181B for flexible ductwork.
3. Aluminum foil coated with pressure-sensitive adhesive on paper release liner.
4. Foil tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.

2.05 DUCT LINER

A. Manufacturers:
1. CertainTeed Corporation: www.certainteed.com/#sle.
2. Ductmate Industries, Inc, a DMI Company; PolyArmor (Basis of Design): www.ductmate.com/#sle.
3. Johns Manville: www.jm.com/#sle.
4. Knauf Insulation: www.knaufinsulation.com/#sle.

B. Insulation: Non-corrosive, incombustible polyester fiber complying with ASTM C1071 and ASTM E84; webbed into a thermal blanket which is then bonded with a FSK Facing.
1. Fungal Resistance: No growth when tested according to ASTM G21.
2. Thermal Resistance at 75 degrees F per ASTM C518:
a. 1-inch Thickness: R-4.2
b. 1-1/4 inch Thickness: R-5
c. 1-1/2 inch Thickness: R-6
d. 2-inch Thickness: R-8
3. Service Temperature: Up to 250 degrees F.
4. Rated Velocity on Coated Air Side for Air Erosion: 4000 fpm.
5. Minimum Noise Reduction Coefficients:
a. 1 inch Thickness: 0.65.
b. 1-1/4 inch Thickness: 0.65
c. 1-1/2 inches Thickness: 0.65.
d. 2 inch Thickness: 0.65.

C. Adhesive: Waterproof, fire-retardant type, ASTM C916.

D. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test ductwork for design pressure prior to applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated Ducts Conveying Air Below Ambient Temperature:
   1. Provide insulation with vapor barrier jackets.
   2. Finish with tape and vapor barrier jacket.
   3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated Ducts Conveying Air Above Ambient Temperature:
   1. Provide with or without standard vapor barrier jacket.
   2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with aluminum jacket.

F. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with aluminum jacket.

G. External Duct Insulation Application:
   1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
   2. Secure insulation without vapor barrier with staples, tape, or wires.
   3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
   4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
   5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

H. Duct and Plenum Liner Application:
   1. Adhere insulation with adhesive for 90 percent coverage.
   2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
   3. Seal and smooth joints. Seal and coat transverse joints.
   4. Seal liner surface penetrations with adhesive.
   5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

3.03 SCHEDULES

A. Refer to Drawings for Duct Insulation Schedule.

END OF SECTION

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SECTION 23 0719
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Flexible removable and reusable blanket insulation.

C. Jacketing and accessories.

1.02 REFERENCE STANDARDS

A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).

C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).

D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.

E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.

F. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. Product Data: Provide insulation schedule for all products. Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.05 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, RIGID

A. Manufacturers:
   1. CertainTeed Corporation: www.certainteed.com.
   2. Johns Manville Corporation: www.jm.com.
   3. Knauf Insulation: www.knaufinsulation.com.
   4. Owens Corning Corporation: www.ocbuildingspec.com/sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulation: ASTM C547and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
   1. K Value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum Service Temperature: 650 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier All Service Jacket (ASJ): White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E. Vapor Barrier Lap Adhesive: Compatible with insulation.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

G. Certifications and Sustainable Features:
   1. Contain an average of a least 25% recycled content.
   2. UL Environment GreenGuard or GreenGuard Gold Certified.
   3. Formaldehyde free or formaldehyde emissions less than 0.010 ppm.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:
   1. Aeroflex USA, Inc; AEROFLEX Self-Seal: www.aeroflexusa.com/#sle.
   2. Armacell LLC; ArmaFlex Ultra with FlameDefense: www.armacell.us/#sle.
   3. K-Flex USA LLC; K-Flex Titan: www.kflexusa.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
   1. Minimum Service Temperature: Minus 40 degrees F.
   2. Maximum Service Temperature: 180 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.04 JACKETING AND ACCESSORIES

A. PVC Plastic.
   1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Connections: Brush on welding adhesive.
   2. Covering Adhesive Mastic: Compatible with insulation.

B. Aluminum Jacket:
   1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.

2.05 **INSULATED PIPE SUPPORTS**

A. Unless otherwise specified, insulated pipe supports shall be provided and installed by the same during pipe support installation.

B. Insulated Pipe Supports should be provided at hanger, support, and guide locations on pipe requiring insulation.

C. The insualted pipe support should consist of either waterproofed calcium silicate or polyisocyanurate foam insulation encircling the entire circumference of the pipe with a PVC or galvanized steel jacket.

D. Provide assembly of same thickness as adjoining insulation. Jacket length shall match or exceed length of insulatin.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated Pipes Conveying Fluids Below Ambient Temperature:
   1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:
   1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

H. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:
   1. Application: Piping 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert location: Between support shield and piping and under the finish jacket.
   4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 8400.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULE

A. Refer to Drawings for HVAC Piping Insulation Schedule

B. Heating Systems: Insulate all heating system supply and return piping per insualtion schedule and code requirements.
   1. Glass Fiber insulation, minimum 1-1/2 inch thick for nominal pipe sizes up to 1 inch. minimum 2 inch thick for nominal pipe sizes of 1.5 inches or larger.

C. Cooling Systems: Insulate all cooling system supply and return piping per insualtion schedule and code requirements.
   1. Glass Fiber insulation, minimum 1 inch thick.

D. Refrigerant Systems: Insulate all refrigerant system suction, liquid, hot-gas and discharge piping per insualtion schedule, code requirements, and equipment manufacturer recommendations.
   1. Flexible Elastomeric Cellular Insualtion, minimum 1 inch thick.

END OF SECTION

SECTION 23 0913
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Control panels.
B. Dampers.
C. Damper Operators:
D. HVAC&R Sensors:
   1. Temperature sensors.
   2. Humidity sensors.
E. Sensors with transmitters:
   1. Building static pressure transmitters.
F. Control Panels
G. Dampers.
H. Zone Temperature Sensors
I. Input/Output Sensors
J. Line-voltage Thermostats
K. Operable Window Status Sensors
L. Thermal Energy Meters.
M. Transmitters
N. User Override Switch

1.02 REFERENCE STANDARDS

A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.
B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. See Division 01 for submittal procedures.
B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.
C. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
D. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 EQUIPMENT - GENERAL

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.02 CONTROL PANELS

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.

B. NEMA Standard 250 general purpose utility enclosures with enamelled finished face panel. Select control panel type appropriate for panel application and installed location:
   1. Type 1 for Indoor Nonhazardous Locations
   2. Type 4 for Outdoor Nonhazardous Locations

C. Provide common keying for all panels.

2.03 DAMPERS

A. HVAC Dampers:

2.04 DAMPER OPERATORS

A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and provide tight seal against maximum system pressures. Provide spring return for two-position control and for fail-safe operation.
   1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
   2. Provide one operator for maximum 36 sq ft damper section.
   3. Adjustable stroke motor having oil immersed gear train, with auxiliary end switch.
   4. Operator to to be controlled at 120 V. Coordinate with electrical.

2.05 **ZONE TEMPERATURE SENSORS**

A. Zone Temperature Sensors without User Interface
   1. Wall-mounted zone temperature sensor for measuring zone temperature and providing input to Direct Digital Control System for HVAC.
      a. Refer to Section 230923
      b. Stainless steel flatplate
      c. Basis of Design: Kele KTP Series
   2. Temperature Sensors:
      a. Accurate within 0.5 degree F with linear output.

b. Range of 0 to 120 degree F
3. Power requirement: None
4. Mounting: Flush mount to standard 4"x2" electrical box.

B. Zone Temperature Sensors with User Interface
1. Wall-mounted zone temperature sensor for measuring zone temperature and providing input to Direct Digital Control System for HVAC.
a. Refer to Section 230923
b. Provide zone temperature sensors by DDC system manufactuer.
c. Basis of Design: **Automated Logic RS Pro**
2. Temperature Sensors:
a. Accurate within 0.5 degree F with linear output.
b. Range of 0 to 120 degree F
3. Power requirement: 12 VDC
4. Communication: 115 kbps R-net connection between sensor(s) and controller.
5. Local access communications port
6. Mounting: Mount to standard 4"x2" electrical box.
7. Display: LCD to displays zone temperature, outside air temperature, zone heating and cooling setpoints.
8. Occupant Override: Zone setpoint adjustment and override feature integral to controller.

2.06 HVAC&R SENSORS

A. Temperature Sensors:
1. Applications
a. Wall-mounted temperature sensors: Stainless steel flatplate mount to standard 4"x2" electrical box.
b. Air-stream temperature sensors: With galvanized enclosure. 10 kOhm sensing element. 29 cm probe.
c. Immersion temperature sensors: With galvanized enclosure. 10 kOhm sensing element. 10 cm probe.
2. Types:
a. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
b. Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F.
c. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
3. Temperature Sensing Device: Compatible with project DDC controllers.
4. Performance Characteristics:
a. RTD:
1) Room Sensor Accuracy: Plus/minus 0.50 degrees F minimum.
2) Duct Averaging Accuracy: Plus/minus 0.50 degrees F minimum.
3) Chilled Water Accuracy: Plus/minus 0.50 degrees F minimum.
4) All Other Accuracy: Plus/minus 0.75 degrees F minimum.
5) Range: Minus 40 degrees F through 220 degrees F minimum.
b. Thermistor:
1) Accuracy (All): Plus/minus 0.36 degrees F minimum.
2) Range: Minus 25 degrees F through 122 degrees F minimum.
3) Heat Dissipation Constant: 2.7 mW per degree C.
c. Temperature Transmitter:

1) Accuracy: 0.10 degree F minimum or plus/minus 0.20 percent of span.
2) Output: 4 to 20 mA.

d. Sensing Range:
1) Provide limited range sensors if required to sense the range expected for a respective point.
2) Use RTD type sensors for extended ranges beyond minus 30 to 230 degrees F.
3) Use temperature transmitters in conjunction with RTD's when RTD's are incompatible with DDC controller direct temperature input.

e. Wire Resistance:
1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F or use temperature transmitter when offset is greater than 1.0 degree F due to wire resistance.
2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.

f. Temperature Averaging Elements:
1) Use on duct sensors for ductwork 10 sq ft or larger.
2) Use averaging elements where prone to stratification with sensor length 8 ft or 16 ft.
3) Provide for all mixed air and heating coil discharge sensors regardless of duct size.

g. Insertion Elements:
1) Use in ducts not affected by temperature stratification or smaller than 11 sq inches.
2) Provide dry type, insertion elements for liquids, installed in immersion wells, with minimum insertion length of 2.5 inches.

B. Humidity Sensors:

C. Damper Position Indication:
1. Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 - 100 percent damper travel.

2.07 OPERABLE WINDOW STATUS SENSORS:

A. Recessed, press-fit magentic contact switch to be provided with operable windows.
1. Sensor to provide binary input based on 0-10 VDC or 4-20 mA from control system.
2. Refer to Section 084000.

2.08 **LINE VOLTAGE THERMOSTATS**

A. Line Voltage Thermostats:
1. Integral manual On/Off/Auto selector switch, single or two pole as required.
2. Dead Band: Maximum 2 degrees F.
3. Rating: Motor load.

2.09 **THERMAL ENERGY (BTU) METERS**

A. Thermal energy measurement for hot water system based on signal inputs from two matched temperature sensors and insertion or inline flow meter, providing energy flow and temperature data on a local alphanumeric display and to the BACnet/IP network via the BACnet/IP communications driver.
1. Basis of Design: Onicon System 10-BAC BTU Meter
2. Substitutions: See Section 016000 - Product Requirements.

B. NIST Traceable Calibration with Certification

C. Precision Solid State Temperature Sensors calibrated and matched to an accuracy better than ±0.15° F from 32-200° F

D. Integral display and keypad .

E. Network Compatible Serial Communications

F. Communications card provides energy, flow and temperature data through a single network connection.

G. Insertion or inline flow meters suitable for system application.

2.10 SENSORS WITH TRANSMITTERS

A. Building Static Pressure Transmitters:
   1. One pipe, direct acting, double bell, scale range 0.01 to 0.25 inch wg positive or negative, and sensitivity of 0.05 inch wg. Transmit electronic signal to receiver with matching scale range.

B. Duct Pressure Transmitters:
   1. One pipe direct acting for HVAC supply air service, range suitable for system, proportional electronic output.

2.11 **USER OVERRIDE SWITCH**

A. Wall-mounted, push button switch for manual override signal to Direct Digital Control System.

B. Flush-mounted with stainless steel cover plate.

C. Red colored button with LED illuminator.
   1. Basis of Design: IDEC Pushbutton Switch: AOW-110R
   2. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

F. Ensure installation of components is complementary to installation of similar components.

G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of thermostats with plans and room details before installation. Locate 60 inches above floor. Align with lighting switches and humidistats; see Section 26 2726.

C. Provide mixing dampers of opposed blade construction arranged to mix streams. Provide pilot positioners on mixed air damper motors.

D. Provide isolation (two-position) dampers of parallel blade construction.

E. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.

F. Mount control panels adjacent to associated equipment on vibration free walls or free-standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

G. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.

H. Provide conduit and electrical wiring in accordance with Section 26 0583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.03 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements relating to maintenance service.

B. Provide service and maintenance of control system for one year from Date of Substantial Completion.

C. Provide complete service of controls systems, including call backs, and submit written report of each service call.

END OF SECTION

SECTION 23 0923
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. System description.
B. Operator interface.
C. Controllers.
D. Power supplies and line filtering.
E. System software.
F. Controller software.
G. HVAC control programs.

1.02 REFERENCE STANDARDS

A. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata (2023).
B. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests; 2019h.
C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
D. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. Product Data: Provide data for each system component and software module.
B. Shop Drawings:
    1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
    2. List connected data points, including connected control unit and input device.
    3. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
    4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
    5. Indicate description and sequence of operation of operating, user, and application software.
C. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.

D. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
   1. Revise shop drawings to reflect actual installation and operating sequences.
   2. Include submittals data in final "Record Documents" form.

E. Operation and Maintenance Data:
   1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
   2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
   3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum 15 years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with minimum 15 years of documented experience.

D. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a five year period after Substantial Completion.

C. Provide five year manufacturer's warranty for field programmable micro-processor based units.

1.07 PROTECTION OF SOFTWARE RIGHTS

A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
   1. Limiting use of software to equipment provided under these specifications.
   2. Limiting copying.
   3. Preserving confidentiality.
   4. Prohibiting transfer to a third party.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Delta Controls: www.deltacontrols.com/#sle.

B. Automated Logic

C. Alerton

D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SYSTEM DESCRIPTION

A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.

B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.

C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.

D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 23 0913.

E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.

F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

2.03 OPERATOR INTERFACE

A. PC Based Work Station:

B. Workstation, controllers, and control backbone to communicate using BACnet protocol and addressing.

C. BACnet protocol to comply with ASHRAE Std 135.

D. Hardware:
   1. Desktop:
      a. Computer(s) and display(s) to be provided by DDC controls manufacturer.
      b. Quantity: As indicated on the drawings.
      c. Location(s): As indicated on the drawings.
      d. Network Connection:
         1) Ethernet interface card.
   2. Laptop:
      a. Laptop(s) to be provided by DDC controls manufacturer.
      b. Quantity: As indicated on the drawings.
      c. Network Connection:
         1) Ethernet interface card.

2.04 CONTROLLERS

A. Building Controllers:
   1. General:
      a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
      b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
      c. Share data between networked controllers.

d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
e. Utilize real-time clock for scheduling.
f. Continuously check processor status and memory circuits for abnormal operation.
g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
h. Communication with other network devices to be based on assigned protocol.

2. Communication:
   a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
   b. Perform routing when connected to a network of custom application and application specific controllers.
   c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
   a. Outdoors and/or in Wet Ambient Conditions:
      1) Mount within waterproof enclosures.
      2) Rated for operation at 40 to 150 degrees F.
   b. Conditioned Space:
      1) Mount within dustproof enclosures.
      2) Rated for operation at 32 to 120 degrees F.
4. Provisions for Serviceability:
   a. Diagnostic LEDs for power, communication, and processor.
   b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

B. Custom Application Controller:
1. General:
   a. Provide sufficient memory to support controller's operating system, database, and programming requirements.
   b. Share data between networked, microprocessor based controllers.
   c. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
   d. Utilize real-time clock for scheduling.
   e. Continuously check processor status and memory circuits for abnormal operation.
   f. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
   g. Communication with other network devices to be based on assigned protocol.
2. Communication:
   a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.

b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.

3. Anticipated Environmental Ambient Conditions:
   a. Outdoors and/or in Wet Ambient Conditions:
      1) Mount within waterproof enclosures.
      2) Rated for operation at 40 to 150 degrees F.
   b. Conditioned Space:
      1) Mount within dustproof enclosures.
      2) Rated for operation at 32 to 120 degrees F.
4. Provisions for Serviceability:
   a. Diagnostic LED's for power, communication, and processor.
   b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

C. Application Specific Controllers:
1. General:
   a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
   b. Customized for operation within the confines of equipment served.
   c. Communication with other network devices to be based on assigned protocol.
2. Communication:
   a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
   b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
   a. Outdoors and/or in Wet Ambient Conditions:
      1) Mount within waterproof enclosures.
      2) Rated for operation at 40 to 150 degrees F.
   b. Conditioned Space:
      1) Mount within dustproof enclosures.
      2) Rated for operation at 32 to 120 degrees F.
4. Provisions for Serviceability:
   a. Diagnostic LEDs for power, communication, and processor.
   b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.

D. Input/Output Interface:
   1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
   2. All Input/Output Points:
      a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
      b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
   3. Binary Inputs:
      a. Allow monitoring of On/Off signals from remote devices.
      b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
      c. Sense dry contact closure with power provided only by the controller.
   4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
   5. Analog Inputs:
      a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
      b. Compatible with and field configurable to commonly available sensing devices.
   6. Binary Outputs:
      a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
      b. Outputs provided with three position (On/Off/Auto) override switches.
      c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
   7. Analog Outputs:
      a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
      b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
      c. Drift to not exceed 0.4 percent of range per year.
   8. Tri State Outputs:
      a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
      b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
      c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
   9. System Object Capacity:
      a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
      b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

2.05 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies:

1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
2. Limit connected loads to 80 percent of rated capacity.
3. Match DC power supply to current output and voltage requirements.
4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
7. Operational Ambient Conditions: 32 to 120 degrees F.
8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
9. Line voltage units UL recognized and CSA approved.

B. Power Line Filtering:
1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
2. Minimum surge protection attributes:
a. Dielectric strength of 1000 volts minimum.
b. Response time of 10 nanoseconds or less.
c. Transverse mode noise attenuation of 65 dB or greater.
d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

2.06 LOCAL AREA NETWORK (LAN)

A. Provide communication between control units over local area network (LAN).

B. LAN Capacity: Not less than 60 stations or nodes.

C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.

D. LAN Data Speed: Minimum 19.2 Kb.

E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.

F. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.

G. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

2.07 SYSTEM SOFTWARE

A. Operating System:
1. Concurrent, multi-tasking capability.
2. System Graphics:
a. Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
b. Animation displayed by shifting image files based on object status.
c. Provide method for operator with password to perform the following:
1) Move between, change size, and change location of graphic displays.
2) Modify on-line.

3) Add, delete, or change dynamic objects consisting of:
(a) Analog and binary values.
(b) Dynamic text.
(c) Static text.
(d) Animation files.

3. Custom Graphics Generation Package:
a. Create, modify, and save graphic files and visio format graphics in PCX formats.
b. HTML graphics to support web browser compatible formats.
c. Capture or convert graphics from Designer.

B. Workstation System Applications:
1. Automatic System Database Save and Restore Functions:
a. Current database copy of each Building Controller is automatically stored on hard disk.
b. Automatic update occurs upon change in any system panel.
c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
a. Save database from any system panel.
b. Clear a panel database.
c. Initiate a download of a specified database to any system panel.
3. Software provided allows system configuration and future changes or additions by operators under proper password protection.
4. On-line Help:
a. Context-sensitive system assists operator in operation and editing.
b. Available for all applications.
c. Relevant screen data provided for particular screen display.
d. Additional help available via hypertext.
5. Security:
a. Operator log-on requires user name and password to view, edit, add, or delete data.
b. System security selectable for each operator.
c. System supervisor sets passwords and security levels for all other operators.
d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
f. All system security data stored in encrypted format.
6. System Diagnostics:
a. Operations Automatically Monitored:
1) Workstations.
2) Printers.
3) Modems.
4) Network connections.
5) Building management panels.
6) Controllers.
b. Device failure is annunciated to the operator.
7. Alarm Processing:
a. All system objects are configurable to "alarm in" and "alarm out" of normal state.

b. Configurable Objects:
    1) Alarm limits.
    2) Alarm limit differentials.
    3) States.
    4) Reactions for each object.

8. Alarm Messages:
    a. Descriptor: English language.
    b. Recognizable Features:
        1) Source.
        2) Location.
        3) Nature.
9. Configurable Alarm Reactions by Workstation and Time of Day:
    a. Logging.
    b. Printing.
    c. Starting programs.
    d. Displaying messages.
    e. Dialing out to remote locations.
    f. Paging.
    g. Providing audible annunciation.
    h. Displaying specific system graphics.
10. Custom Trend Logs:
    a. Definable for any data object in the system including interval, start time, and stop time.
    b. Trend Data:
        1) Sampled and stored on the building controller panel.
        2) Archivable on hard disk.
        3) Retrievable for use in reports, spreadsheets and standard database programs.
        4) Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
        5) Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.
11. Alarm and Event Log:
    a. View all system alarms and change of states from any system location.
    b. Events listed chronologically.
    c. Operator with proper security acknowledges and clears alarms.
    d. Alarms not cleared by operator are archived to the workstation hard disk.
12. Object, Property Status and Control:
    a. Provide a method to view, edit if applicable, the status of any object and property in the system.
    b. Status Available by the Following Methods:
        1) Menu.
        2) Graphics.
        3) Custom Programs.
13. Reports and Logs:
    a. Reporting Package:
        1) Allows operator to select, modify, or create reports.
        2) Definable as to data content, format, interval, and date.
        3) Archivable to hard disk.
    b. Real-time logs available by type or status such as alarm, lockout, normal, etc.

c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
d. Set to be printed on operator command or specific time(s).

14. Reports:
    a. Standard:
        1) Objects with current values.
        2) Current alarms not locked out.
        3) Disabled and overridden objects, points and SNVTs.
        4) Objects in manual or automatic alarm lockout.
        5) Objects in alarm lockout currently in alarm.
        6) Logs:
            (a) Alarm History.
            (b) System messages.
            (c) System events.
            (d) Trends.
    b. Custom:
        1) Daily.
        2) Weekly.
        3) Monthly.
        4) Annual.
        5) Time and date stamped.
        6) Title.
        7) Facility name.
    c. Tenant Override:
        1) Monthly report showing total, requested, after-hours HVAC and lighting services on a daily basis for each tenant.
        2) Annual report showing override usage on a monthly basis.
    d. Electrical, Fuel, and Weather:
        1) Electrical Meter(s):
            (a) Monthly showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
            (b) Annual summary showing monthly electrical consumption and peak demand with time and date stamp for each meter.
        2) Fuel Meter(s):
            (a) Monthly showing daily natural gas consumption for each meter.
            (b) Annual summary showing monthly consumption for each meter.
        3) Weather:
            (a) Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.

C. Workstation Applications Editors:
    1. Provide editing software for each system application at PC workstation.
    2. Downloaded application is executed at controller panel.
    3. Full screen editor for each application allows operator to view and change:
        a. Configuration.
        b. Name.
        c. Control parameters.
        d. Set-points.
    4. Scheduling:
        a. Monthly calendar indicates schedules, holidays, and exceptions.

b. Allows several related objects to be scheduled and copied to other objects or dates.
c. Start and stop times adjustable from master schedule.

5. Custom Application Programming:
   a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
   b. Programming Features:
      1) English oriented language, based on BASIC, FORTRAN, C, or PASCAL syntax allowing for free form programming.
      2) Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
      3) Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
      4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
      5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
      6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
      7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
      8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values cab be used in IF/THEN comparisons, calculations, programming statement logic, etc.
      9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

2.08 CONTROLLER SOFTWARE

A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.

B. System Security:
   1. User access secured via user passwords and user names.
   2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
   3. User Log On/Log Off attempts are recorded.
   4. Automatic Log Off occurs following the last keystroke after a user defined delay time.

C. Object or Object Group Scheduling:
   1. Weekly Schedules Based on Separate, Daily Schedules:
      a. Include start, stop, optimal stop, and night economizer.
      b. 10 events maximum per schedule.
      c. Start/stop times adjustable for each group object.
   2. Exception Schedules:
      a. Based on any day of the year.
      b. Defined up to one year in advance.
      c. Automatically discarded and replaced with standard schedule for that day of the week upon execution.

3. Holiday or Special Schedules:
    a. Capability to define up to 99 schedules.
    b. Repeated annually.
    c. Length of each period is operator defined.

D. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.

E. Alarms:
1. Binary object is set to alarm based on the operator specified state.
2. Analog object to have high/low alarm limits.
3. All alarming is capable of being automatically and manually disabled.
4. Alarm Reporting:
    a. Operator determines action to be taken for alarm event.
    b. Alarms to be routed to appropriate workstation.
    c. Reporting Options:
        1) Start programs.
        2) Logged.
        3) Custom messaging.
        4) Graphical displays.
        5) Dial out to workstation receivers via system protocol.

F. Demand Limiting:
1. Building power consumption monitored from signals generated by a pulse generator, mounted at the building power meter.
2. Demand limit controlled via load shedding or load restoration in a predetermined and predictive manner.
3. Demand Reduction Methods:
    a. Supply air temperature reset.
    b. Space temperature set-point reset.
    c. Equipment off/on prioritization.
4. Relevant variables that influence demand limiting control are based on the power company methodology for computing demand charges.
5. Operator On-Line Changes Allowed:
    a. Addition and deletion of loads controlled.
    b. Changes in demand intervals.
    c. Changes in demand limit for meter(s).
    d. Maximum equipment shutoff time.
    e. Minimum equipment shutoff time.
    f. Select rotational or sequential shedding and restoring.
    g. Shed/restore priority.
6. Information and Reports available Hourly, Daily, and Monthly:
    a. Total electric consumption.
    b. Peak demand.
    c. Date and time of peak demand.
    d. Daily peak demand.

G. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.

H. Sequencing: Application software based upon specified sequences of operation in Section 23 0993.

I. PID Control Characteristics:

1. Direct or reverse action.
2. Anti-windup.
3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
4. User selectable controlled variable, set-point, and PED gains.

J. Staggered Start Application:
1. Prevents all controlled equipment from simultaneously restarting after power outage.
2. Order of equipment startup is user selectable.

K. Energy Calculations:
1. Accumulated instantaneous power or flow rates are converted to energy use data.
2. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.

L. Anti-Short Cycling:
1. All binary output objects protected from short-cycling.
2. Allows minimum on-time and off-time to be selected.

M. On-Off Control with Differential:
1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.

N. Run-Time Totalization:
1. Totalize run-times for all binary input objects.
2. Provides operator with capability to assign high run-time alarm.

2.09 **SEQUENCE OF OPERATIONS:**

A. As Indicated on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.02 INSTALLATION

A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 23 0993.

C. Provide with 120v AC, 15 amp power circuit to each programmable control unit.

D. Provide conduit and electrical wiring in accordance with Section 26 0583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

E. Install all control wiring in conduit.

1. Control wiring located within accessible ceiling plenums may be installed as plenum rated cable and suspended from structure with j-hooks.

3.03 MANUFACTURER'S FIELD SERVICES

A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

B. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 3 day period.

C. Provide basic operator training for 5 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 40 hours dedicated instructor time. Provide training on site.

3.04 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate complete and operating system to Owner.

3.05 MAINTENANCE

A. Provide service and maintenance of energy management and control systems for one years from Date of Substantial Completion.

B. Provide two complete inspections, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.

END OF SECTION

SECTION 23 0934
VARIABLE-FREQUENCY MOTOR CONTROLLERS FOR HVAC

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SECTION 23 2113
HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Heating water piping, above grade.
B. Chilled water piping, buried.
C. Chilled water piping, above grade.
D. Condensate drainage piping
E. Valves:
   1. Ball valves.
   2. Butterfly valves.
   3. Check valves.

1.02 REFERENCE STANDARDS

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.
B. ASME B31.9 - Building Services Piping; 2020.
C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
E. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.
F. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
G. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
H. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
I. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.
J. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).
K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
L. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
M. AWWA C606 - Grooved and Shouldered Joints; 2022.
N. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of underground piping with size, location and installation of service utilities.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data:
   1. Include data on pipe materials, pipe fittings, valves, and accessories.
   2. Indicate valve data and ratings.
   3. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

D. Project Record Documents: Record actual locations of valves.

E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum three years of experience.

C. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

D. Date stamp all castings used for coupling housings, fittings, valve bodies, etc. for quality assurance and traceability.

E. Coupling Manufacturer:
   1. Perform on-site training by factory-trained representative to the Contractor's field personnel in the proper use of grooving tools and installation of grooved joint products.
   2. Periodic job site visits by factory-trained representative to ensure best practices in grooved joint installation.
   3. A distributor's representative is not considered qualified to perform the training.

F. Welder Qualifications: Certify in accordance with ASME BPVC-IX.
   1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
   1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
   2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
   3. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

D. Valves: Provide valves where indicated:

2.02 HEATING WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn, using one of the following joint types:

2.03 CHILLED WATER PIPING, BURIED

A. Direct buried factory prefabricated piping system. All pipe shall be supplied by the same manufacturer.

B. Manufacturers.
   1. Perma-Pipe/ Ricweil
   2. Thermal Pipe Systems
   3. Rovanco
   4. Insul-Tek
   5. Substitutions: See Section 016000 - Product Requirements

C. Steel Pipe: ASTM A53/A53M, Schedule 40, black with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape.
   1. Fittings: ASTM A234/A234M, wrought steel welding type with double layer, half-lapped polyethylene tape.
   2. Joints: Welded in accordance with AWS D1.1/D1.1M.
   3. Casing: Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.

D. Insulation: Foamed-in-place closed-cell polyurethane foam completely fills the annular space between the pipe and outer jacket. Nominal density of 2 lb/cf, thermal conductivity (“K” factor) is 0.14 BTU in./ (HR) (SQ.FT.) (F) at 73F.

E. PVC Outer Jacket: Type 1, Grade 1 Polyvinyl Chloride with a minimum wall thickness of 0.060 inches

2.04 CHILLED WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), hard drawn; using one of the following joint types:

2.05 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.

C. Hangers for Cold Pipe Sizes 2 Inches and Greater: Carbon steel, adjustable, clevis.

D. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

E. Hangers for Hot Pipe Sizes 6 Inches and Greater: Adjustable steel yoke, cast iron roll, double hanger.

F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

G. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.

H. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

I. Wall Support for Pipe Sizes 4 Inches and Greater: Welded steel bracket and wrought steel clamp.

J. Wall Support for Hot Pipe Sizes 6 Inches and Greater: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

K. Vertical Support: Steel riser clamp.

L. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

M. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

N. Floor Support for Hot Pipe Sizes 6 Inches and Greater: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

O. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

P. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

Q. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

R. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
   1. Bases: High-density polypropylene.
   2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   3. Steel Components: Stainless steel or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.

4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion-resistant material.
5. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.

2.06 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe of 2 Inches and Less:
   1. Ferrous Piping: 150 psi brass or malleable iron, threaded.
   2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe 2 Inches and Greater:
   1. Ferrous Piping: 150 psig forged steel, slip-on.
   2. Copper Piping: Bronze.
   3. Gaskets: 1/16 inch thick, preformed neoprene.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
   1. Dimensions and Testing: In accordance with AWWA C606.
   2. Mechanical Couplings: Comply with ASTM F1476.
   3. Housing Material: Ductile iron, galvanized complying with ASTM A536.
   4. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
   5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
   6. When pipe is field grooved, provide coupling manufacturer's grooving tools.

D. Dielectric Connections:
   1. Waterways:
      a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
      b. Dry insulation barrier able to withstand 600-volt breakdown test.
      c. Construct of galvanized steel with threaded end connections to match connecting piping.
      d. Suitable for the required operating pressures and temperatures.
   2. Flanges:
      a. Dielectric flanges with same pressure ratings as standard flanges.
      b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
      c. Dry insulation barrier able to withstand 600-volt breakdown test.
      d. Construct of galvanized steel with threaded end connections to match connecting piping.
      e. Suitable for the required operating pressures and temperatures.

2.07 GATE VALVES

A. Manufacturers:
   1. Tyco Flow Control: www.tycoflowcontrol.com.

2.08 BUTTERFLY VALVES

A. Manufacturers:
   1. Tyco Flow Control: www.tycoflowcontrol.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck.
C. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM encapsulation, or Buna-N encapsulation.
D. Stem: Stainless steel with stem offset from the centerline to provide full 360-degree circumferential setting.
E. Operator: 10 position lever handle.

2.09 SWING CHECK VALVES

A. Manufacturers:
   1. Tyco Flow Control: www.tycoflowcontrol.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.
B. Up To and Including 2 Inches:
   1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.
C. Over 2 Inches:
   1. Iron body, bronze trim, stainless steel or bronze swing disc, renewable disc and seat, flanged ends.

2.10 SPRING LOADED CHECK VALVES

A. Manufacturers:
   1. Tyco Flow Control: www.tycoflowcontrol.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.
B. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer, or threaded lug ends.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
C. Remove scale and dirt on inside and outside before assembly.
D. Prepare piping connections to equipment using jointing system specified.
E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
F. After completion, fill, clean, and treat systems. See Section 23 2500 for additional requirements.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install heating water, condenser water, and engine exhaust piping to ASME B31.9 requirements. Install chilled water piping to ASME B31.5 requirements.
C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
D. Install piping to conserve building space and to avoid interference with use of space.

E. Group piping whenever practical at common elevations.

F. Sleeve pipe passing through partitions, walls, and floors.

G. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

H. Slope piping and arrange to drain at low points.

I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 23 0516.
   1. Flexible couplings may be used in header piping to accommodate thermal growth, thermal contraction in lieu of expansion loops.
   2. Use flexible couplings in expansion loops.

J. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

K. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
   2. Prime coat exposed steel hangers and supports. See Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

L. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 23 0719.

M. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 3100 .

N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.

O. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.

P. Install valves with stems upright or horizontal, not inverted.

3.03 **BELOW GRADE PIPING INSTALLATION**

A. Provide the services of a certified manufacturer’s representative to instruct the contractor on the installation procedures of the pipe and to be present on site to assist during critical stages of installation and testing. The representative must be a direct employee of the manufacturer who is certified to provide Field Technical Assistance (FTA).

B. All straight sections shall be factory pre-insulated and jacketed. The piping system manufacturer, to determine the stresses and displacement of the service pipe, shall analyze the piping system layout. The piping system design and manufacturer shall be in strict conformance with ANSI B31.1, latest edition. Installation of the piping system shall be in accordance with the manufacturer’s instructions. Provide all necessary fittings, anchors expansion, piping, loops and accessories. Provide complete piping layout drawings and shop drawings, submittals of these piping systems prior to installation for approval.

C. Pipes shall be set in a minimum of 6” sand.

D. Underground Pipe Thrust Blocks: A concrete block shall be cast over all changes in direction and shall be large enough for firm anchorage into undisturbed trench sidewalls and/or bottom. The concrete block shall be at least 30 inches in length and extend a minimum of 9 inches beyond the top and bottom of the anchor plate.

E. One (1) day of FTA shall be provided for each 500 feet of pipe installed with a minimum of ten (10) days required. The number of days shall be spread out over the duration of the installation, not consecutive days. The FTA representative shall observe critical periods of the installation including the following:
   1. Inspection of the first load of material during unloading:
   2. Initial inspection of the trench and pipe placement.
   3. Initial field joint closure instruction and inspection.
   4. Any field modifications to the piping system.
   5. Initial backfill of piping in trench.

F. FTA representative shall prepare and submit a signed report consisting of the installation log indicating actual installed conditions and test certification. The report shall include certification that the installed (to date) is in conformance with the manufacturer's recommendations.

G. All underground piping systems must be inspected by the Owner's Representative prior to backfilling.

3.04 SCHEDULES

A. Hanger Spacing for Copper Tubing.
   1. 1/2 Inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
   2. 1 Inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
   3. 1-1/2 Inches and 2 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.

B. Hanger Spacing for Steel Piping.
   1. 1-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
   2. 2 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
   3. 2-1/2 Inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
   4. 3 Inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
   5. 4 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
   6. 6 Inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
   7. 8 Inches: Maximum span, 19 feet; minimum rod size, 5/8 inch.
   8. 10 Inches: Maximum span, 20 feet; minimum rod size, 3/4 inch.
   9. 12 Inches: Maximum span, 23 feet; minimum rod size, 7/8 inch.

END OF SECTION

SECTION 23 2114
HYDRONIC SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Expansion tanks.
B. Automatic Water Fill Assembly
C. Air vents.
D. Air separators.
E. Strainers.
F. Combination pump discharge valves.
G. Pressure-temperature test plugs.
H. Balancing valves.
I. Automatic flow control valves.
J. Flow meters.
K. Relief valves.
L. Pressure reducing valves.

1.02 REFERENCE STANDARDS

A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.

1.03 SUBMITTALS

A. See Division 01 for submittal procedures.
B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
D. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 EXPANSION TANKS

A. Manufacturers:
1. American Wheatley, a company of Global Flow Products, LLC; _____: www.wheatleyhvac.com/#sle.
2. Amtrol Inc; _____: www.amtrol.com/#sle.
3. Bell & Gossett, a brand of Xylem, Inc; _____: www.bellgossett.com/#sle.
4. Taco, Inc; _____: www.taco-hvac.com/#sle.
5. Armstrong.

B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, adjustable flexible EPDM bladder seal factory precharged to 12 psi, and steel support stand.

2.02 AUTOMATIC WATER FILL ASSEMBLY

A. Pre-adjustable automatic filling valve with testable reduced pressure zone backflow preventer.
1. Brass body.
2. Max inlet pressure: 140 psi
3. Max working temp: 140˚F
4. Setting pressure range: 6 - 90 psi
5. Preset outlet pressure: 15 psi
6. Pressure gauge scale: 0 - 100 psi / 0 - 7 bar
7. Compliance with ASSE 1013
8. Basis of Design: Caleffi Model 574 AutoFill Combo

B. Make-Up Water Treatment Filter
1. Stainless Steel Filter Housing
2. Flow rate: 10 gpm
3. Cartridge: Nominal 20 micron rating
4. Basis of Design: Pentek ST Series housing (part number 156017-02) with Pentek S1 Series cartridge (part number) 155001-43.

2.03 AIR VENTS

A. Manual Air Vent: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

B. Float Air Vent:
1. Brass or stainless steel body;
2. Stainless steel, copper, polypropylene, or solid non-metallic float;
3. Stainless steel valve and valve seat;
4. suitable for system operating temperature and pressure;
5. With isolating valve.

C. Maximum Fluid Pressure: 150 psi.

D. Maximum Fluid Temperature: 250 degrees F.

2.04 AIR SEPARATORS

A. Coalescing Air/Dirt Separators:
   1. Manufacturers:
      a. Armstrong International, Inc; _____: www.armstronginternational.com/#sle.
      b. Bell & Gossett, a brand of Xylem, Inc; _____: www.bellgossett.com/#sle.
      c. Spirotherm, Inc; _____: www.spirotherm.com/#sle.
   2. Tank: Fabricated steel tank; tested and stamped in accordance with ASME BPVC-VIII-1 for maximum fluid service subject to application requirements and manufacturer's standard maximum operating conditions.
   3. Coalescing Medium: Provide structured copper or stainless steel medium filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100 percent free air, 100 percent entrained air, and 99.6 percent dissolved air at the installed location.
   4. Air Vent: Integral float actuated air vent at top fitting of tank rated at 150 psi, threaded to top of separator.
   5. End Connections: Class 150 flanged for 2-1/2 inch and larger otherwise threaded.
   6. Blowdown Connection: Threaded.
   7. Size: Match system flow capacity.
   8. Maximum Fluid Service Pressure: 150 psi.
   9. Maximum Fluid Service Temperature: 250 degrees F.

2.05 STRAINERS

A. Size 2 inch and Under:
   1. Provide threaded, grooved, or sweat brass or iron body for up to 175 psi working pressure, Y-pattern strainer with 1/32 inch stainless steel perforated screen.

B. Size 2-1/2 inch to 4 inch:
   1. Provide flanged or grooved iron body for up to 175 psi working pressure, up to 250 degrees F working temperature, Y-pattern strainer with 1/16 inch or 3/64 inch stainless steel perforated screen.

2.06 PRESSURE-TEMPERATURE TEST PLUGS

A. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.

B. Application: Use extended length plugs to clear insulated piping.

2.07 BALANCING VALVES

A. Size 2 inch and Smaller:
   1. Provide ball or globe style with flow balancing, shut-off capabilities, memory stops, and minimum of two metering ports and female sweat, NPT threaded, press, or soldered connections.
   2. Metal construction materials consist of bronze or brass.
   3. Non-metal construction materials consist of Teflon or EPDM.

B. Size 2-1/2 inch and Larger:
   1. Provide ball, globe, or butterfly style with flow balancing, shut-off capabilities, memory stops, and minimum of two metering ports and flanged, grooved, or weld-end connections.

2. Valve body construction materials consist of cast iron or carbon steel.
3. Internal components construction materials consist of brass, bronze, Teflon, or EPDM.

2.08 AUTOMATIC FLOW CONTROL VALVES

A. Construction:
   1. Brass, bronze, or iron body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain.
   2. Built-in lug-type outlet butterfly valve with 2-position handle.

B. Calibration: Control flow within 10 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, minimum pressure 2 psi.

C. Control Mechanism: Provide stainless steel or nickel-plated, brass piston or regulator cup, operating against stainless steel helical or wave formed spring or elastomeric diaphragm and polyphenylsulfone orifice plate.

2.09 FLOW METERS

A. Orifice principle by-pass circuit with direct reading gauge, soldered or flanged piping connections for 125 psi working pressure, with shut off valves, and drain and vent connections.

B. Direct reading with insertion tube, threaded coupling, for 150 psi working pressure, maximum 240 degrees F, 5 percent accuracy.

2.10 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.11 PRESSURE REDUCING VALVES

A. Manufacturers:
   1. Apollo Valves; _____: www.apollovalves.com/#sle.
   2. Armstrong International, Inc; _____: www.armstronginternational.com/#sle.
   3. Caleffi.

B. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve. Refer to Section 23 2113.

C. Materials of Construction:
   1. Valve Body: Constructed of bronze, cast iron, brass, or iron.
   2. Internal Components: Construct of stainless steel or brass and engineered plastics or composition material.

D. Connections:
   1. NPT threaded: 1/2 inch or 3/4inch.
   2. Soldered: 1/2 inch.

E. Provide integral check valve and strainer.

F. Maximum Inlet Pressure: 400 psi.

G. Maximum Fluid Temperature: 180 degrees F.

H. Adjustable Pressure Range: From 10 to 45 psi, set to 25 psi.

2.12 PRESSURE INDEPENDENT VALVES

A. Manufacturers:

1. Griswold Controls LLC; PIC-V: www.griswoldcontrols.com/#sle.
2. Belimo.
3. Danfoss

B. Size 2 inch and Smaller:
   1. Provide ball, globe, or _____ style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded, soldered, or _____ connections.
   2. Metal construction materials consist of bronze, brass, or _____.
   3. Non-metal construction materials consist of Teflon, EPDM, engineered resin, or _____.

C. Size 2-1/2 inch and Larger:
   1. Provide ball, globe, butterfly, or _____ style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged, grooved, weld end, or _____ connections.
   2. Valve body construction materials consist of cast iron, carbon steel, ductile iron, or _____.
   3. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, EPDM, NORYL, engineered resin, or _____.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required to release trapped air.

D. Install drains at low points in piping system mains for system drain down and at low points in branch piping to remove trapped water. Drains shall consist of a tee fitting, NPS 3/4" ball valve, and short NPS 3/4" threaded nipple with cap.

E. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

F. Provide air separator on suction side of system circulation pump and connect to expansion tank.

G. Provide valved drain and hose connection on strainer blowdown connection.

H. Provide pump suction fitting on suction side of base-mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.

I. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps where indicated.

J. Support pump fittings with floor-mounted pipe and flange supports.

K. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.

L. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

M. Pipe relief valve outlet to nearest floor drain.

N. Where one line vents several relief valves, make cross-sectional area equal to sum of individual vent areas.

END OF SECTION

SECTION 23 2123
HYDRONIC PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Circulators.
B. In-line pumps.
C. End-suction pumps.

1.02 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
B. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Division 01 for submittal procedures.
B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.
D. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture, assembly, and field performance of pumps, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Armstrong Fluid Technology, Inc: www.armstrongfluidtechnology.com/#sle.
B. Bell & Gossett, a Xylem Inc. brand: www.bellgossett.com/#sle.
C. Wilo.
D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 GENERAL

A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Electrical Requirements:
   1. Listed and classified by UL or testing agency acceptable to authority having jurisdiction as suitable for the purpose specified and indicated.
   2. Variable Frequency Drives (VFDs): Provide in accordance with Section 23 0934, except for integral-VFDs.
   3. Enclosures: Provide unspecified product(s) required to fit motor:

2.03 IN-LINE PUMPS

A. Split-Coupled, Single-Stage Pump: Vertical pump with radially- or horizontally-split casing; rated for discharge pressures up to 175 psi.

B. Casing: Cast iron with seal flush connection, threaded suction, and discharge ports with gauge port and drain plug.

C. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.

D. Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.

E. Seal: Mechanical seal, 225 degrees F maximum continuous duty temperature.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.

C. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.

D. Provide air cock and drain connection on horizontal pump casings.

E. Provide drains for bases and seals, piped to and discharging into floor drains.

F. Check, align, and certify alignment of base-mounted pumps prior to start-up.

G. Install close coupled and base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place.

H. Lubricate pumps before start-up.

I. Provide side-stream filtration system for closed loop systems. Install across pump with flow from pump discharge to pump suction from pump tappings.

J. Controls Human-Machine Interface (HMI): HVAC operator terminal; see Section 25 3500.

END OF SECTION

SECTION 23 2500
HVAC WATER TREATMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Materials.
   1. System cleaner.
   2. Closed system treatment (water).

B. By-pass (pot) feeder.

1.02 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.

D. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

E. Certificate: Submit certificate of compliance from Authority Having Jurisdiction indicating approval of chemicals and their proposed disposal.

F. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section,with minimum three years of experience and approved by manufacturer.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with applicable codes for addition of non-potable chemicals to building mechanical systems and to public sewage systems.

B. Comply with UL (DIR) requirements.

C. Perform work in accordance with local health department regulations.

2.02 MATERIALS

A. System Cleaner:
   1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodiumtripoly phosphate and sodium molybdate.
   2. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite or microbiocides such as quarternary ammonia compounds, tributyltin oxide, methylene bis (thiocyanate).

B. Closed System Treatment (Water):
   1. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
   2. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
   3. Conductivity enhancers; phosphates or phosphonates.

2.03 BY-PASS (POT) FEEDER

A. Two (2), five (5), or twelve (12) gal bypass pot feeder with quick opening cap for working pressure of 175 psi.
   1. 2 Gallon Feeder: up to 500 gallon piping system volume
   2. 5 Gallon Feeder: up to 5,000 gallon piping system volume
   3. 12 Gallon Feeder: more than 5,000 gallon piping system volume

PART 3 EXECUTION

3.01 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

B. Place terminal control valves in open position during cleaning.

C. Verify that electric power is available and of the correct characteristics.

3.02 CLEANING SEQUENCE

A. Concentration:
   1. As recommended by manufacturer.

B. Hot Water Heating Systems:
   1. Circulate for a minimum of 12 hours at design temperatures as recommended by chemical manufacturer, then drain system as qucikly as possible.
   2. Refill with clean water and repeat until system cleaner is removed.

C. Chilled Water Systems:
   1. Circulate for 48 hours, then drain systems as quickly as possible.
   2. Refill with clean water, circulate for 24 hours, then drain.
   3. Refill with clean water and repeat until system cleaner is removed.

D. Use neutralizer agents on recommendation of system cleaner supplier and approval of Architect.

E. Flush open systems with clean water for one hour minimum. Drain completely and refill.

F. Remove, clean, and replace strainer screens.

G. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.04 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

C. Provide 3/4 inch water coupon rack around circulating pumps with space for 4 test specimens.

3.05 CLOSEOUT ACTIVITIES

A. Training: Train Owner's personnel on operation and maintenance of chemical treatment system.
   1. Provide minimum of two hours of instruction for two people.
   2. Have operation and maintenance data prepared and available for review during training.
   3. Conduct training using actual equipment after treated system has been put into full operation.

3.06 MAINTENANCE

A. Perform maintenance work using competent and qualified personnel under the supervision of the equipment manufacturer or original installer.

B. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of Owner.

C. Provide service and maintenance of treatment systems for one year from Date of Substantial Completion.

D. Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.

E. Provide laboratory and technical assistance services during this maintenance period.

F. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

END OF SECTION

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SECTION 23 3100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ducts.

B. Flexible ducts.

1.02 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

D. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

F. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.

G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

I. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.

J. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

K. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. Product Data: Provide data for duct materials.

B. Shop Drawings: Indicate duct fitting types, gauges, sizes, welds, and configuration.

C. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate per appropriate seal class, following SMACNA (LEAK).

D. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.

1.05 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with SMACNA (DCS) guidelines unless stated otherwise.

B. Provide metal duct unless otherwise indicated.

C. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 23 3319.

D. Seismic Restraint: Fabricate in compliance with SMACNA (SRM) requirements; see Section 23 0548.

E. Duct Sealing and Leakage in accordance with Static Pressure Class:
   1. Low Pressure Service: Up to 2 in-wc:
      a. Seal: Class C, apply to seal off transverse joints.
      b. Leakage:
         1) Rectangular: Class 24 or 24 cfm/100 sq ft.
         2) Round: Class 12 or 12 cfm/100 sq ft.
   2. Low Pressure Service: From 2 in-wc to 3 in-wc:
      a. Seal: Class B, apply sealing of transverse joints and longitudinal seams.
      b. Leakage:
         1) Rectangular: Class 12 or 12 cfm/100 sq ft.
         2) Round: Class 6 or 6 cfm/100 sq ft.
   3. Medium and High Pressure Service: Above 3 in-wc:
      a. Seal: Class A, apply sealing of transverse joints, longitudinal seams, and duct wall penetrations.
      b. Leakage:
         1) Rectangular: Class 6 or 6 cfm/100 sq ft.
         2) Round: Class 3 or 3 cfm/100 sq ft.

F. Duct Fabrication Requirements:
   1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
   2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
   3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
   4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.

5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
6. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.02 METAL DUCTS

A. Material Requirements:
   1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

B. Rectangular Metal Duct:
   1. Rectangular Double Wall Insulated: Rectangular spiral lock seam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with the solid inner wall.

C. Round Spiral Duct:
   1. Round spiral lock seam duct with galvanized steel outer wall.

D. Connectors, Fittings, Sealants, and Miscellaneous:
   1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.
   2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
   3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
      a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
      b. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
      c. For Use with Flexible Ducts: UL labeled.
   4. Gasket Tape:
      a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.
   5. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
   6. Hanger Fasteners: Attach hangers to structure using appropriate fasteners as follows:
      a. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
      b. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
      c. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
      d. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
      e. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.

2.03 FLEXIBLE DUCTS

A. Acoustic Flexible Ducts: UL 181, Class 1, spunbond nylon, mechanically fastened and rolled using galvanized steel to form spiral helix.
   1. Inner Core: Spunbonded, nonwoven inner core.
   2. Pressure Rating: 6 in-wc positive and 5 in-wc negative.
   3. Maximum Velocity: 4000 fpm.
   4. Temperature Range: Minus 20 degrees F to 250 degrees F.

5. Manufacturers:
   a. Flexmaster USA, a brand of Masterduct, Inc; Type 6: www.flexmasterusa.com/#sle.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install products following the manufacturer's instructions.

C. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Flexible Ducts: Connect to metal ducts with mechanical fastener.

F. Exposed, Painted Ductwork: Prior to painting prepare ductwork surface by cleaning with water-based detergent to remove residual dirt and lubricating oils and wipe dry with lint free cloth.

G. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.

H. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.

I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

J. Use double nuts and lock washers on threaded rod supports for equipment subject to vibration.

K. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

L. Louver Fit-out:
   1. Provide blank-out panels sealing available area of wall-mounted exterior-faced louver when connected ductwork is smaller than actual louver free area, and duct outlet is smaller than the louver frame.
   2. Use the same duct material painted black on the exterior side, then seal louver frame and duct.

M. Fire Partitions: Provide firestopping sealing. See Section 07 8400.

N. Duct Accessories, Terminal Units, Inlets, and Outlets: Interconnect as indicated in Sections 23 3300, 23 3600, and 23 3700.

O. Duct Insulation: Provide duct insulation. See Section 23 0713.

P. Painting: Provide surface finish as indicated on drawings. See Sections 09 9113 and 09 9123.

Q. Ductwork Penetrations Below HVAC Units: Cut away roofing only where necessary to accommodate supply and reurn ducts. Seal all gaps around supply and return ducts with acoustic mastic.

3.02 **DUCT LEAKAGE TESTING**

A. Duct leakage testing shall follow requirements in California Mechanical Code, Chapter 6 and shall follow procedures in HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012, 2nd Edition.

B. The maximum permitted duct leakage shall be 5 cfm/100 sf duct surface area when tested at 3 in wg.

END OF SECTION

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SECTION 23 3300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air turning devices/extractors.
B. Backdraft dampers - metal.
C. Duct access doors.
D. Fire dampers.
E. Flexible duct connectors.
F. Manual volume control dampers.
G. Miscellaneous Products:
   1. Damper operators.
   2. Damper position switch.
   3. Duct opening closure film.
H. Remote actuated volume control dampers.

1.02 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
B. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association
C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
D. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
E. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
F. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. Product Data: Provide for shop-fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.
B. Manufacturer's Installation Instructions: Provide instructions for fire dampers.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
C. Comply with NFPA 90A and NFPA 90B.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

A. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.02 BACKDRAFT DAMPERS - METAL

A. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.03 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:
   1. Greenheck: https://www.greenheck.com/#sle
   2. Nailor Industries Inc
   3. Pottorff; Model FSD-140 (Basis of Design): www.pottorff.com/#sle.
   4. Ruskin Company: www.ruskin.com/#sle
   5. United Enertech: www.unitedenertech.com/#sle.

B. Ratings:
   1. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
   2. Fire Rating: 1-1/2 hours or 3-hours in accordance with UL-555.
   3. Smoke Rating: Class-2 (20 cfm/sf at 4 in wg) leakage in accordance with UL-555S
   4. Air Flow Rating: 2000 fpm
   5. Differential Pressure Rating: 4 in.wg.

C. Provide factory sleeve and collar for each damper.

D. Construction:
   1. Frame: Hat-shaped channel, roll formed galvanized steel with interlocking gusseted corners. Structurally equivalent to 13 gauge (2.3mm) U-channel type frame. Low profile head and sill on sizes less than 13 inches (330 mm) high.
   2. Blades: 6 inch maximum width x 16 gauge (152mm x 1.6mm), 3-V shape, roll formed galvanized steel.
   3. Blade Seals: Silicone rubber permanently bonded to blade.
   4. Jamb Seals: Stainless steel, flexible metal compression type.
   5. Axels: Minimum ½” (13mm) diameter plated steel hex-shaped, mechanically attached to blade.
   6. Bearings: Self-lubricating stainless steel, sleeve-type turning in extruded hole in frame.
   7. Linkage: Concealed in frame.
   8. Fire Closure Device: Resettable
   9. Release Temperature: 165 F
   10. Mounting: Vertical and/or Horizontal (1 ½ hour rated only)
   11. Sleeve: Standard 16 inches long x 20 gauge (406mm x 1.0mm), factory installed.

12. Actuator: Electric 120 V, 60 Hz, two-position, fail close, external mount

E. Position Indicator Switch Package: Shall connect directly to the blade axel for positive annunciation (interconnecting arms, wire-forms, or brackets shall not be accepted) and provide full open and full closed blade indication to a remote location.

F. Damper shall be controlled by area wide smoke and fire detection and alarm system. Coordinate with Section 283000 "Fire Alarm System"

2.04 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Access doors with sheet metal screw fasteners are not acceptable.

2.05 FIRE DAMPERS

A. Manufacturers:
1. Nailor Industries, Inc: www.nailor.com/#sle.
2. Pottorff: www.pottorff.com/#sle.
3. Ruskin Company: www.ruskin.com/#sle.
4. United Enertech: www.unitedenertech.com/#sle.

B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

C. Horizontal Dampers: Galvanized steel, 22-gauge, 0.0299-inch frame, stainless steel closure spring, and lightweight, heat-retardant, non-asbestos fabric blanket.

D. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1-inch pressure-class ducts up to 12 inches in height.

E. Multiple Blade Dampers: 16-gauge, 0.0598-inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

F. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.06 FLEXIBLE DUCT CONNECTORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.
1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz/sq yd.
a. Net Fabric Width: Approximately 2 inches wide.
2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.

C. Maximum Installed Length: 14 inch.

2.07 **MANUAL VOLUME CONTROL DAMPERS**

A. Manufacturers:
1. Nailor Industries, Inc: www.nailor.com/#sle.
2. Ruskin Company: www.ruskin.com/#sle.
3. United Enertech: www.unitedenertech.com/#sle.

B. Application: Provide Manual Volume Control Dampers for any balancing damper located in an accessible location.

C. Fabricate in accordance with SMACNA (DCS) and as indicated.

D. Single Blade Dampers:
   1. Fabricate for duct sizes up to 6 by 30 inch.
   2. Blade: 24 gauge, 0.0239 inch, minimum.

E. Multi-Blade Damper: Fabricate consisting of opposed blades with maximum blade sizes 8 by 72 inches. Assemble center- and edge-crimped blades in prime-coated or galvanized-channel frame with suitable hardware.
   1. Blade: 18 gauge, 0.0478 inch, minimum.

F. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

G. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
   3. Where rod lengths exceed 30 inches provide regulator at both ends.

2.08 **REMOTE ACTUATED VOLUME CONTROL DAMPERS**

A. Application: Provide battery powered, low-voltage Remote Actuated Volume Control Dampers for any balancing damper located in hard ceiling or inaccessible locations.

B. Manufacturers:
   1. Young's Regulator
   2. Metropolitan Air Technology
   3. Ruskin

C. Description: Balancing Damper actuated by a low votage (9V or 12V) DC motor for use above hard ceilings and in other inaccessible locations. Remote controller provides power, control and damper position feedback via a cable of up to 500 feet.

D. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

E. Shell: Galvanized steel, 24 gage minimum.

F. Blade: Galvanized steel, 20 gage minimum.

G. Shaft: 1/2" Plated Steel

H. Bushing: Oil Impregnated Bronze

I. Controller: Hand held, battery powered controller, with position indicator.

J. Termination: Concealed and located as indicated on Drawings. If termination is not indicated on Drawings, locate termination in concealed, accessible ceiling areas, or if not feasible, locate termination recessed in hard ceiling with escuteon plate to match ceiling color

2.09 MISCELLANEOUS PRODUCTS

A. Damper Operators: Provide electric operators; see Section 25 3513.

B. Damper position switch; see Section 25 3516.

C. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
   1. Thickness: 2 mils.
   2. High tack water based adhesive.
   3. UV stable light blue color.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 23 3100 for duct construction and pressure class.

B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 by 8 inch size access door for hand and shoulder access, or as indicated on drawings. Provide minimum 4 by 4 inch size access door for balancing dampers only. Review locations prior to fabrication.

C. Provide duct test holes where indicated and required for testing and balancing purposes.

D. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire-rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

E. Demonstrate re-setting of fire dampers to Owner's representative.

F. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

G. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

H. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum two duct widths from duct take-off.

I. Use splitter dampers only where indicated.

J. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

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SECTION 23 3423
HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof exhausters.

B. Inline centrifugal fans and blowers.

1.02 REFERENCE STANDARDS

A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.

B. AMCA 99 - Standards Handbook; 2016.

C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.

D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016, with Errata (2018).

E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.

F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

G. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate installation instructions.

D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Fan Belts: One set for each individual fan.

1.04 FIELD CONDITIONS

A. Request Owner permission to use permanent ventilator(s) for ventilation during construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Greenheck Fan Corporation: www.greenheck.com/#sle.

B. Loren Cook Company: www.lorencook.com/#sle.

C. PennBarry, Division of Air System Components: www.pennbarry.com/#sle.

D. Substitutions: Refer to Division 01.

2.02 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: Comply with AMCA 204.

B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.

C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.

D. Fabrication: Comply with AMCA 99.

E. UL Compliance: UL 705, listed, labeled, designed, manufactured, and tested.

F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.03 ROOF EXHAUSTERS

A. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.

B. Roof Curb: 8 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips.

C. Disconnect Switch: Factory wired, nonfusible, in housing for thermal overload protected motor and wall mounted multiple speed switch.

D. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.

E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm gets attained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

F. Performance Ratings: As indicated on drawings.

2.04 INLINE CENTRIFUGAL FANS AND BLOWERS

A. Centrifugal Fan Unit: V-belt or direct driven, with galvanized steel housing lined with acoustic insulation, resiliently-mounted motor, gravity backdraft damper in discharge.

B. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm gets reached with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.

C. Performance Ratings: As indicated on drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.

C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.

D. Hung Cabinet Fans:
   1. Install fans with resilient mountings and flexible electrical leads, see Section 23 0548.
   2. Install flexible connections between fan and ductwork; see Section 23 3300. Ensure metal bands of connectors are parallel with minimum 1 inch flex between ductwork and fan while running.

E. Provide sheaves required for final air balance.

F. Install backdraft dampers on inlet to roof and wall exhausters.

G. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

END OF SECTION

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SECTION 23 3600
AIR TERMINAL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single-duct terminal units.
B. Hot water heating coils.
C. Controls for terminal units.

1.02 REFERENCE STANDARDS

A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).
B. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017 (Reaffirmed 2023).
C. ASHRAE Std 130 - Laboratory Methods of Testing Air Terminal Units; 2016.
D. ASTM A492 - Standard Specification for Stainless Steel Rope Wire; 1995 (Reapproved 2019).
E. ASTM A603 - Standard Specification for Metallic-Coated Steel Structural Wire Rope; 2019.
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
H. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.
I. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Division 01 for submittal procedures.
B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate airflow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
C. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.
D. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
E. Project Record Documents: Record actual locations of units and locations of access doors required for access of valving.
F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements for additional provisions.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 SINGLE-DUCT, VARIABLE-VOLUME AND CONSTANT-VOLUME UNITS

A. Manufacturers:
   1. Krueger-HVAC; Model LMHS: www.krueger-hvac.com/#sle.
   2. Price Industries, Inc: www.priceindustries.com/#sle.
   3. Titus HVAC: www.titus-hvac.com/#sle.
   4. Trane, a brand of Ingersoll Rand: www.trane.com/#sle.

B. Acoustic Performance Requirements:
   1. Sound ratings of air distribution assemblies: Not to exceed 30 NC at a 0.75 in wg static pressure drop across the unit, and the downstream static pressure of 0.50 in wg.

C. General:
   1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
   2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.

D. Unit Casing:
   1. Minimum 22 gauge, 0.0299 inch galvanized steel.
   2. Air Inlet Collar: Provide round, suitable for standard duct sizes.
   3. Unit Discharge: Rectangular, with slip-and-drive connections.
   4. Acceptable Liners:
      a. 1 inch thick polyurethane foam adhesive complying with UL 181 erosion requirements in accordance with ASHRAE Std 62.1, and having a maximum smoke developed index of 50 for both insulation and adhesive, when tested in accordance with ASTM E84.
      b. Liner shall have a density of 1.5 pound / cubic foot and an R-value of 4.0.
      c. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.

E. Damper Assembly:
   1. Heavy-gauge, galvanized steel, or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
   2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
   3. Incorporate low leak damper blades for tight airflow shutoff.
      a. Air Leakage Past Closed Damper: Maximum two percent of unit maximum airflow at 3 in-wc inlet static pressure, tested in accordance with ASHRAE Std 130.

F. Electrical Requirements:
   1. Single-point power connection.
   2. Equipment wiring to comply with requirements of NFPA 70.

2.02 HEATING COILS

A. Hot Water Heating Coil:
   1. Coil: Multi-Row, seamless copper tubes mechanically expanded into aluminum or aluminum-plated fins arranged in a counter-flow manner with self-venting drainable circuits.
   2. Casing: Slip-in type made of 22 gauge zinc-coated (galvanized) steel.
   3. Maximum Working Pressure: 300 psig.
   4. Performance: AHRI 410 certified and listed with logo shown on product sheet.

2.03 CONTROLS FOR TERMINAL UNITS

A. Remote Operation:
   1. Occupied and unoccupied operating modes.
   2. Remote reset of temperature of airflow setpoints.
   3. Monitoring and adjusting with portable terminal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.
C. Provide ceiling access doors or locate units above easily removable ceiling components.
D. Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See Section 23 0548.
E. Do not support from ductwork.
F. Provide seismic restraints for any terminal air unit with weight in excess of 25 lbs.
G. Connect to ductwork in accordance with Section 23 3100.
H. Provide minimum of either 24” or 3 times inlet duct diameter of straight supply air duct at inlet connection to terminal air unit.
I. Provide either attenuator section as idciated on drawings or provide minimum of 4 ft of 1 inch thick lined ductwork downstream of terminal air units.
J. Verify that electric power is available and of the correct characteristics.

3.02 ADJUSTING

A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to zero percent full flow. Set units with heating coils for minimum 50 percent full flow.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.
B. Provide manufacturer's field representative to test, inspect, instruct, and observe field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.

1. Operational Test:
   a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   b. Test and adjust controls and safeties.
   c. Replace damaged and malfunctioning controls and other equipment.
   d. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 23 3700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Diffusers:

B. Rectangular ceiling diffusers.

C. Round ceiling diffusers.

D. Slot ceiling diffusers.

E. Registers/grilles:
   1. Floor-mounted, linear supply register/grilles.
   2. Ceiling-mounted, exhaust and return register/grilles.
   3. Ceiling-mounted, linear exhaust and return register/grilles.
   4. Ceiling-mounted, supply register/grilles.
   5. Wall-mounted, supply register/grilles.
   6. Wall-mounted, exhaust and return register/grilles.
   7. Wall-mounted, linear register/grilles.

F. Door grilles.

G. Roof hoods.

H. Goosenecks.

I. Gravity ventilators.

1.02 REFERENCE STANDARDS

A. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021, with Editorial Revision (2022).

B. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2022.

C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.03 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Project Record Documents: Record actual locations of air outlets and inlets.

PART 2 PRODUCTS

2.01 **GENERAL REQUIREMENTS**

A. Refer to Drawings for air outlet and inlet requirements.

2.02 MANUFACTURERS

A. Krueger-HVAC: www.krueger-hvac.com/#sle.

B. Price Industries: www.price-hvac.com/#sle.

C. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com/#sle.

2.03 ROUND CEILING DIFFUSERS

A. Type: Round, stamped or spun, plaque-face diffuser to discharge air in 360 degree pattern. Diffuser collar shall project not more than 1 inch above ceiling. In plaster ceilings, provide plaster ring and ceiling plaque.

B. Fabrication: Steel with baked enamel finish.

C. Color: As selected by Architect from manufacturer's standard range.

2.04 RECTANGULAR CEILING DIFFUSERS

A. Type: Provide square, plaque diffuser to discharge air in 360 degree, one way, two way, three way, and four way pattern.

B. Connections: Round.

C. Frame: Provide surface mount, snap-in, inverted T-bar, and spline type. In plaster ceilings, provide plaster frame and ceiling frame.

D. Fabrication: Steel with baked enamel finish.

E. Color: As selected by Architect from manufacturer's standard range.

2.05 CEILING SLOT DIFFUSERS

A. Type: Continuous 1 inch wide slot, 1 slot wide, with adjustable vanes for left, right, or vertical discharge .

B. Fabrication: Aluminum extrusions with factory baked enamel finish.

C. Color: To be selected by Architect from manufacturer's standard range.

D. Frame: 1 inch margin with concealed mounting and gasket, open end construction.

E. Plenum: Integral, galvanized steel, insulated.

2.06 CEILING SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Construction: Made of aluminum extrusions with factory enamel finish.

D. Color: As selected by Architect from manufacturer's standard range.

E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.07 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical face.

B. Frame: 1-1/4 inch margin with countersunk screw mounting.

C. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.

D. Color: To be selected by Architect from manufacturer's standard range.

E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.08 CEILING LINEAR EXHAUST AND RETURN GRILLES

A. Type: Streamlined blades with 90 degree one-way deflection, 1/8 by 3/4 inch on 1/4 inch centers.

B. Frame: 1-1/4 inch margin, extra heavy for floor mounting, with countersunk screw mounting.

C. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.

D. Color: To be selected by Architect from manufacturer's standard range.

2.09 WALL SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical face, single deflection.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.

D. Color: To be selected by Architect from manufacturer's standard range.

E. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

2.10 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.

B. Frame: 1-1/4 inch margin with countersunk screw mounting.

C. Fabrication: Steel frames and blades, with factory baked enamel finish.

D. Color: To be selected by Architect from manufacturer's standard range.

2.11 LINEAR WALL REGISTERS/GRILLES

A. Type: Streamlined blades with 0 degree deflection, 1/8 by 3/4 inch on 1/4 inch centers.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Aluminum extrusions, with factory baked enamel finish.

D. Color: To be selected by Architect from manufacturer's standard range.

2.12 LINEAR FLOOR SUPPLY REGISTERS/GRILLES

A. Type: Streamlined blades with 0 degree deflection, 1/8 by 3/4 inch on 1/4 inch centers, assembled on expanded tubes mandrel construction.

B. Frame: 1 inch margin frame with countersunk screw mounting, and mounting frame.

C. Fabrication: Aluminum extrusions with factory baked enamel finish.

D. Color: To be selected by Architect from manufacturer's standard range.

E. Damper: Integral hinged single blade damper with removable key operator, operable from face.

2.13 DOOR GRILLES

A. Type: V-shaped louvers of 20 gauge, 0.0359 inch thick steel, 1 inch deep on 1/2 inch centers.

B. Frame: 20 gauge, 0.0359 inch steel with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.

2.14 ROOF HOODS

A. Fabricate air inlet or exhaust hoods in accordance with SMACNA (DCS).

B. Fabricate of galvanized steel, minimum 16 gauge, 0.0598 inch base and 20 gauge, 0.0359 inch hood, or aluminum, minimum 16 gauge, 0.0598 inch base and 18 gauge, 0.0598 inch hood; suitably reinforced; with removable hood; birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake, and factory prime coat finish.

C. Fabricate louver penthouses with mitered corners and reinforce with structural angles.

D. Mount unit on minimum 12 inch high curb base with insulation between duct and curb.

E. Make hood outlet area minimum of twice throat area.

2.15 GOOSENECKS

A. Fabricate in accordance with of minimum 18 gauge, 0.0598 inch galvanized steel.

B. Mount on minimum 12 inch high curb base where size exceeds 9 by 9 inch.

2.16 GRAVITY VENTILATORS

A. Hood Intake and Relief Gravity Ventilator:
   1. Manufacturers:
      a. Greenheck Fan Corporation: www.greenheck.com/#sle.
      b. Loren Cook Company: www.lorencook.com/#sle.
   2. General:
      a. Low silhouette for intake applications with natural gravity or negative pressure system(s).
      b. Performance ratings and factory testing in accordance with AMCA 511 and AMCA 550.
      c. Suitable for non-ducted applications.
      d. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.

3. Hood and Base:
   a. Material: Aluminum.
   b. Curb Cap: Pre-punched mounting holes for installation.
4. Birdscreen:
   a. Fabricate in accordance with ASTM B221 (ASTM B221M).
   b. Construction: 1/2 inch Galvanized mesh.
   c. Horizontally mounted across hood intake area.
5. Hood Support: Galvanized steel construction and fastened so hood can be removed completely from base or hinged open.
6. Options/Accessories:
   a. Roof Curbs:
      1) Flat Roofs:
      2) Pitched Roofs: Welded, straight side curb with flashing flange and wood nailer.
      3) Material: Aluminum.
      4) Insulation Thickness: 1 inch.
   b. Dampers:
      1) Type: Gravity.
      2) Factory designed to prevents outside air from entering back into building when fan is off.
      3) Balanced for minimal resistance to flow.
   c. Insect Screen:
      1) Fabricate in accordance with ASTM B221 (ASTM B221M).
      2) Construct of fine mesh aluminum.
      3) Fitted to top of throat to prevent entry of insects.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers and grilles and registers, despite whether dampers are specified as part of diffuser, or grille and register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION

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SECTION 23 5216
CONDENSING BOILERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured units.
B. Boiler construction.
C. Boiler trim.
D. Fuel burning system.
E. Factory installed controls.

1.02 REFERENCE STANDARDS

A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
C. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata (2023).
D. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2023.
E. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); Current Edition.
F. NFPA 54 - National Fuel Gas Code; 2021.
G. SCAQMD 1146.1 - Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters; 1990, with Amendment (2018).

1.03 SUBMITTALS

A. See Division for submittals procedures.
B. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.
C. Manufacturer's Installation Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.
D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.
E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.05 WARRANTY

A. See Division 01 for additional warranty requirements.

B. Provide a five year warranty to include coverage for heat exchanger.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Modular Condensing Hot Water Boiler for Indoor Applications:
   1. Lochinvar LLC; _____: www.lochinvar.com/#sle.
   2. RBI Boilers..

2.02 MANUFACTURED UNITS

A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.

B. Unit: Metal membrane wall, water or fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for indoor application.

2.03 BOILER CONSTRUCTION

A. Comply with the minimum requirements of ASME BPVC-IV and ANSI Z21.13 for construction of boilers.

B. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE Std 90.1 I-P.

C. Required Directory Listings:
   1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
   2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at www.nationalboard.org.

D. Heat Exchanger: Construct with materials that are impervious to corrosion where subject to contact with corrosive condensables.

E. Provide adequate tappings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.

F. Insulate casing with insulation material, protected and covered by heavy-gauge metal jacket.

G. Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic, powder coated, painted, or weather-proofed finish.

2.04 BOILER TRIM

A. ASME rated pressure relief valve.

B. Flow switch.

C. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.

D. Temperature and pressure gauge.

E. Pressure Switches:
   1. High gas pressure.
   2. Low gas pressure.
   3. Air pressure.

F. Manual reset high limit.

G. Boiler Pump (where required by boiler design):
   1. Primary pump, factory supplied and sized for field installation to ensure minimum, continuous circulation through boiler.
   2. Where pump is not provided by boiler manufacturer, provide pump in accordance with boiler manufacturer's recommendations.
   3. Pump time delay.

2.05 FUEL BURNING SYSTEM

A. Provide forced draft automatic burner or pulse combustion, integral to boiler, designed to burn natural gas, propane, and No. 2 fuel oil, and maintain fuel-air ratios automatically.
   1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.
   2. Forced Draft Design: Mixes combustion air and gas to achieve 90 percent combustion efficiency.
   3. Pulse Combustion Design: Self-aspirating, not requiring blower for combustion.
   4. Combustion Air Filter: Protects fuel burning system from debris.

B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.

C. Emission of Oxides of Nitrogen Requirements: Comply with SCAQMD 1146.1 for natural gas fired system, as applicable.

D. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe.

2.06 FACTORY INSTALLED CONTROLS

A. Option for internal or external (0-10) VDC control.

B. Temperature Controls:
   1. Automatic reset type to control fuel burning system on-off and firing rate to maintain temperature.
   2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.
   3. Low-fire start time delay relay.

C. Electronic PI setpoint/modulation control system.

D. Microprocessor-based, fuel/air mixing controls.

E. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
   1. External Point Mapping: Provide mapping table for each parameter included in the local visual interface with software-toggle flag to allow reduced mapping of available points.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.

C. Coordinate factory installed controls with Section 23 0913.

D. Coordinate provisions for water treatment in accordance with Section 23 2500.

E. Pipe relief valves to nearest floor drain.

F. Pipe cooled condensate produced by the combustion process from the boiler condensate connection and/or flue stack with suitable piping material to neutralizer prior to discharging into nearest floor drain.

G. Install primary boiler pump in accordance with Section 23 2123.

H. Provide piping connection and accessories in accordance with Section 23 2114.

I. Provide for connection to electrical service in accordance with Section 26 0583.

J. Connect vent combustion generated fumes to breeching, chimney or exhaust stack; see Section 23 5100.

K. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front-end interface; see Section 25 1500.

3.02 CLOSEOUT ACTIVITIES

A. See Division 01 for closeout submittals.

B. See Division 01 for additional Demonstration and Training requirements.

C. Demonstrate proper operation of equipment to Owner's designated representative.

D. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Conduct walking tour of project.
   3. Briefly describe function, operation, and maintenance of each component.

E. Training: Train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Manufacturer's training personnel.
   4. Location: At project site.

END OF SECTION

SECTION 23 7313
MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Casing construction.
B. Fan section.
C. Coil section.
D. Filter and air cleaner section.
E. Damper section.
F. Airflow measurement.
G. Air cleaning systems.
H. Access section.
I. Roof mounting curb.

1.02 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).
B. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).
C. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
D. AMCA 99 - Standards Handbook; 2016.
E. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016, with Errata (2018).
F. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.
G. AMCA 611 - Certified Ratings Program - Product Rating Manual for Airflow Measurement Stations; 2015.
H. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Addendum (2022).
I. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
J. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
K. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.03 SUBMITTALS

1.04 QUALITY ASSURANCE

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.06 WARRANTY

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Daikin Applied; _____: www.daikinapplied.com/#sle.

B. Trane Inc; _____: www.trane.com/#sle.

2.02 CASING CONSTRUCTION

A. Full Perimeter Base Rail:
   1. Construct of galvanized steel.
   2. Provide base rail of sufficient height to raise unit for external trapping of condensate drain pans.

B. Casing:
   1. Construct of one piece, insulated, double wall panels.
   2. Provide mid-span, no through metal, internal thermal break.
   3. Construct outer panels of galvanized steel and inner panels of galvanized steel.
   4. Casing Air Pressure Performance Requirements:

C. Access Doors:
   1. Construction, thermal and air pressure performance same as casing.
   2. Provide surface mounted handles on hinged, swing doors.

D. Outside Air and Exhaust Air Weather Hood:
   1. Fabricate from same material as casing outer panel.
   2. Extend hood past perimeter of unit casing opening so as not to instruct airflow path.
   3. Paint hoods with same finish as external surface of outdoor units.
   4. Provide inlet hood for each fresh air damper with a sine wave moisture eliminator to prevent entrainment of water into the unit from outside air.
   5. Provide exhaust hoods for each exhaust air opening.
   6. Size each hood for 100 percent of nominal fresh air damper capacities.

E. Unit Flooring: Construct with sufficient strength to support expected people and equipment loads associated with maintenance activities.

F. Casing Leakage: Seal joints and provide airtight access doors so that air leakage does not exceed one percent of design flow at the specified casing pressure.

G. Insulation:
   1. Provide minimum thermal thickness of 12 R throughout.
   2. Completely fill panel cavities in each direction to prevent voids and settling.
   3. Comply with NFPA 90A.

H. Drain Pan Construction:
   1. Provide cooling coil and humidifier sections with an insulated, double wall, galvanized steel drain pan complying with ASHRAE Std 62.1 for indoor air quality and sufficiently sized to collect all condensate.
   2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions.
   3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.
   4. Provide threaded drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.

I. Finish:

2.03 FAN SECTION

A. Performance Ratings: Determined in accordance with AMCA 210 and labeled with AMCA Certified Rating Seal.

B. Bearings: Self-aligning, grease lubricated, with lubrication fittings extended to exterior of casing with plastic tube and grease fitting rigidly attached to casing.

C. External Motor Junction Box: Factory mount NEMA 4 external junction box and connect to extended motor leads from internally mounted motors.

D. Fan Accessories:

E. Flexible Duct Connections:
   1. For separating fan, coil, and adjacent sections.

F. Drives:
   1. Comply with AMCA 99.
   2. Bearings: Heavy duty pillow block type, ball bearings, with ABMA STD 9 L-10 life at 50,000 hours.
   3. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
   4. Belt Guard: Fabricate to SMACNA (DCS); 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.04 COIL SECTION

A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.

B. Drain Pans: 24 inch downstream of coil and down spouts for cooling coil banks more than one coil high.

C. Eliminators: Three break of galvanized steel, mounted over drain pan.

D. Air Coils:

1. Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.

E. Fabrication:
1. Tubes: 5/8 inch OD seamless copper expanded into fins, brazed joints.
2. Fins: Aluminum.
3. Casing: Die formed channel frame of galvanized steel.

2.05 FILTER AND AIR CLEANER SECTION

A. General: Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass.

B. Throwaway Filters:
1. Media: 2 inch fiberglass with rigid supporting mesh across the leaving face, capable of operating up to a maximum of 500 fpm without loss of efficiency and holding capacity.
2. Frame: Rigid.
3. Minimum Efficiency Reporting Value: MERV 13 when tested in accordance with ASHRAE Std 52.2.

2.06 DAMPER SECTION

A. Damper Blades:
1. Double-skin airfoil design with metal, compressible jamb seals and extruded-vinyl blade-edge seals on each blade.
2. Self-lubricating stainless steel or synthetic sleeve bearings.
3. Comply with ASHRAE Std 90.1 I-P for rated maximum leakage rate.
4. Provide leakage testing and pressure ratings in compliance with AMCA 500-D test methods.
5. Arrange in parallel or opposed-blade configuration.

B. Barometric Relief Dampers:
1. Frame: Roll formed galvanized steel.
2. Blades: Roll formed galvanized steel.
3. Blade Seals: Extruded vinyl, mechanically attached to the blade edge.
4. Material:

2.07 AIRFLOW MEASUREMENT

A. Flow Meter:
1. Provide airflow measurement system to directly measure fan airflow or measure differential pressure that can be used to calculate airflow without interfering with submitted airflow performance and noise levels.
2. Accuracy: Plus/minus 5 percent (device and transmitter) when operating within the stable operating region of the fan curve.

B. Air Flow Measurement Station:
1. Provide factory installed, airflow measurement station tested in accordance with AMCA 611 and bearing the AMCA Ratings Seal for Airflow Measurement Performance.
2. Station Location: Install in outdoor, return, and supply opening to measure airflow.
3. Damper Blades:
a. Galvanized steel or extruded aluminum construction.
b. Housed in galvanized steel or extruded aluminum frame and mechanically fastened to a rotating axle rod.

c. Comply with ASHRAE Std 90.1 I-P for rated maximum leakage rate.
4. Measurement Range: Minimum of 15 percent to 100 percent of unit nominal flow.
5. Operation: Provide low voltage signal corresponding to actual airflow for controlling and documenting airflow.
6. Accuracy: Plus/minus 5 percent.

2.08 ACCESS SECTION

A. Provide where indicated on drawings to allow for inspection, cleaning, and maintenance of field-installed components.

B. Construct access doors same as previously specified within this Section.

2.09 ROOF MOUNTING CURB

A. Roof Vibration Isolation Mounting Curb: 14 inches high galvanized steel, channel frame with gaskets and nailer strips.

B. Include roof curb accessories for each roof mounted unit.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Bolt sections together with gaskets.

C. Isolate fan section with flexible duct connections.

D. Install flexible duct connections between fan inlet and discharge ductwork and air handling unit sections. Ensure that metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

E. Provide fixed sheaves required for final air balance.

F. Make connections to coils with unions or flanges.

G. Hydronic Coils:
1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
3. Locate water supply at bottom of supply header and return water connection at top.
4. Provide manual air vents at high points complete with stop valve.
5. Ensure water coils are drainable and provide drain connection at low points.

H. Insulate Coil Headers Located Outside Air Flow as Specified for Piping: Refer to Section 22 0719.

I. Insulate Coil Headers Located Outside Air Flow as Specified for Piping: Refer to Section 23 0719.

J. Cooling Coils:
1. Pipe drain and overflow to nearest floor drain.

3.02 FIELD QUALITY CONTROL

A. Final Acceptance Requirements:

1. Use dial indicator gauges to demonstrate fan and motor are aligned.
2. Verify compliance with specifications using vibration analysis.
3. Maximum Vibration Levels:

B. Coordination of Other Tests and Inspections:
1. Provide access and _____ as required to accommodate timely performance.

3.03 SYSTEM STARTUP

A. Provide manufacturer's field representative to perform systems startup.

B. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.

C. Adjust for proper operation within manufacturer's published tolerances.

3.04 CLOSEOUT ACTIVITIES

A. Demonstrate proper operation of equipment to Owner's designated representative.

B. Demonstration: Demonstrate operation of system to Owner's personnel.
1. Use operation and maintenance data as reference during demonstration.
2. Briefly describe function, operation, and maintenance of each component.

C. Training: Train Owner's personnel on operation and maintenance of system.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Instructor: Manufacturer's training personnel.
4. Location: At project site.

END OF SECTION

SECTION 23 8101
TERMINAL HEAT TRANSFER UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fan-coil units.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide typical catalog of information including arrangements.
C. Shop Drawings:
D. Samples: Submit one sample of each radiation cabinet detailed.
E. Operation and Maintenance Data: Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
F. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.04 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide five year manufacturers warranty for fan-coil unit.

PART 3 EXECUTION

2.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Do not damage equipment or finishes.
C. Fan-Coil Units: Install as indicated. Coordinate to assure correct recess size for recessed units.
D. Hydronic Units: Provide with shut-off valve on supply and lockshield balancing valve on return piping. If not easily accessible, extend vent to exterior surface of cabinet for easy servicing. For cabinet unit heaters, fan coil units, and unit heaters, provide float operated automatic air vents with stop valve.
E. Units with Cooling Coils: Connect drain pan to condensate drain.

2.02 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

SECTION 23 8126
SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air cooled condensing units.

B. Indoor air handling (fan and coil) units for ductless systems.

C. Refrigerant piping.

1.02 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.

B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.

C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Errata (2023).

D. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.

G. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

D. Design Data: Indicate refrigerant pipe sizing.

E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Trane Inc: www.trane.com/#sle.

B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SYSTEM DESIGN

A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
   1. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with all refrigerant lines insulated.

B. Performance Requirements: See Drawings for additional requirements.

C. Electrical Characteristics: As Indicated on Drawings
   1. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 26 0583.

2.03 INDOOR AIR HANDLING UNITS FOR DUCTLESS SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
   1. Location: Ceiling or Wall Mount as Indicated.
   2. Cabinet: Galvanized steel.
   3. Fan: Line-flow fan direct driven by a single motor.

B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
   1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
   2. Manufacturer: System manufacturer.

2.04 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
   1. Comply with AHRI 210/240.
   2. Refrigerant: R-410A.
   3. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
   4. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL 207.

B. Compressor: Hermetic, two speed 1800 and 3600 rpm, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high-pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.

C. Accessories: Filter drier, high-pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
   1. Provide thermostatic expansion valves.

D. Operating Controls:
   1. Control by room thermostat to maintain room temperature setting.

E. Mounting Pad: Precast concrete parking bumpers, minimum 4 inches square; minimum of two located under cabinet feet.

2.05 **REFRIGERANT PIPING**

A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
   1. Fittings: ASME B16.22 wrought copper.
   2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy.

B. Pipe Supports and Anchors:
   1. Provide hangers and supports that comply with MSS SP-58.
      a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.

C. Refrigerant Piping Insualtion
   1. Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3; use molded tubular material wherever possible.
      a. Minimum Service Temperature: -40 degrees F.
      b. Maximum Service Temperature: 220 degrees F.
      c. Connection: Waterproof vapor barrier adhesive.
   2. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.06 ACCESSORY EQUIPMENT

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.

B. Install in accordance with NFPA 90A and NFPA 90B.

3.02 **PIPING INSTALLATION**

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and avoid interference with use of space.

D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Install refrigeration systems in accordance with ASHRAE Std 15.

G. Provide pessure testing for refrigerant piping per manufacturer's recommendations.

H. Pipe condensate drain from indoor unit to drain as indicated on Drawings.

I. Insulate all refrigerant system suction, liquid, hot-gas and discharge piping per insualtion schedule, code requirements, and equipment manufacturer recommendations.
   1. Flexible Elastomeric Cellular Insualtion, minimum 1 inch thick.

J. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.5.
   2. Support horizontal piping as scheduled.
   3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   4. Place hangers within 12 inches of each horizontal elbow.

3.03 **SCHEDULE**

A. Refer to Drawings.

END OF SECTION

SECTION 23 8241
WATER-TO-WATER HEAT PUMPS

PART 1 GENERAL

1.01 ABBREVIATIONS AND ACRONYMS

1.02 REFERENCE STANDARDS

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata (2023).

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

D. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

E. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.03 QUALITY ASSURANCE

1.04 DELIVERY, STORAGE, AND HANDLING

A. Verify upon delivery that equipment nameplate data, including electrical data, matches specified and ordered equipment. Verify that refrigerant charge has been retained during shipping.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store products under cover and elevated above grade.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL WATER-TO-WATER HEAT PUMP FABRICATION REQUIREMENTS

A. Energy Efficiency: ASHRAE Std 90.1 I-P EER and COP ratings, minimum.

B. Factory assemble internal components, safety-controls, accessories, filters, piping, cable, and wires, then charge with R-410A refrigerant prior to testing.

C. Include marked terminal strip to interface field mounted components and accessories.

D. Comply with UL 1995, place service and caution labels on unit in appropriate locations.

E. Cabinet Assembly:
   1. Construct of zinc-coated, heavy-gauge, galvanized steel with exposed edges rounded.

2. Finish: Factory apply electrostatic powder paint or baked enamel finish. Coordinate with Architect for specific color finish requirements of console units or other units installed within occupied spaces.
3. Provide access panels for inspection, cleaning, and servicing of refrigerant, controls, and heat exchangers.
4. Interior Insulation: Minimum 1/2 inch thick, dual density, bonded glass fiber.
5. Provide flame spread of less than 25, and smoke developed classification of less than 50 when tested in accordance with ASTM E84 and UL 723.
6. Sound and Noise Suppression:
   a. Mechanical Rooms: 18 gauge, 0.05 inch, minimum.
   b. Occupied Spaces: 16 gauge, 0.06 inch, minimum.
   c. Compressor enclosure lined with 1/2 inch thick insulation.
   d. Include vibration isolation between compressor and heat exchanger.
   e. Include length-wise unit base stiffeners.
   f. Foam gasket sealant around compressor and end panel perimeter.

F. Compressor Section:
1. Provide rubber mounting vibration isolation devices underneath mounting base.
2. Safety Interlocked Devices:
   a. Thermal overload protection.
   b. High pressure switch for protection against excessive discharge pressure.
   c. Low pressure safety for protection against loss of refrigerant charge.

G. Refrigerant Tubing Lines:
1. Tubing made of copper with service pressure ports on high and low pressure sides.
2. Free from contaminants and conditions such as drilling fragments, dirt, and oil.
3. Include drier, thermal expansion valve, and other related components.
4. Freeze Protection: 30 degrees F, thermistor based.

H. Water-to-Refrigerant Heat Exchanger:
1. Coaxial Type: Provide aluminum or copper tube and fins.
2. Brazed-Plate Type: Stainless steel, with bidirectional liquid line filter drier.
3. Insulate heat exchanger, water lines, and refrigerant suction lines for prevention of condensation at temperatures below 60 degrees F.
4. Provide rubber isolation to the heat exchanging device for enhanced sound attenuation.
5. Freeze Protection: 35 degrees F by thermistor sensing.
6. Minimum Working Pressure: 400 psi water side, 600 psi DX side.
7. End Connections: Copper NPT. Provide flow shut-off ball valves.
8. Accessories:
   a. Strainer, PT test plug, and flow regulator.
   b. Unit-controlled, return-water-side solenoid valve.

I. Electrical:
1. Provide factory-installed phase loss safety device for 3-phase units.
2. Configure unit for single point connection, include terminal for field-installed components.

J. Unit Controls: DDC.
1. Application Specific Controller; see Section 25 1400 unless factory-provided.
2. Tested to monitor and handle sequencing functions and other operational modes using supplied field mounted sensors and switches.
3. Controller Interface:
   a. Wall mounted device with monitoring display.
   b. Pushbutton or key operated for local control and configuration.

4. Coordination and Sequencing:
   a. Internal Devices: Include compressors, sensors, switches, valves, safeties, other components.
   b. Field-Installed Devices: Solenoid valves, EWT sensors, LWT sensors, load-pump contact, source pump contact, and other devices required for operation.
   c. Safeties: At minimum include anti-short-cycle compressor protection, condensate overflow, refrigerant high-pressure, refrigerant low-pressure, loss-of-charge, and refrigerant freeze protection.
5. Power:
   a. Factory-mounted and internally-wired into nonfused electrical disconnect.
   b. Configure safety-lockout circuits to be reset either using reset switch or power cycling.
   c. 24 VAC/VDC, include minimum of 10 VA spare load capacity for potential field use.

2.02 HYDRONIC, DUAL-STAGE, GROUND-COUPLED HEAT PUMP

A. Manufacturers:
   1. Trane.

B. Compressor: Hermetically sealed dual-stage scroll type, reversing cycle.

C. Water to-Refrigerant Heat Exchangers: Brazed-plate type.

D. End Connections: Copper NPT, back mounted. Provide flow shut-off ball valves.

E. Electrical: 208 to 230 VAC, 3-phase, 60 Hz with field-installed disconnect switch.
   1. Provide factory-installed phase guard safety device for 3-phase units.
   2. Configure unit for single point connection, include terminal for field-installed components.

F. Unit Controls: Factory-installed DDC with thermostat; see Section 25 1400.
   1. BAS, SCADA, or other Integrated Automation Link: BACnet MS/TP in accordance with ASHRAE Std 135.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that available power supply complies with equipment specifications.

B. Do not begin installation until buried ground loop has been properly prepared and is ready for connection. Notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Ensure electric utility connections are achieved in an orderly and expeditious manner.

C. Verify that equipment is undamaged, including refrigerant components and shipped loose items.

3.03 INSTALLATION

A. Install equipment in accordance with manufacturer's written installation instructions.

B. Unit Mounting:
   1. Ground or Surface-Mount: Include vibration-isolated support base; see Section 23 0548.

2. Above Finished Floor: Include hangers and supports; see Section 23 0529.
3. Do not obstruct maintenance access to equipment by any type of piping, electrical conduit, or any other utility.

C. Electrical: Provide equipment raceway, wiring, and cables; see Section 26 0583.

D. Start system and adjust controls and equipment for satisfactory operation.

E. Adjust water temperature control system and place in operation so that water quantities circulated are as required.

END OF SECTION

SECTION 26 0505
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

2.01 SECTION INCLUDES

A. Electrical demolition.

2.02 RELATED REQUIREMENTS

A. Section 01 7000 - Execution and Closeout Requirements: Additional requirements for alterations work.

B. Section 02 8400 - Polychlorinate Biphenyl (PCB) Remediation: Removal of equipment and materials containing substances regulated under the Federal Toxic Substances Control Act (TSCA), including but not limited to those containing PCBs and mercury.

2.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Sustainable Design Documentation: Submit certification of removal and appropriate disposal of abandoned cables containing lead stabilizers.

PART 2 PRODUCTS

3.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

4.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as indicated.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Owner before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

4.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
   2. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify Owner before partially or completely disabling system.
   2. Notify local fire service.
   3. Make notifications at least 24 hours in advance.
   4. Make temporary connections to maintain service in areas adjacent to work area.

F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify Owner at least 24 hours before partially or completely disabling system.
   2. Notify telephone utility company at least 24 hours before partially or completely disabling system.
   3. Make temporary connections to maintain service in areas adjacent to work area.

4.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
   1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
   2. PCB- and DEHP-containing lighting ballasts.
   3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

4.04 CLEANING AND REPAIR

A. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.

B. Clean and repair existing materials and equipment that remain or that are to be reused.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace broken electrical parts.

END OF SECTION

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SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.
B. Nonmetallic-sheathed cable.
C. Underground feeder and branch-circuit cable.
D. Service entrance cable.
E. Armored cable.
F. Metal-clad cable.
G. Power and control tray cable.
H. Manufactured wiring systems.
I. Wiring connectors.
J. Electrical tape.
K. Heat shrink tubing.
L. Oxide inhibiting compound.
M. Wire pulling lubricant.
N. Cable ties.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.
B. Section 26 0505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
C. Section 26 0513 - Medium-Voltage Cables: Cables and terminations for systems 601 V through 35,000 V.
D. Section 26 0519.13 - Undercarpet Electrical Power Cables: Flat conductor cable and fittings for undercarpet power distribution.
E. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
F. Section 26 0536 - Cable Trays for Electrical Systems: Additional installation requirements for cables installed in cable tray systems.
G. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
H. Section 26 2100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.
I. Section 26 3100 - Photovoltaic Collectors: Additional wiring requirements for photovoltaic systems.

J. Section 28 4600 - Fire Detection and Alarm: Fire alarm system conductors and cables.
K. Section 31 2316 - Excavation.
L. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
M. Section 31 2323 - Fill: Bedding and backfilling.

1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005 (Reapproved 2021).
F. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.
G. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2020.
H. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation); 2008a (Validated 2019).
I. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
J. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable; 2018.
K. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF); 2007.
L. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
M. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
O. UL 4 - Armored Cable; Current Edition, Including All Revisions.
P. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
Q. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
R. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
S. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
T. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
U. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.
V. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
W. UL 719 - Nonmetallic-Sheathed Cables; Current Edition, Including All Revisions.

X. UL 854 - Service-Entrance Cables; Current Edition, Including All Revisions.

Y. UL 1277 - Electrical Power and Control Tray Cables with Optional Optical-Fiber Members; Current Edition, Including All Revisions.

Z. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Sustainable Design Documentation: Submit manufacturer's product data on conductor and cable showing compliance with specified lead content requirements.

D. Manufactured Wiring System Shop Drawings: Provide plan views indicating proposed system layout with components identified; indicate branch circuit connections.

E. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.

F. Field Quality Control Test Reports.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Project Record Documents: Record actual installed circuiting arrangements. Record actual routingfor underground circuits.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Manufactured Wiring Systems Cable Assemblies: One of each configuration, 6 feet length.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
   1. Exceptions:
      a. Use manufactured wiring systems for branch circuits where concealed under raised floors.
         1) Exception: Provide single conductor building wire in raceway for circuit homerun from distribution box to panelboard.
      b. Use power and control tray cable or metal-clad cable for installation in cable tray.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Armored cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
         1) Maximum Length: 6 feet.
   2. In addition to other applicable restrictions, may not be used:
      a. Unless approved by Owner.
      b. Where not approved for use by the authority having jurisdiction.
      c. Where exposed to view.
      d. Where exposed to damage.
      e. For damp, wet, or corrosive locations.
      f. For isolated ground circuits.

F. Metal-clad cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.

1) Maximum Length: 6 feet.

2. In addition to other applicable restrictions, may not be used:
   a. Unless approved by Owner.
   b. Where not approved for use by the authority having jurisdiction.
   c. Where exposed to view.
   d. Where exposed to damage.
   e. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductor Material:
   1. Provide copper conductors except where aluminum conductors are specifically indicated. Substitution of aluminum conductors for copper is not permitted. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
   2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
   3. Tinned Copper Conductors: Comply with ASTM B33.
   4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.

H. Minimum Conductor Size:12 AWG.
   1. Branch Circuits: 12 AWG.
      a. Exceptions:
         1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
         2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
         3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
   2. Control Circuits: 14 AWG.

I. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

J. Conductor Color Coding:
   1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
   2. Color Coding Method: Integrally colored insulation.
      a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
   3. Color Code:
      a. 480Y/277 V, 3 Phase, 4 Wire System:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.
4) Neutral/Grounded: Gray.

b. 208Y/120 V, 3 Phase, 4 Wire System:
1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Neutral/Grounded: White.

c. Equipment Ground, All Systems: Green.
d. Isolated Ground, All Systems: Green with yellow stripe.
e. Travelers for 3-Way and 4-Way Switching: Pink.
f. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
1. Copper Building Wire:
a. Cerro Wire LLC: www.cerrowire.com.
b. Encore Wire Corporation: www.encorewire.com/#sle.
c. General Cable Technologies Corporation: www.generalcable.com/#sle.
d. Southwire Company: www.southwire.com/#sle.
e. Substitutions: See Section 01 6000 - Product Requirements.
2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):
a. Encore Wire Corporation: www.encorewire.com/#sle.
b. Southwire Company: www.southwire.com/#sle.
c. Stabiloy, a brand of General Cable Technologies Corporation: www.stabiloy.com/#sle.
d. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
1. Feeders and Branch Circuits:
a. Size 10 AWG and Smaller: Solid.
b. Size 8 AWG and Larger: Stranded.
2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
a. Size 4 AWG and Larger: Type XHHW-2.
b. Installed Underground: Type XHHW-2.
c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.
2. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type XHHW-2.

2.04 NONMETALLIC-SHEATHED CABLE

A. Manufacturers:
   1. Cerro Wire LLC: www.cerrowire.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type NM multiple-conductor cable listed and labeled as complying with UL 719, Type NM-B.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

2.05 UNDERGROUND FEEDER AND BRANCH-CIRCUIT CABLE

A. Manufacturers:
   1. Cerro Wire LLC: www.cerrowire.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type UF multiple-conductor cable listed and labeled as complying with UL 493, Type UF-B.

C. Provide equipment grounding conductor unless otherwise indicated.

D. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

E. Insulation Voltage Rating: 600 V.

F. Cable Jacket: Listed and labeled as sunlight resistant.

2.06 SERVICE ENTRANCE CABLE

A. Manufacturers:
   1. Copper Service Entrance Cable:
      a. Cerro Wire LLC: www.cerrowire.com/#sle.
      b. Encore Wire Corporation: www.encorewire.com/#sle.
      c. Southwire Company: www.southwire.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Aluminum Service Entrance Cable:
      a. Encore Wire Corporation: www.encorewire.com/#sle.
      b. General Cable Technologies Corporation
      c. Sttabiloy
      d. Southwire Company: www.southwire.com/#sle.

B. Service Entrance Cable for Underground Use: NFPA 70, Type USE single-conductor cable listed and labeled as complying with UL 854, Type USE-2, and with UL 44 Type RHH/RHW-2.

C. Conductor Stranding: Stranded.

D. Insulation Voltage Rating: 600 V.

2.07 ARMORED CABLE

A. Manufacturers:
   1. AFC Cable Systems Inc: www.afcweb.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type AC cable listed and labeled as complying with UL 4, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN.

F. Grounding: Combination of interlocking armor and integral bonding wire.
   1. Provide additional full-size integral insulated equipment grounding conductor for redundant grounding, suitable for general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities.

G. Armor: Steel, interlocked tape.

2.08 POWER AND CONTROL TRAY CABLE

A. Manufacturers:
   1. Encore Wire Corporation: www.encorewire.com/#sle.
   2. General Cable Technologies Corporation
   3. Okonite: www.okonite.com/#sle.
   4. Southwire Company: www.southwire.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type TC cable listed and labeled as complying with UL 1277.

C. Where exposed run cable is indicated between cable tray and utilization equipment in qualifying industrial establishments as determined by authorities having jurisdiction, provide tray cable marked as Type TC-ER in accordance with NFPA 70.

D. Conductor Stranding: Stranded.

E. Insulation Voltage Rating: 600 V.

F. Insulation: Type XHHW or XHHW-2.

G. Grounding: Full-size integral equipment grounding conductor.

H. Jacket: PVC or Chlorinated Polyethylene (CPE).

2.09 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 0526.

C. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
   2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
   3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
   4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
   5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
   6. Aluminum Conductors: Use compression connectors for all connections.
   7. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
   8. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. Ideal Industries, Inc: www.idealindustries.com/#sle.
      c. NSI Industries LLC: www.nsiindustries.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

H. Push-in Wire Connectors: Rated 600 V, 221 degrees F.
   1. Manufacturers:
      a. Ideal Industries, Inc: www.idealindustries.com/#sle.
      b. NSI Industries LLC: www.nsiindustries.com/#sle.
      c. Wago Corporation: www.wago.us/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

I. Mechanical Connectors: Provide bolted type or set-screw type.
   1. Manufacturers:
   2.
      a. Burndy LLC: www.burndy.com/#sle.
      b. Bundy, LLC
      c. Ilsco: www.ilsco.com/#sle.
      d. Thomas & Betts Corporation: www.tnb.com/#sle.
      e. Substitutions: See Section 01 6000 - Product Requirements.

J. Compression Connectors: Provide circumferential type or hex type crimp configuration.
   1. Manufacturers:

a. Burndy LLC: www.burndy.com/#sle.
b. Thomas & Betts Corporation: www.tnb.com/#sle.
c. Substitutions: See Section 01 6000 - Product Requirements.

K. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
1. Manufacturers:
a. Burndy LLC: www.burndy.com/#sle.
b. Ilsco: www.ilsco.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: See Section 01 6000 - Product Requirements.

2.10 WIRING ACCESSORIES

A. Electrical Tape:
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. Burndy LLC: www.burndy.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: See Section 01 6000 - Product Requirements.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
1. Manufacturers:
a. Burndy LLC: www.burndy.com/#sle.
b. Ideal Industries, Inc: www.idealindustries.com/#sle.
c. Ilsco: www.ilsco.com/#sle.
d. Substitutions: See Section 01 6000 - Product Requirements.

D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. American Polywater Corporation: www.polywater.com/#sle.
      c. Ideal Industries, Inc: www.idealindustries.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

E. Cable Ties: Material and tensile strength rating suitable for application.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated without specific routing, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
   8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
   9. Provide oversized neutral/grounded conductors where indicated and as specified below.
      a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.

b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install armored cable (Type AC) in accordance with NECA 120.

E. Install metal-clad cable (Type MC) in accordance with NECA 120.

F. Installation in Raceway:
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

I. Terminate cables using suitable fittings.
1. Armored Cable (Type AC):
a. Use listed fittings and anti-short, insulating bushings.
b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.
2. Metal-Clad Cable (Type MC):
a. Use listed fittings.
b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.

J. Install conductors with a minimum of 12 inches of slack at each outlet.

K. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

M. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

N. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
3. Do not remove conductor strands to facilitate insertion into connector.
4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.

5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

O. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

P. Insulate ends of spare conductors using vinyl insulating electrical tape.

Q. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

S. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

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SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.
B. Conductors for grounding and bonding.
C. Connectors for grounding and bonding.
D. Ground bars.
E. Ground rod electrodes.
F. Chemically-enhanced ground electrodes.
G. Ground plate electrodes.
H. Ground enhancement material.
I. Ground access wells.
J. Pre-fabricated signal reference grids.

1.02 RELATED REQUIREMENTS

A. Section 09 6500 - Resilient Flooring: Static control flooring.
B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
   1. Includes oxide inhibiting compound.
C. Section 26 0536 - Cable Trays for Electrical Systems: Additional grounding and bonding requirements for cable tray systems.
D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
E. Section 26 3100 - Photovoltaic Collectors: Additional grounding and bonding requirements for photovoltaic systems.
F. Section 26 5600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.
G. Section 33 7900 - Site Grounding.

1.03 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.
D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. NFPA 99 - Health Care Facilities Code; 2024.

G. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2023.

H. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.
   2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   3. For signal reference grids, coordinate the work with access flooring furnished in accordance with Section 09 6900.
   4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Shop Drawings:
   1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Field quality control test reports.

F. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

B. Do not use products for applications other than as permitted by NFPA 70 and product listing.

C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
   3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

F. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   2. Metal Underground Water Pipe(s):
      a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
      b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
      c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
   3. Metal In-Ground Support Structure:
      a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
   4. Concrete-Encased Electrode:
      a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
   5. Ground Rod Electrode(s):

a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
b. Space electrodes not less than 10 feet from each other and any other ground electrode.
c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
d. Provide ground enhancement material around electrode where indicated.
e. Provide ground access well for each electrode.

6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
7. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
   a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
   b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
   c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
8. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.

G. Service-Supplied System Grounding:
1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

H. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
1. Provide grounding electrode system for each separate building or structure.
2. Provide equipment grounding conductor routed with supply conductors.
3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.

I. Separately Derived System Grounding:
1. Separately derived systems include, but are not limited to:
   a. Transformers (except autotransformers such as buck-boost transformers).
   b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
   c. Generators, when neutral is switched in the transfer switch.
2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.

4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
6. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

J. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
    a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
    b. Metal gas piping.
    c. Metal process piping.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame.
10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
11. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
12. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.

K. Isolated Ground System:
1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.

3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.

L. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
1. Use insulated copper conductors unless otherwise indicated.
a. Exceptions:
1) Use bare copper conductors where installed underground in direct contact with earth.
2) Use bare copper conductors where directly encased in concrete (not in raceway).
2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gage of specified conductors.

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
a. Exceptions:
1) Use mechanical connectors for connections to electrodes at ground access wells.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
a. Exceptions:
1) Use exothermic welded connections for connections to metal building frame.
4. Manufacturers - Mechanical and Compression Connectors:
a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
b. Burndy LLC: www.burndy.com/#sle.
c. Harger Lightning & Grounding: www.harger.com/#sle.
d. Thomas & Betts Corporation: www.tnb.com/#sle.
e. Substitutions: See Section 01 6000 - Product Requirements.
5. Manufacturers - Exothermic Welded Connections:
a. Burndy LLC: www.burndy.com/#sle.

b. Cadweld, a brand of Erico International Corporation: www.erico.com/#sle.
c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.

D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.
5. Manufacturers:
a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
b. Erico International Corporation: www.erico.com/#sle.
c. Galvan Industries, Inc: www.galvanelectrical.com/#sle.
d. Harger Lightning & Grounding: www.harger.com/#sle.
e. Substitutions: See Section 01 6000 - Product Requirements.

F. Ground Enhancement Material:
1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.

G. Ground Access Wells:
1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
4. Cover: Factory-identified by permanent means with word "GROUND".

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.

1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.

D. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches.

E. Make grounding and bonding connections using specified connectors.
1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

F. Identify grounding and bonding system components in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

C. Section 26 0533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

D. Section 26 0536 - Cable Trays for Electrical Systems: Additional support and attachment requirements for cable tray.

E. Section 26 0533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

F. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.

G. Section 26 2513 - Low-Voltage Busways: Additional support and attachment requirements for busway.

H. Section 26 3100 - Photovoltaic Collectors: Photovoltaic module mounting systems.

I. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

J. Section 26 5133 - Luminaires and Drivers - Lutron: Additional support and attachment requirements for luminaires.

K. Section 26 5600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

F. MFMA-4 - Metal Framing Standards Publication; 2004.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
   1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

D. Derating Calculations for Fiberglass Channel (Strut) Framing Systems: Indicate load ratings adjusted for applicable service conditions.

E. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.

F. Installer's Qualification Statement: Include evidence of compliance with specified requirements.

G. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

D. Installer Qualifications for Field-Welding: As specified in Section 05 5000.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
      c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Components for Vibration Isolation and/or Seismic Controls: Comply with Section 26 0548.

C. Materials for Metal Fabricated Supports: Comply with Section 05 5000.

D. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
   2. Conduit Clamps: Bolted type unless otherwise indicated.
   3. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Erico International Corporation: www.erico.com/#sle.
      c. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      d. Thomas & Betts Corporation: www.tnb.com/#sle.
      e. Substitutions: See Section 01 6000 - Product Requirements.

E. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
   1. Manufacturers:

a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
b. Erico International Corporation: www.erico.com/#sle.
c. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
d. Thomas & Betts Corporation: www.tnb.com/#sle.
e. Substitutions: See Section 01 6000 - Product Requirements.

F. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.
2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
3. Channel Material:
a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
6. Manufacturers:
a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
b. Thomas & Betts Corporation: www.tnb.com/#sle.
c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
d. Substitutions: See Section 01 6000 - Product Requirements.
e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

G. Fiberglass Channel (Strut) Framing Systems: Factory-fabricated continuous-slot fiberglass channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Channel Material: Use polyester resin or vinyl ester resin.
2. Minimum Channel Dimensions: 1-5/8 inch width by 1 inch height.
3. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.
4. Manufacturers:
a. Enduro Composites: www.endurocomposites.com/#sle.
b. Substitutions: See Section 01 6000 - Product Requirements.
c. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

H. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
a. Equipment Supports: 1/2 inch diameter.
b. Busway Supports: 1/2 inch diameter.
c. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
d. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.
e. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
f. Outlet Boxes: 1/4 inch diameter.
g. Luminaires: 1/4 inch diameter.

I. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.

1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
3. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
4. Manufacturers:
   a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
   b. Erico International Corporation: www.erico.com/#sle.
   c. PHP Systems/Design: www.phpsd.com/#sle.
   d. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
   e. Substitutions: See Section 01 6000 - Product Requirements.

J. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.
11. Hammer-driven anchors and fasteners are not permitted.
12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a. Comply with MFMA-4.
    b. Channel Material: Use galvanized steel.
    c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
14. Manufacturers - Mechanical Anchors:
    a. Hilti, Inc: www.us.hilti.com/#sle.
    b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
    c. Powers Fasteners, Inc: www.powers.com/#sle.
    d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

H. Provide required vibration isolation and/or seismic controls in accordance with Section 26 0548.

I. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
   5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

J. Conduit Support and Attachment: Also comply with Section 26 0533.13.

K. Cable Tray Support and Attachment: Also comply with Section 26 0536.

L. Box Support and Attachment: Also comply with Section 26 0533.16.

M. Busway Support and Attachment: Also comply with Section 26 2513.

N. Interior Luminaire Support and Attachment: Also comply with Section 26 5100.

O. Exterior Luminaire Support and Attachment: Also comply with Section 26 5600.

P. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

Q. Secure fasteners according to manufacturer's recommended torque settings.

R. Remove temporary supports.

S. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

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SECTION 26 0533.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Aluminum rigid metal conduit (RMC).
C. Intermediate metal conduit (IMC).
D. PVC-coated galvanized steel rigid metal conduit (RMC).
E. Flexible metal conduit (FMC).
F. Liquidtight flexible metal conduit (LFMC).
G. Electrical metallic tubing (EMT).
H. Rigid polyvinyl chloride (PVC) conduit.
I. Electrical nonmetallic tubing (ENT).
J. Liquidtight flexible nonmetallic conduit (LFNC).
K. Reinforced thermosetting resin conduit (RTRC).
L. Conduit fittings.
M. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete encasement of conduits.
B. Section 07 8400 - Firestopping.
C. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
D. Section 26 0526 - Grounding and Bonding for Electrical Systems.
    1. Includes additional requirements for fittings for grounding and bonding.
E. Section 26 0529 - Hangers and Supports for Electrical Systems.
F. Section 26 0533.16 - Boxes for Electrical Systems.
G. Section 26 0533.23 - Surface Raceways for Electrical Systems.
H. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
I. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
J. Section 26 2100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
K. Section 27 1000 - Structured Cabling: Additional requirements for communications systems conduits.
L. Section 31 2316 - Excavation.
M. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.

N. Section 31 2323 - Fill: Bedding and backfilling.
O. Section 33 7119 - Electrical Underground Ducts, Ductbanks, and Manholes.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A); 2020.
D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.
E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
I. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.
J. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
K. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
L. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT); 2014 (Reaffirmed 2019).
M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
N. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
O. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
P. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
Q. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
R. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
S. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
T. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
   4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

C. Shop Drawings:
   1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
   2. Include proposed locations of roof penetrations and proposed methods for sealing.

D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:
   1. Under Slab on Grade: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
   2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).

3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
6. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
7. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.

D. Embedded Within Concrete:
1. Within Slab on Grade (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
2. Within Slab Above Ground (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.

E. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT). Do not use MC cable in walls or ceilings except for the final connection to lighting fixtures, and less than 6' lengths.

F. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.

H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
1. Locations subject to physical damage include, but are not limited to:
a. Where exposed below 8 feet, except within electrical and communication rooms or closets.

J. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.

K. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

2.02 CONDUIT REQUIREMENTS

A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.

B. Electrical Service Conduits: Also comply with Section 26 2100.

C. Communications Systems Conduits: Also comply with Section 27 1000.

D. Fittings for Grounding and Bonding: Also comply with Section 26 0526.

E. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

F. Provide products listed, classified, and labeled as suitable for the purpose intended.

G. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
   2. Underground, Interior: 3/4 inch (21 mm) trade size.
   3. Underground, Exterior: 1 inch (27 mm) trade size.

H. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com/#sle.
   2. Republic Conduit: www.republic-conduit.com/#sle.
   3. Wheatland Tube, a Division of Zekelman Industries www.wheatland.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
   4. Material: Use steel or malleable iron.
      a. Do not use die cast zinc fittings.
   5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 ALUMINUM RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com/#sle.
   2. Republic Conduit: www.republic-conduit.com/#sle.
   3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
   4. Material: Use aluminum.
   5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:
   1. Allied Tube & Conduit www.alliedeg.com/#sle.
   2. Republic Conduit: www.republic-conduit.com/#sle.
   3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.
   4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.06 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Thomas & Betts Corporation www.tnb.com/#sle.
   2. Robroy Industries www.robroy.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.

D. Interior Coating: Urethane, minimum thickness of 2 mil.

E. PVC-Coated Fittings:

1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.

F. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.07 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
2. Electri-Flex Company www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Electric Co www.emerson.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.

2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: See Section 01 6000 - Product Requirements.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.

2.09 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
1. Allied Tube & Conduit www.alliedeg.com/#sle.
2. Republic Conduit www.republic-conduit.com/#sle.

3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: See Section 01 6000 - Product Requirements.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
a. Do not use die cast zinc fittings.
4. Connectors and Couplings: Use compression (gland) or set-screw type.
a. Do not use indenter type connectors and couplings.
b. Do not use set-screw type connectors and couplings.
5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
1. Cantex Inc: www.cantexinc.com/#sle.
2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
3. JM Eagle www.jmeagle.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.11 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

A. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).

B. Supports: Per manufacturer's recommendations.

C. Fittings: Same type and manufacturer as conduit to be connected.

2.12 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

E. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

F. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

G. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

H. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for the conduit/duct arrangement to be installed.
   1. Products:
      a. Advance Products & Systems, LLC; Duct Bank Spacers: www.apsonline.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

I. Bore Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for installation within casing; furnished with roller wheels to facilitate installation, openings to facilitate grout flow, and holes for stabilization cable; suitable for the casing and conduit/duct arrangement to be installed.
   1. Products:
      a. Advance Products & Systems, LLC; Bore Spacers: www.apsonline.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.

E. Install intermediate metal conduit (IMC) in accordance with NECA 101.

F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.

G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

H. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated without specific routing, determine exact routing required.
   3. Conceal all conduits unless specifically indicated to be exposed.
   4. Conduits in the following areas may be exposed, unless otherwise indicated:

a. Electrical rooms.
b. Mechanical equipment rooms.
c. Within joists in areas with no ceiling.

5. Unless otherwise approved, do not route conduits exposed:
   a. Across floors.
   b. Across roofs.
   c. Across top of parapet walls.
   d. Across building exterior surfaces.
6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
7. Arrange conduit to maintain adequate headroom, clearances, and access.
8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
9. Arrange conduit to provide no more than 150 feet between pull points.
10. Route conduits above water and drain piping where possible.
11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
    a. Heaters.
    b. Hot water piping.
    c. Flues.
14. Group parallel conduits in the same area together on a common rack.

I. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide required vibration isolation and/or seismic controls in accordance with Section 26 0548.
3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
4. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
5. Use conduit strap to support single surface-mounted conduit.
   a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
6. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
7. Use conduit clamp to support single conduit from beam clamp or threaded rod.
8. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
9. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
10. Use of spring steel conduit clips for support of conduits is not permitted.
11. Use of wire for support of conduits is not permitted.
    a. For securing conduits to studs in hollow stud walls.
    b. For suspending conduits supported by spring steel conduit clips (only where specifically indicated or permitted).

12. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

J. Connections and Terminations:
   1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
   2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
   3. Use suitable adapters where required to transition from one type of conduit to another.
   4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
   5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
   6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
   7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
   8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

K. Penetrations:
   1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
   2. Make penetrations perpendicular to surfaces unless otherwise indicated.
   3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
   4. Conceal bends for conduit risers emerging above ground.
   5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
   6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
   7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
   8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
   9. Provide metal escutcheon plates for conduit penetrations exposed to public view.
   10. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

L. Underground Installation:
   1. Provide trenching and backfilling in accordance with Section 31 2316.13.
   2. Minimum Cover, Unless Otherwise Indicated or Required:
      a. Underground, Exterior: 24 inches.
      b. Under Slab on Grade: 12 inches to bottom of slab.
   3. Provide underground warning tape in accordance with Section 26 0553 along entire conduit length for service entrance where not concrete-encased.

M. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
   1. Include proposed conduit arrangement with submittals.
   2. Maximum Conduit Size: 1 inch (27 mm) unless otherwise approved.

3. Install conduits within middle one third of slab thickness.
4. Secure conduits to prevent floating or movement during pouring of concrete.

N. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 03 3000 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.

O. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.

P. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
4. Where conduits are subject to earth movement by settlement or frost.

Q. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
3. Where conduits penetrate coolers or freezers.

R. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

S. Provide grounding and bonding in accordance with Section 26 0526.

T. Identify conduits in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

D. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

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SECTION 26 0533.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
C. Boxes and enclosures for integrated power, data, and audio/video.
D. Boxes for hazardous (classified) locations.
E. Floor boxes.
F. Underground boxes/enclosures.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.
B. Section 07 8400 - Firestopping.
C. Section 08 3100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
D. Section 26 0526 - Grounding and Bonding for Electrical Systems.
E. Section 26 0529 - Hangers and Supports for Electrical Systems.
F. Section 26 0533.13 - Conduit for Electrical Systems:
    1. Conduit bodies and other fittings.
    2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
G. Section 26 0533.23 - Surface Raceways for Electrical Systems:
    1. Accessory boxes designed specifically for surface raceway systems.
    2. Lay-in wireways and wiring troughs with removable covers.
H. Section 26 0539 - Underfloor Raceways for Electrical Systems: Junction boxes for underfloor duct systems.
I. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
J. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
K. Section 26 2726 - Wiring Devices:
    1. Wall plates.
    2. Floor box service fittings.
    3. Poke-through assemblies.
    4. Access floor boxes.
    5. Additional requirements for locating boxes for wiring devices.
L. Section 26 2813 - Fuses: Spare fuse cabinets.

M. Section 27 1000 - Structured Cabling: Additional requirements for communications systems outlet boxes.

N. Section 33 7119 - Electrical Underground Ducts, Ductbanks, and Manholes: Concrete manholes for electrical systems.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).

E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013 (Reaffirmed 2020).

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. SCTE 77 - Specifications for Underground Enclosure Integrity; 2023.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

J. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.

K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

L. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
   5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
   6. Coordinate the work with other trades to preserve insulation integrity.
   7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
   8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
   1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.

C. Samples:
   1. Floor Boxes: Provide one sample(s) of each floor box proposed for substitution upon request.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Keys for Lockable Enclosures: Two of each different key.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
   4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
   5. Use nonmetallic boxes where exposed rigid PVC conduit is used.
   6. Use suitable concrete type boxes where flush-mounted in concrete.
   7. Use suitable masonry type boxes where flush-mounted in masonry walls.
   8. Use raised covers suitable for the type of wall construction and device configuration where required.
   9. Use shallow boxes where required by the type of wall construction.
   10. Do not use "through-wall" boxes designed for access from both sides of wall.
   11. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   12. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
   13. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
   14. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
   15. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
   16. Minimum Box Size, Unless Otherwise Indicated:
      a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
      b. Communications Systems Outlets: Comply with Section 27 1000.
   17. Wall Plates: Comply with Section 26 2726.
   18. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.
      c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com/#sle.
      d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      e. Thomas & Betts Corporation: www.tnb.com/#sle.
      f. Substitutions: See Section 01 6000 - Product Requirements.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
   1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
   2. NEMA 250 Environment Type, Unless Otherwise Indicated:
      a. Indoor Clean, Dry Locations: Type 1, painted steel.
      b. Outdoor Locations: Type 3R, painted steel.
   3. Junction and Pull Boxes Larger Than 100 cubic inches:
      a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
      b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.

4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
    b. Back Panels: Painted steel, removable.
    c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
6. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
    c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.
    d. Substitutions: See Section 01 6000 - Product Requirements.

D. Boxes and Enclosures for Integrated Power, Data, and Audio/Video: Size and configuration as indicated or as required with partitions to separate services; field-connected gangable boxes may be used.
1. Manufacturers:
    a. Hubbell Incorporated: www.hubbell.com/#sle.
    b. Substitutions: See Section 01 6000 - Product Requirements.

E. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.
1. Manufacturers:
    a. Appleton, a brand of Emerson Electric Co: www.emerson.com/#sle.
    b. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    c. Hubbell Incorporated; Killark Products: www.hubbell-killark.com/#sle.
    d. Substitutions: See Section 01 6000 - Product Requirements.

F. Floor Boxes:
1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 2726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
2. Use cast iron floor boxes within slab on grade.
3. Use sheet-steel or cast iron floor boxes within slab above grade.
4. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
5. Manufacturer: Same as manufacturer of floor box service fittings.

G. Underground Boxes/Enclosures:
1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
2. Size: As indicated on drawings.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
4. Provide logo on cover to indicate type of service.
5. Applications:
    a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
    b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.

c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.

6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
   a. Manufacturers:
      1) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com/#sle.
      2) MacLean Highline: www.macleanhighline.com/#sle.
      3) Oldcastle Precast, Inc: www.oldcastleprecast.com/#sle.
      4) Substitutions: See Section 01 6000 - Product Requirements.
   b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.
   c. Product(s):
      1) MacLean Highline PHA Series: Straight wall, all-polymer concrete splice box/pull box; available Tier 8, Tier 15, and Tier 22 load ratings.
         (a) 11 by 18 by 12 inches nominal; Model PHA111812 (stackable).
      2) MacLean Highline CHA Series: Fiberglass/polymer concrete splice box/pull box; available Tier 8 and Tier 15 load ratings.
         (a) 11 by 18 by 12 inches nominal; Model CHA111812.
      3) MacLean Highline CVA Series: Fiberglass/polymer concrete splice vault; available Tier 8, Tier 15, and Tier 22 load ratings.
         (a) 30 by 48 by 18 inches nominal; Model CVA304818.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:
   1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.
   2. Unless dimensioned, box locations indicated are approximate.
   3. Locate boxes as required for devices installed under other sections or by others.
      a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.

b. Communications Systems Outlets: Comply with Section 27 1000.

4. Locate boxes so that wall plates do not span different building finishes.
5. Locate boxes so that wall plates do not cross masonry joints.
6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
   a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
   b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.
11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    a. Concealed above accessible suspended ceilings.
    b. Within joists in areas with no ceiling.
    c. Electrical rooms.
    d. Mechanical equipment rooms.

I. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide required seismic controls in accordance with Section 26 0548.
3. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
4. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
5. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L. Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.

M. Install boxes as required to preserve insulation integrity.

N. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

O. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.

P. Underground Boxes/Enclosures:
   1. Install enclosure on gravel base, minimum 6 inches deep.
   2. Flush-mount enclosures located in concrete or paved areas.
   3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
   4. Provide cast-in-place concrete collar constructed in accordance with Section 03 3000, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.
   5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

Q. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

S. Close unused box openings.

T. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

U. Provide grounding and bonding in accordance with Section 26 0526.

V. Identify boxes in accordance with Section 26 0553.

3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 0533.23
SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface raceway systems.
B. Wireways.
C. Wall duct.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
B. Section 26 0529 - Hangers and Supports for Electrical Systems.
   1. Includes metal channel (strut) used as raceway.
C. Section 26 0533.13 - Conduit for Electrical Systems.
D. Section 26 0533.16 - Boxes for Electrical Systems.
E. Section 26 0539 - Underfloor Raceways for Electrical Systems: Trench duct.
F. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
G. Section 26 2723 - Indoor Service Poles.
H. Section 26 2726 - Wiring Devices: Receptacles.
I. Section 27 1000 - Structured Cabling: Voice and data jacks.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
D. NEMA PRP 5 - Installation Guidelines for Surface Nonmetallic Raceway; 2021.
E. UL 5 - Surface Metal Raceways and Fittings; Current Edition, Including All Revisions.
F. UL 5A - Nonmetallic Surface Raceways and Fittings; Current Edition, Including All Revisions.
G. UL 111 - Outline of Investigation for Multioutlet Assemblies; Current Edition, Including All Revisions.
H. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.

2. Coordinate rough-in locations of outlet boxes provided under Section 26 0533.16 and conduit provided under Section 26 0533.13 as required for installation of raceways provided under this section.
3. Verify minimum sizes of raceways with the actual conductors and components to be installed.
4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install raceways until final surface finishes and painting are complete.
2. Do not begin installation of conductors and cables until installation of raceways is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including dimensions, knockout sizes and locations, materials, fabrication details, finishes, service condition requirements, and accessories.
1. Surface Raceway Systems: Include information on fill capacities for conductors and cables.

C. Shop Drawings:
1. Pre-wired Surface Raceway Systems: Provide plan and elevation views including dimensioned locations of wiring devices and circuiting arrangements.
2. Wireways: Provide dimensioned plan and elevation views including adjacent equipment with all required clearances indicated.

D. Samples: Three of each type and color of surface raceway system specified, 6 inches in length.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 RACEWAY REQUIREMENTS

A. Provide all components, fittings, supports, and accessories required for a complete raceway system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

2.02 SURFACE RACEWAY SYSTEMS

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell.com/#sle.
   2. MonoSystems, Inc: www.monosystems.com/#sle.
   3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Surface Metal Raceways: Listed and labeled as complying with UL 5.

C. Surface Nonmetallic Raceways: Listed and labeled as complying with UL 5A.

D. Multioutlet Assemblies: Listed and labeled as complying with UL 111.

E. Metal Channel (Strut) Used as Raceway: Comply with Section 26 0529.

F. Surface Raceway System:
   1. Raceway Type: Single channel, painted steel.
   2. Length: As indicated on the drawings.
   3. Color: To be selected by Architect.
   4. Accessory Device Boxes: Suitable for the devices to be installed; color to match raceway.
   5. Integrated Device Provisions:
      a. Receptacles:
         1) Comply with Section 26 2726, except for finishes.
         2) Configuration: As indicated on the drawings.
         3) Color: Match raceway.
         4) Spacing: As indicated on the drawings.
      b. Communications Outlets:
         1) Voice and Data Jacks: As specified in Section 27 1000.
         2) Voice and Data Jacks: Include provisions for jacks furnished by others.
         3) Configuration: As indicated on the drawings.
         4) Spacing: As indicated on the drawings.
   6. Products:
      a. Hubbell Incorporated: www.hubbell.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 WIREWAYS

A. Manufacturers:
   1. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com/#sle.
   2. Enduro Composites: www.endurocomposites.com/#sle.
   3. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
   4. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

5. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: Lay-in wireways and wiring troughs with removable covers; listed and labeled as complying with UL 870.

C. Wireway Type, Unless Otherwise Indicated:
   1. Indoor Clean, Dry Locations: NEMA 250, Type 1, painted steel with screw-cover.
   2. Outdoor Locations: NEMA 250, Type 3R, painted steel with screw-cover; include provision for padlocking.

D. Finish for Painted Steel Wireways: Manufacturer's standard grey unless otherwise indicated.

E. Minimum Wireway Size: 4 by 4 inches unless otherwise indicated.

F. Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.04 WALL DUCT

A. Manufacturers:
   1. Dennis Filges Company, Inc: www.filgesco.com/#sle.
   2. Hubbell Incorporated: www.hubbell.com/#sle.
   3. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
   4. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.
   6. Source Limitations: Where the wall duct system includes connections to trench duct as specified in Section 26 0539, furnish wall duct and associated components produced by the same manufacturer as the trench duct to be installed.

B. Description: Metal raceways specifically designed for enclosure of wiring to X-ray machines and similar medical equipment; listed and labeled as complying with UL 870.

C. Material: Steel, unless otherwise indicated.

D. Mounting Provisions: Suitable for surface- or flush-mounting as indicated.

E. Size: As indicated on the drawings.

2.05 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Factory test each production unit for pre-wired surface raceway systems to verify proper wiring.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes and conduit terminations are installed in proper locations and are properly sized in accordance with NFPA 70 to accommodate raceways.

C. Verify that mounting surfaces are ready to receive raceways and that final surface finishes are complete, including painting.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install raceways plumb and level.

D. Arrange wireways and associated raceway connections to comply with NFPA 70, including but not limited to requirements for deflected conductors and wireways used as pullboxes. Increase size of wireway where necessary.

E. Secure and support raceways in accordance with Section 26 0529 at intervals complying with NFPA 70 and manufacturer's requirements.

F. Close unused raceway openings.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Identify raceways in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect raceways for damage and defects.

C. Surface Raceway Systems with Integrated Devices: Test each wiring device to verify operation and proper polarity.

D. Correct wiring deficiencies and replace damaged or defective raceways.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 PROTECTION

A. Protect installed raceways from subsequent construction operations.

END OF SECTION

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SECTION 26 0548
VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vibration isolation requirements.

B. Seismic control requirements.
   1. Includes requirements for seismic qualification of equipment not specified in this section.

C. Vibration-isolated equipment support bases.

D. Vibration isolators.

E. External seismic snubber assemblies.

F. Seismic restraint systems.

1.02 RELATED REQUIREMENTS

A. Section 01 4533 - Code-Required Special Inspections and Procedures.

B. Section 03 3000 - Cast-in-Place Concrete.

C. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

D. Section 26 0529 - Hangers and Supports for Electrical Systems.

1.03 DEFINITIONS

A. Electrical Component: Where referenced in this section in regards to seismic controls, applies to any portion of the electrical system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g. conduit, cable tray).

B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.

C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.

E. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.

F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.

G. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2020).

I. MFMA-4 - Metal Framing Standards Publication; 2004.

J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Seismic Controls:
      a. Coordinate the arrangement of seismic restraints with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
      b. Coordinate the work with other trades to accommodate relative positioning of essential and non-essential components in consideration of seismic interaction.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
   1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification method for spring element load capacities.
   2. Seismic Controls: Include seismic load capacities.

D. Shop Drawings - Vibration Isolation Systems:
   1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
   2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

E. Shop Drawings - Seismic Controls:
   1. Include dimensioned plan views and sections indicating proposed electrical component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.

2. Identify mounting conditions required for equipment seismic qualification.
3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
4. Indicate proposed arrangement of distributed system trapeze support groupings.
5. Indicate proposed locations for distributed system flexible fittings and/or connections.
6. Indicate locations of seismic separations where applicable.
7. Include point load drawings indicating design loads transmitted to structure at each attachment location.

F. Seismic Design Data:
1. Compile information on project-specific characteristics of actual installed electrical components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
a. Component operating weight and center of gravity.
b. Component elevation in the building in relation to the roof elevation (z/h).
c. Component importance factor (Ip).
d. For distributed systems, component materials and connection methods.
e. Component amplification factor (ap) and component response modification factor (Rp), determined in accordance with ASCE 7 tables.
f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).
2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.

G. Certification for seismically qualified equipment; identify basis for certification.

H. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.

I. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

J. Evidence of qualifications for seismic controls designer.

K. Evidence of qualifications for manufacturer.

L. Manufacturer’s detailed field testing and inspection procedures.

M. Field quality control test reports.

1.07 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

D. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
1. Designer may be employed by the manufacturer of the seismic restraint products.

E. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing electrical equipment and/or electrical connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:
   1. Select vibration isolators to provide required static deflection.
   2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
   3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
   4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
   5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2 inch operating clearance beneath base unless otherwise indicated.

D. Equipment Isolation:
   1. Transformers:
      a. Specified vibration isolators are in addition to any factory-installed internal core and coil assembly vibration isolators unless otherwise indicated.
      b. Floor-Mounted Transformers, Non-Seismic Applications: Use resilent material isolator pads, resilient material isolator mounts, or open (unhoused) spring isolators.
      c. Floor-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts or seismic type restrained spring isolators.
      d. Suspended Transformers, Non-Seismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
      e. Suspended Transformers, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
      f. Wall-Mounted Transformers, Non-Seismic Applications: Use resilient material isolator mounts.
      g. Wall-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts.
      h. Minimum Static Deflection:
         1) Transformers Mounted on Grade-Level Slabs: 0.25 inch deflection unless otherwise indicated.
         2) Transformers Mounted at Above-Grade Levels: 0.5 inch deflection unless otherwise indicated.
   2. Engine Generators:

a. Specified vibration isolators are in addition to any factory-installed internal vibration isolators between generator set and integral base unless otherwise indicated; obtain generator set manufacturer approval of applied vibration isolation.
b. Non-Seismic Applications, Isolators Not Located Below Sub-Base Fuel Tank: Use housed spring isolators or restrained spring isolators.
c. Non-Seismic Applications, Isolators Located Below Sub-Base Fuel Tank: Use restrained spring isolators.
d. Seismic Applications: Use seismic type restrained spring isolators.
e. Provide vibration-isolated concrete inertia bases where indicated.
f. Minimum Static Deflection:
1) Generators Mounted on Grade-Level Slabs: 1 inch deflection unless otherwise indicated.
2) Generators Mounted at Above-Grade Levels: 2 inch deflection unless otherwise indicated.

E. Conduit Isolation:
1. Use flexible conduit or cable for electrical connections to vibration-isolated equipment, including equipment installed under other sections or by others.
a. Minimum Length: 3 feet unless otherwise indicated.
2. Vibration Isolators:
a. Provide vibration isolators for conduit supports:
1) Located within 50 feet of connected vibration-isolated equipment where flexible connection to equipment is not possible.
2) For conduits over 2 inch trade size located below or within 50 feet of noise-sensitive areas indicated.
b. Minimum Static Deflection:
1) First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
2) Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
c. Suspended Conduits, Non-Seismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
d. Suspended Conduits, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
e. Use modular seal or approved resilient material where vibration-isolated conduits penetrate building elements (e.g. walls, floors) arranged to prevent vibration transmission to structure.

2.02 SEISMIC CONTROL REQUIREMENTS

A. Design and provide electrical component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor electrical components.

B. Seismic Design Criteria: As indicated on drawings.

C. Seismic Qualification of Equipment:
1. Provide special certification for electrical equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.

2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.

D. Premanufactured Modular Electrical Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.

E. Seismic Restraints:
1. Provide seismic restraints for electrical components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
2. Seismic Restraint Exemptions:
a. Exemptions for Seismic Design Category C:
1) Electrical components where either of the following apply:
(a) The component importance factor (Ip) is 1.0 and the component is positively attached to the structure.
(b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
b. Exemptions for Seismic Design Category D, E, and F:
1) Discrete electrical components that are positively attached to the structure where either of the following apply:
(a) The component weighs 400 pounds or less, has a center of mass located 4 feet or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor (Ip) is 1.0.
(b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
c. Conduit, Cable Tray, and Raceway Exemptions, All Seismic Design Categories:
1) Raceways with component importance factor (Ip) of 1.0 where flexible connections are provided between cable tray or raceway and associated components, where cable tray or raceway is positively attached to the structure, and where one of the following apply:
(a) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
(b) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 200 pounds or less.
(c) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
(d) Hanger supported conduits, cable trays, or raceways with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds or less.

2) Conduits less than 2-1/2 inch trade size.

d. Lighting Exemptions, All Seismic Design Categories:
   1) Suspended luminaires where attachments are designed to accommodate 1.4 times the operating weight acting in both the vertical and horizontal directions and connections to structure allow for 360 degree range of motion in the horizontal plane; arrange to prevent impact between luminaires and the structure or other nonstructural components.
   2) Lay-in luminaires weighing less than 56 pounds secured to ceiling grid and provided with safety wires in accordance with ASTM E580/E580M.

3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
   a. ASHRAE (HVACA).
   b. FEMA 413.
   c. FEMA E-74.
   d. SMACNA (SRM).
4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third party registered professional engineer acceptable to authorities having jurisdiction.
5. Seismic Type Vibration Isolators:
   a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
6. External Seismic Snubber Assemblies:
   a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
   b. Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
7. Seismic Restraint Systems:
   a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
   b. Use only cable restraints to restrain vibration-isolated electrical components, including distributed systems.
   c. Use only one restraint system type for a given electrical component or distributed system (e.g. conduit, cable tray) run; mixing of cable and rigid restraints on a given component/run is not permitted.
   d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain electrical component in all lateral directions; consider bracket geometry in anchor load calculations.
   e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported electrical component weight.
   f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported electrical component weight.
   g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
   h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.

i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
j. Manufacturer's certified seismic restraint design may be submitted as an alternative to project-specific design and documentation, subject to approval of authorities having jurisdiction.

F. Seismic Attachments:
1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use power-actuated fasteners.
4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
6. Concrete Housekeeping Pads:
a. Increase size of pad as required to comply with anchor requirements.
b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

G. Seismic Interactions:
1. Include provisions to prevent seismic impact between electrical components and other structural or nonstructural components.
2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
3. Comply with minimum clearance requirements between electrical equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.

H. Seismic Relative Displacement Provisions:
1. Use suitable fittings or flexible connections to accommodate:
a. Relative displacements at connections between components, including distributed systems (e.g. conduit, cable tray); do not exceed load limits for equipment utility connections.
b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
c. Design displacements at seismic separations.
d. Anticipated drifts between floors.

2.03 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Manufacturers:
1. Vibration-Isolated Equipment Support Bases:
a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
b. Mason Industries: www.mason-ind.com/#sle.
c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
2. Substitutions: See Section 01 6000 - Product Requirements.

3. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. Vibration-Isolated Structural Steel Bases:
   1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.

C. Vibration-Isolated Concrete Inertia Bases:
   1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
   2. Minimum Base Depth: 6 inches.
   3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
   4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
   5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 03 3000.

2.04 VIBRATION ISOLATORS

A. Manufacturers:
   1. Vibration Isolators:
      a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
      b. Mason Industries: www.mason-ind.com/#sle.
      c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.
   3. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:
   1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
   2. Spring Elements for Spring Isolators:
      a. Color code or otherwise identify springs to indicate load capacity.
      b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
      c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
      d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
      e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
      f. Selected to function without undue stress or overloading.
   3. Seismic Snubbing Elements for Seismic Isolators:
      a. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
      b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

C. Vibration Isolators for Non-Seismic Applications:
   1. Resilient Material Isolator Pads:
      a. Description: Single or multiple layer pads utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material.
      b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.

c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.

2. Resilient Material Isolator Mounts, Non-Seismic:
   a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material; fail-safe type.
3. Open (Unhoused) Spring Isolators:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
   b. Bottom Load Plate: Non-skid molded elastomeric isolator material or steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
4. Housed Spring Isolators:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
   b. Furnished with integral elastomeric snubbing elements, non-adjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
   c. Bottom Load Plate: Steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
   d. Furnished with integral leveling device for positioning and securing supported equipment.
5. Restrained Spring Isolators, Non-Seismic:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
   b. Bottom Load Plate: Steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
   d. Provides constant free and operating height.
6. Resilient Material Isolator Hangers, Non-Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
7. Spring Isolator Hangers, Non-Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.
8. Combination Resilient Material/Spring Isolator Hangers, Non-Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g. neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.

D. Vibration Isolators for Seismic Applications:
   1. Resilient Material Isolator Mounts, Seismic:
      a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g. neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
   2. Restrained Spring Isolators, Seismic:
      a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g. neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
      b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
      c. Furnished with integral leveling device for positioning and securing supported equipment.
      d. Provides constant free and operating height.
   3. Resilient Material Isolator Hangers, Seismic:
      a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g. neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
   4. Spring Isolator Hangers, Seismic:
      a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
      b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.
   5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
      a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g. neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
      b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.

2.05 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

A. Manufacturers:
   1. External Seismic Snubber Assemblies:
      a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
      b. Mason Industries: www.mason-ind.com/#sle.
      c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.
   3. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.

C. Seismic Snubbing Elements:
   1. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
   2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

2.06 SEISMIC RESTRAINT SYSTEMS

A. Manufacturers:
   1. Seismic Restraint Systems:
      a. Eaton Corporation: www.eaton.com/#sle.
      b. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
      c. Mason Industries: www.mason-ind.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.
   3. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.

B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

C. Cable Restraints:
   1. Comply with ASCE 19.
   2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
   3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
   4. Use protective thimbles for cable loops where potential for cable damage exists.

D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 01 4533 and statement of special inspections as required by applicable building code.

B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.

1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

C. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.

D. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install products in accordance with applicable requirements of NECA 1 (general workmanship).

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Secure fasteners according to manufacturer's recommended torque settings.

E. Install flexible conduit and cable connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

F. Vibration Isolation Systems:
1. Vibration-Isolated Equipment Support Bases:
   a. Provide specified minimum clearance beneath base.
2. Spring Isolators:
   a. Position equipment at operating height; provide temporary blocking as required.
   b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
   c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
3. Isolator Hangers:
   a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
   b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
4. Clean debris from beneath vibration-isolated equipment that could cause short circuiting of isolation.
5. Use elastomeric grommets for attachments where required to prevent short circuiting of isolation.
6. Adjust isolators to be free of isolation short circuits during normal operation.
7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

G. Seismic Controls:
1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris or other obstructions.
2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.

3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
4. Equipment with Sheet Metal Housings:
    a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
    b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
    c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
5. Concrete Housekeeping Pads:
    a. Size in accordance with seismic design to meet anchor requirements.
    b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
6. Seismic Restraint Systems:
    a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
    b. Install restraints within permissible angles in accordance with seismic design.
    c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
    d. Install cable restraints for vibration-isolated components slightly slack to prevent short circuiting of isolation.
    e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Provide services of a manufacturer's authorized representative for vibration isolation systems and seismic controls to observe installation and assist in inspection and testing. Include manufacturer's detailed testing and inspection procedures and field reports with submittals.

D. Vibration Isolation Systems:
    1. Verify isolator static deflections.
    2. Verify required clearance beneath vibration-isolated equipment support bases.
    3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

E. Seismic Controls:
    1. Verify snubbing element air gaps.

F. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.05 ATTACHMENTS

A. Statement of special inspections.

END OF SECTION

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.
B. Identification nameplates and labels.
C. Wire and cable markers.
D. Voltage markers.
E. Underground warning tape.
F. Floor marking tape.
G. Warning signs and labels.

1.02 RELATED REQUIREMENTS

A. Section 09 9113 - Exterior Painting.
B. Section 09 9123 - Interior Painting.
C. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
D. Section 26 0536 - Cable Trays for Electrical Systems: Additional identification requirements for cable tray systems.
E. Section 26 0573 - Power System Studies: Arc flash hazard warning labels.
F. Section 26 2300 - Low-Voltage Switchgear: Factory-installed mimic bus.
G. Section 26 2726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.
H. Section 26 3100 - Photovoltaic Collectors: Additional identification requirements for photovoltaic systems.
I. Section 27 1000 - Structured Cabling: Identification for communications cabling and devices.

1.03 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011 (Reaffirmed 2017).
B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011 (Reaffirmed 2017).
C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

D. Samples:
   1. Identification Nameplates: One of each type and color specified.
   2. Warning Signs and Labels: One of each type and legend specified.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.07 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Switchgear:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.
         4) Use identification nameplate to identify main and tie devices.

5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
6) See Section 26 2300 for factory-installed mimic bus.

b. Switchboards:
1) Identify ampere rating.
2) Identify voltage and phase.
3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Use identification nameplate to identify main overcurrent protective device.
5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

c. Motor Control Centers:
1) Identify ampere rating.
2) Identify voltage and phase.
3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Use identification nameplate to identify main overcurrent protective device.
5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

d. Panelboards:
1) Identify ampere rating.
2) Identify voltage and phase.
3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

e. Transformers:
1) Identify kVA rating.
2) Identify voltage and phase for primary and secondary.
3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Identify load(s) served. Include location when not within sight of equipment.

f. Enclosed switches, circuit breakers, and motor controllers:
1) Identify voltage and phase.
2) Identify power source and circuit number. Include location when not within sight of equipment.
3) Identify load(s) served. Include location when not within sight of equipment.

g. Busway:
1) Identify ampere rating.
2) Identify voltage and phase.
3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Provide identification at maximum intervals of 40 feet.
5) Use identification nameplate to identify load(s) served for each plug-in unit. Include location when not within sight of equipment.

h. Time Switches:
   1) Identify load(s) served and associated circuits controlled. Include location.
i. Enclosed Contactors:
   1) Identify ampere rating.
   2) Identify voltage and phase.
   3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
   4) Identify coil voltage.
   5) Identify load(s) and associated circuits controlled. Include location.
j. Centralized Emergency Lighting Inverters:
   1) Identify input and output voltage and phase.
   2) Identify power source and circuit number for normal power source. Include location when not within sight of equipment.
   3) Identify load(s) served. Include location.
k. Transfer Switches:
   1) Identify voltage and phase.
   2) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.
   3) Identify load(s) served. Include location when not within sight of equipment.
   4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.
l. Electricity Meters:
   1) Identify load(s) metered.

2. Service Equipment:
   a. Use identification nameplate to identify each service disconnecting means.
   b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
3. Emergency System Equipment:
   a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
   b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
   c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.
4. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
5. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
6. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
7. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
8. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
9. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.

10. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
11. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
    a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Section 09 9123 and 09 9113.
12. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
    a. Service equipment.
    b. Elevator control panels.
    c. Industrial machinery.
13. Arc Flash Hazard Warning Labels: Comply with Section 26 0573.
14. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
15. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
16. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
17. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.

C. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
2. Identification for Communications Conductors and Cables: Comply with Section 27 1000.
3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
    a. At each source and load connection.
    b. Within boxes when more than one circuit is present.
    c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
    d. In cable tray, at maximum intervals of 20 feet.
5. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
6. Use underground warning tape to identify direct buried cables.

D. Identification for Raceways:
1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
2. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.

a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
1) Color Code:
(a) Emergency Power System: Red.
2) Field-Painting: Comply with Section 09 9123 and 09 9113.
3) Vinyl Color Coding Electrical Tape: Comply with Section 26 0519.

3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
4. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
5. Use underground warning tape to identify underground raceways.
6. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.

E. Identification for Cable Tray: Comply with Section 26 0536.

F. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
2. Use voltage markers or color coded boxes to identify systems other than normal power system.
a. Color-Coded Boxes: Field-painted in accordance with Section 09 9123 and 09 9113 per the same color code used for raceways.
3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
a. For exposed boxes in public areas, use only identification labels.
4. Use warning labels to identify electrical hazards for boxes containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".

G. Identification for Devices:
1. Identification for Communications Devices: Comply with Section 27 1000.
2. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.
3. Factory Pre-Marked Wallplates: Comply with Section 26 2726.
4. Use identification label to identify fire alarm system devices.
a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
5. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
6. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
7. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

H. Identification for Luminaires:
1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

I. Identification for Photovoltaic Systems: Comply with Section 26 3100

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
   1. Manufacturers:
      a. Brimar Industries, Inc: www.brimar.com/#sle.
      b. Kolbi Pipe Marker Co{CH#275749}: www.kolbipipemarkers.com/#sle.
      c. Seton Identification Products: www.seton.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Materials:
      a. Indoor Clean, Dry Locations: Use plastic nameplates.
      b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
   3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
   4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
   5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
   6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
   1. Manufacturers:
      a. Brady Corporation: www.bradyid.com/#sle.
      b. Brother International Corporation: www.brother-usa.com/#sle.
      c. Panduit Corp: www.panduit.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
      a. Use only for indoor locations.
   3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
   1. Minimum Size: 1 inch by 2.5 inches.
   2. Legend:
      a. System designation where applicable:
         1) Emergency Power System: Identify with text "EMERGENCY".
         2) Fire Alarm System: Identify with text "FIRE ALARM".
      b. Equipment designation or other approved description.
      c. Other information as indicated.
   3. Text: All capitalized unless otherwise indicated.
   4. Minimum Text Height:
      a. System Designation: 1 inch.
      b. Equipment Designation: 1/2 inch.
      c. Other Information: 1/4 inch.
      d. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
   5. Color:
      a. Normal Power System: White text on black background.

b. Emergency Power System: White text on red background.
c. Fire Alarm System: White text on red background.

D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch.
5. Color: Black text on white background unless otherwise indicated.
a. Exceptions:
1) Provide white text on red background for general information or operational instructions for emergency systems.
2) Provide white text on red background for general information or operational instructions for fire alarm systems.

E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch.
5. Color: Black text on yellow background unless otherwise indicated.

F. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Power source and circuit number or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

G. Format for Control Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

H. Format for Fire Alarm Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Designation indicated and device zone or address.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Red text on white background.

2.03 WIRE AND CABLE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
2. HellermannTyton: www.hellermanntyton.com/#sle.
3. Panduit Corp: www.panduit.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

F. Minimum Text Height: 1/8 inch.

G. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
2. Brimar Industries, Inc: www.brimar.com/#sle.
3.
4. Seton Identification Products: www.seton.com/#sle.

B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

D. Minimum Size:
1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

E. Legend:
1. Markers for Voltage Identification: Highest voltage present.
2. Markers for System Identification:
a. Emergency Power System: Text "EMERGENCY".

F. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
2. Brimar Industries, Inc: www.brimar.com/#sle.
3. Seton Identification Products: www.seton.com/#sle.

B. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
1. Exception: Use foil-backed detectable type tape where required by serving utility or where directed by Owner.

C. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.

D. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

E. Legend: Type of service, continuously repeated over full length of tape.

F. Color:

1. Tape for Buried Power Lines: Black text on red background.
2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.06 FLOOR MARKING TAPE

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com/#sle.
   2. Brimar Industries, Inc: www.brimar.com/#sle.
   3. Seton Identification Products: www.seton.com/#sle.

B. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches wide, with alternating black and white stripes.

2.07 WARNING SIGNS AND LABELS

A. Manufacturers:
   1. Brimar Industries, Inc: www.brimar.com/#sle.
   2. Clarion Safety Systems, LLC: www.clarionsafety.com/#sle.
   3. Seton Identification Products: www.seton.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:
   1. Materials:
      a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
      b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
   2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
   3. Minimum Size: 7 by 10 inches unless otherwise indicated.

D. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.

3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Branch Devices: Adjacent to device.
6. Interior Components: Legible from the point of access.
7. Conduits: Legible from the floor.
8. Boxes: Outside face of cover.
9. Conductors and Cables: Legible from the point of access.
10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

G. Secure rigid signs using stainless steel screws.

H. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

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SECTION 26 0573
POWER SYSTEM STUDIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Short-circuit study.

B. Protective device coordination study.

C. Arc flash and shock risk assessment.
   1. Includes arc flash hazard warning labels.

D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.02 RELATED REQUIREMENTS

A. Section 26 0553 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.

B. Section 26 1116 - Secondary Unit Substations.

C. Section 26 1300 - Medium-Voltage Switchgear.

D. Section 26 1321 - Air Interrupter Switches.

E. Section 26 1839 - Medium-Voltage Motor Controllers.

F. Section 26 2100 - Low-Voltage Electrical Service Entrance.
   1. Includes Utility Company contact information.

G. Section 26 2300 - Low-Voltage Switchgear.

H. Section 26 2413 - Switchboards.

I. Section 26 2416 - Panelboards.

J. Section 26 2419 - Motor-Control Centers.

K. Section 26 2513 - Low-Voltage Busways.

L. Section 26 2813 - Fuses.

M. Section 26 2816.13 - Enclosed Circuit Breakers.

N. Section 26 2816.16 - Enclosed Switches.

O. Section 26 2913 - Enclosed Controllers.

P. Section 26 3323 - Central Battery Equipment.

Q. Section 26 3533.16 - Low-Voltage Power Factor Correction Equipment.

1.03 REFERENCE STANDARDS

A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011 (Reaffirmed 2017).

B. IEEE 141 - IEEE Recommended Practice for Electric Power Distribution for Industrial Plants; 1993 (Reaffirmed 1999).

C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001, with Errata (2003).
D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.
E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems; 2006.
F. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations; 2018, with Errata (2019).
G. NEMA MG 1 - Motors and Generators; 2021.
H. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
J. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Existing Installations: Coordinate with equipment manufacturer(s) to obtain data necessary for completion of studies.
   2. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
   3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
B. Pre-Study Meeting: Conduct meeting with Owner to discuss system operating modes and conditions to be considered in studies.
C. Sequencing:
   1. Submit study reports prior to or concurrent with product submittals.
   2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.
   3. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).
D. Scheduling:
   1. Arrange access to existing facility for data collection with Owner.
   2. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Study preparer's qualifications.
C. Field testing agency's qualifications.
D. Study reports, stamped or sealed and signed by study preparer.
E. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
   1. Include characteristic time-current trip curves for protective devices.

2. Include impedance data for busway.
3. Include impedance data for engine generators.
4. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
5. Include documentation of listed series ratings upon request.
6. Identify modifications made in accordance with studies that:
   a. Can be made at no additional cost to Owner.
   b. As submitted will involve a change to the contract sum.

F. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.

G. Site-specific arc flash hazard warning labels.

H. Field quality control reports.

I. Certification that field adjustable protective devices have been set in accordance with requirements of studies.

J. Project Record Documents: Revise studies as required to reflect as-built conditions.
   1. Include hard copies with operation and maintenance data submittals.
   2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.06 POWER SYSTEM STUDIES

A. Scope of Studies:
   1. Perform analysis of new electrical distribution system as indicated on drawings.
   2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
   3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
      a. Known Operating Modes:
         1) Utility as source.

B. General Study Requirements:
   1. Comply with NFPA 70.
   2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C. Data Collection:
   1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
      a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
         1) Obtain up-to-date information from Utility Company.
         2) Utility Company: See Section 26 2100 for Utility Company contact information.
      b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
      c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
      d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.

e. Protective Devices:
1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.

2. Existing Installations:
a. Provide the services of field testing agency or equipment manufacturer's representative to perform field data collection.
b. Collect data on existing electrical distribution system necessary for completion of studies, including field verification of available existing data (e.g. construction documents, previous studies). Include actual settings for field-adjustable devices.
c. Available Existing Data:

D. Short-Circuit Study:
1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
a. Maximum utility fault currents.
b. Maximum motor contribution.
c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.

E. Protective Device Coordination Study:
1. Comply with applicable portions of IEEE 242 and IEEE 399.
2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. Analyze protective devices and associated settings for suitable margins between time-current curves to achieve full selective coordination while providing adequate protection for equipment and conductors.

F. Arc Flash and Shock Risk Assessment:
1. Comply with NFPA 70E.
2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
a. To clarify IEEE 1584 statement that "equipment below 240 V need not be considered unless it involves at least one 125 kVA or larger low-impedance transformer in its immediate power supply" for purposes of studies, study preparer to include equipment rated less than 240 V fed by transformers less than 125 kVA in calculations.
b. Where reasonable, study preparer may assume a maximum clearing time of two seconds in accordance with IEEE 1584, provided that the conditions are such that a worker's egress from an arc flash event would not be inhibited.
c. For single-phase systems, study preparer to perform calculations assuming three-phase system in accordance with IEEE 1584 yielding conservative results.

3. For equipment with main devices mounted in separate compartmentalized sections, perform calculations on both the line and load side of the main device.
4. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
    a. Maximum and minimum utility fault currents.
    b. Maximum and minimum motor contribution.
    c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

G. Study Reports:
1. General Requirements:
    a. Identify date of study and study preparer.
    b. Identify study methodology and software product(s) used.
    c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
    d. Identify base used for per unit values.
    e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
    f. Include conclusions and recommendations.
2. Short-Circuit Study:
    a. For each scenario, identify at each bus location:
        1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
        2) Fault point X/R ratio.
        3) Associated equipment short circuit current ratings.
    b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
3. Protective Device Coordination Study:
    a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
    b. For each graph include (where applicable):
        1) Partial single-line diagram identifying the portion of the system illustrated.
        2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
        3) Conductors: Damage curves.
        4) Transformers: Inrush points and damage curves.
        5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
        6) Motors: Full load current, starting curves, and damage curves.
        7) Capacitors: Full load current and damage curves.
    c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
        1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
        2) Include ground fault pickup and delay.
        3) Include fuse ratings.
        4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
    d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.

4. Arc Flash and Shock Risk Assessment:
    a. For each scenario, identify at each bus location:
        1) Calculated incident energy and associated working distance.
        2) Calculated arc flash boundary.
        3) Bolted fault current.
        4) Arcing fault current.
        5) Clearing time.
        6) Arc gap distance.
    b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.
    c. Identify locations where the calculated maximum incident energy exceeds 40 calories per sq cm.

1.07 QUALITY ASSURANCE

A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in the preparation of studies of similar type and complexity using specified computer software.
    1. Study preparer may be employed by the manufacturer of the electrical distribution equipment.
    2. Study preparer may be employed by field testing agency.
    3. Acceptable Study Preparers:

B. Field Testing Agency Qualifications: Independent testing organization specializing in testing, analysis, and maintenance of electrical systems with minimum five years experience; NETA Accredited Company.
    1. Field Supervisor: Certified electrical testing technician; NETA ETT Level III.

C. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
    1. Acceptable Software Products:
        a. EasyPower LLC: www.easypower.com/#sle.
        b. ETAP/Operation Technology, Inc: www.etap.com/#sle.
        c. Power Analytics Corporation: www.poweranalytics.com/#sle.
        d. SKM Systems Analysis, Inc: www.skm.com/#sle.

PART 2 PRODUCTS

2.01 ARC FLASH HAZARD WARNING LABELS

A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
    1. Materials: Comply with Section 26 0553.
    2. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
        a. Include orange header that reads "WARNING" where calculated incident energy is less than 40 calories per square cm.
        b. Include red header that reads "DANGER" where calculated incident energy is 40 calories per square cm or greater.
        c. Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.

d. Include the following information:
   1) Arc flash boundary.
   2) Available incident energy and corresponding working distance.
   3) Site-specific PPE (personnel protective equipment) requirements.
   4) Nominal system voltage.
   5) Limited approach boundary.
   6) Restricted approach boundary.
   7) Equipment identification.
   8) Date calculations were performed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install arc flash warning labels in accordance with Section 26 0553.

3.02 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Provide the services of field testing agency or equipment manufacturer's representative to perform inspection, testing, and adjusting.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Adjust equipment and protective devices for compliance with studies and recommended settings.

E. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.

F. Submit detailed reports indicating inspection and testing results, and final adjusted settings.

3.03 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Training: Include as part of the base bid training for Owner's personnel on electrical safety pertaining to arc flash and shock hazards.
   1. Use site-specific arc flash and shock risk assessment report as training reference, supplemented with additional training materials as required.
   2. Provide minimum of eight hours of training.
   3. Instructor: Representative of entity performing study.
   4. Location: At project site.

3.04 ATTACHMENTS

A. Previous studies.

B. Existing drawings.

END OF SECTION

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SECTION 26 0583
WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
B. Section 26 0533.13 - Conduit for Electrical Systems.
C. Section 26 0533.16 - Boxes for Electrical Systems.
D. Section 26 2726 - Wiring Devices.
E. Section 26 2816.16 - Enclosed Switches.
F. Section 26 2913 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   2. Determine connection locations and requirements.
B. Sequencing:
   1. Install rough-in of electrical connections before installation of equipment is required.
   2. Make electrical connections before required start-up of equipment.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
   1. Colors: Conform to NEMA WD 1.
   2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
   3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Disconnect Switches: As specified in Section 26 2816.16 and in individual equipment sections.

C. Wiring Devices: As specified in Section 26 2726.

D. Flexible Conduit: As specified in Section 26 0533.13.

E. Wire and Cable: As specified in Section 26 0519.

F. Boxes: As specified in Section 26 0533.16.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 26 0923
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Occupancy sensors.
B. Outdoor motion sensors.
C. Time switches.
D. In-wall time switches.
E. In-wall interval timers.
F. Outdoor photo controls.
G. Daylighting controls.
H. Lighting contactors.
I. Control accessories.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
B. Section 26 0529 - Hangers and Supports for Electrical Systems
C. Section 26 0533.16 - Boxes for Electrical Systems.
D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
E. Section 26 0573 - Power System Studies.
F. Section 26 0918 - Remote Control Switching Devices: Remotely controlled devices for lighting control, including networked lighting controls, programmable relay panels, and remote control switching relays.
G. Section 26 2726 - Wiring Devices: Devices for manual control of lighting, including wall switches.
    1. Includes finish requirements for wall controls specified in this section.
    2. Includes accessory receptacles, switches, dimmers and wall plates, to match lighting controls specified in this section.
H. Section 26 2813 - Fuses.
I. Section 26 2913 - Enclosed Controllers : General purpose contactors.
J. Section 26 5100 - Interior Lighting.
K. Section 26 5561 - Theatrical Lighting: Controls for stage lighting units.
L. Section 26 5600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.

B. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2023.

C. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols; 2020.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

E. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

G. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.

H. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

I. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; 2017.

J. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.

M. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

N. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.

O. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

P. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

Q. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.

R. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
   3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
   4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
   5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not install lighting control devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

C. Shop Drawings:
   1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
   2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.

D. Field Quality Control Reports.

E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Operation and Maintenance Data: Include detailed information on device programming and setup.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Locking Receptacle-Mounted Outdoor Photo Controls: Five percent of total quantity installed for each type, but not less than two of each type.
   3. Indicating Lights: Two of each different type.

H. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for all occupancy sensors.

C. Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.

D. Provide two year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.02 OCCUPANCY SENSORS

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Acuity Brands: www.acuitybrands.com
3. Sensor Switch Inc: www.sensorswitch.com/#sle.
4. WattStopper: www.wattstopper.com/#sle.
5. Substitutions: See Section 01 6000 - Product Requirements.
6. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. All Occupancy Sensors:
1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
2. Sensor Technology:
   a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
   b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
   c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
   d. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.

6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
8. Sensitivity: Field adjustable.
9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
10. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above the selected level.
11. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
12. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
13. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.
14. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
15. Wireless Sensors:
    a. RF Range: 30 feet through typical construction materials.
    b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
    c. Power: Battery-operated with minimum ten-year battery life.

C. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
    a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
    b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
    c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
    d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
    e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
    f. Provide selectable audible alert to notify occupant of impending load turn-off.
    g. Finish: Match finishes specified for wiring devices in Section 26 2726, unless otherwise indicated.
    h. Provide vandal resistant lenses for passive infrared (PIR) and dual technology wall switch occupancy sensors where indicated.
2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

D. Wall Dimmer Occupancy Sensors:
1. General Requirements:
    a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability , and no leakage current to load in off mode.

b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
c. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
d. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
e. Provide field adjustable dimming preset for occupied state.
f. Provide fade-to-off operation to notify occupant of impending load turn-off.
g. Finish: Match finishes specified for wiring devices in Section 26 2726, unless otherwise indicated.

2. Passive Infrared (PIR) Wall Dimmer Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
   a. Products:
      1) Lutron Maestro C.L Sensor Dimmer Series; www.lutron.com/#sle.
      2) Lutron Maestro Occupancy Sensor Dimmer Series; www.lutron.com/#sle.
      3) Lutron Maestro 0-10V Dimmer Sensor Series; www.lutron.com/#sle.
      4) Substitutions: See Section 01 6000 - Product Requirements.

E. Ceiling Mounted Occupancy Sensors:
   1. All Ceiling Mounted Occupancy Sensors:
      a. Description: Low profile occupancy sensors designed for ceiling installation.
      b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
      c. Provide field selectable setting for disabling LED motion detector visual indicator.
      d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
      e. Finish: White unless otherwise indicated.
   2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
      a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
         1) Products:
            (a) Lutron LOS-CIR Series; www.lutron.com/#sle.
            (b) Lutron Radio Powr Savr Wireless Sensors; www.lutron.com/#sle.
      b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
         1) Products:
   3. Ultrasonic Ceiling Mounted Occupancy Sensors:
      a. Standard Range Sensors: Capable of detecting motion within an area of 500 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
         1) Products:
            (a) Lutron LOS-CUS Series; www.lutron.com/#sle.
      b. Medium Range Sensors: Capable of detecting motion within an area of 1,000 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
         1) Products:
            (a) Lutron LOS-CUS Series; www.lutron.com/#sle.
      c. Extended Range Sensors: Capable of detecting motion within an area of 2,000 square feet at a mounting height of 9 feet.
         1) Products:

(a) Lutron LOS-CUS Series; www.lutron.com/#sle.

4. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
   a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
      1) Products:
         (a) Lutron LOS-CDT Series; www.lutron.com/#sle.
   b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
      1) Products:
         (a) Lutron LOS-CDT Series; www.lutron.com/#sle.
5. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
   a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
   b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet.

F. Directional Occupancy Sensors:
   1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
      a. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
      b. Provide field selectable setting for disabling LED motion detector visual indicator.
      c. Finish: White unless otherwise indicated.
   2. Passive Infrared (PIR) Directional Occupancy Sensors:
      a. Standard Range Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.

G. Luminaire Mounted Occupancy Sensors: Designed for direct luminaire installation and control, suitable for use with specified luminaires.

H. Power Packs for Low Voltage Occupancy Sensors:
   1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
   2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
   3. Input Supply Voltage: Dual rated for 120/277 V ac.
   4. Load Rating: As required to control the load indicated on drawings.

I. Power Packs for Wireless Occupancy Sensors:
   1. Description: Plenum rated, self-contained relay compatible with specified wireless occupancy sensors for switching of line voltage loads.
   2. Input Supply Voltage: Dual rated for 120/277 V ac.
   3. Load Rating: As required to control the load indicated on drawings.

2.03 OUTDOOR MOTION SENSORS

A. Description: Factory-assembled wet location listed device suitable for wall or ceiling/eave mounting, with integral swivel for field adjustment of coverage, capable of detecting motion for automatic control of load indicated.

B. Sensor Technology: Passive Infrared (PIR) designed to detect occupancy by sensing movement of thermal energy between zones.

C. Operation: Unless otherwise indicated, motion sensor to turn load on when motion is detected and to turn load off when no motion is detected during an adjustable turn-off delay time interval.

D. Turn-Off Delay: Field adjustable, with time delay settings available up to 15 minutes.

E. Integral Photocell: For dusk to dawn operation.

F. Manual Override: Activated by switching power off to unit and then back on.

G. Load Rating: 1,000 W incandescent and fluorescent load at 120 V ac.

H. Coverage: Capable of detecting motion within a distance of 50 feet at a mounting height of 8 feet, with a field of view of 270 degrees.

2.04 TIME SWITCHES

A. Manufacturers:
1. Intermatic, Inc: www.intermatic.com/#sle.
2. Tork, a division of NSI Industries LLC: www.tork.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.
4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. Digital Electronic Time Switches:
1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
2. Program Capability:
   a. 24-Hour Time Switches: Single channel, with same schedule for each day of the week and skip-a-day feature to omit selected days.
   b. 7-Day Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days.
   c. Astronomic Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
3. Schedule Capacity: Not less than 16 programmable on/off operations.
4. Provide automatic daylight savings time and leap year compensation.
5. Provide power outage backup to retain programming and maintain clock.
6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
7. Input Supply Voltage: As indicated on the drawings.
8. Output Switch Configuration: As required to control the load indicated on drawings.
9. Output Switch Contact Ratings: As required to control the load indicated on drawings.
10. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:

2.05 IN-WALL TIME SWITCHES

2.06 IN-WALL INTERVAL TIMERS

2.07 OUTDOOR PHOTO CONTROLS

A. Manufacturers:
1. Intermatic, Inc: www.intermatic.com/#sle.

2. Tork, a division of NSI Industries LLC: www.tork.com/#sle.

B. Stem-Mounted Outdoor Photo Controls:
1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
2. Housing: Weatherproof, impact resistant polycarbonate.
3. Photo Sensor: Cadmium sulfide.
4. Provide external sliding shield for field adjustment of light level activation.
5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
6. Voltage: As required to control the load indicated on the drawings.
7. Failure Mode: Fails to the on position.
8. Load Rating: As required to control the load indicated on the drawings.
9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

C. Locking Receptacle-Mounted Outdoor Photo Controls
1. Description: Plug-in locking type photo control unit complying with ANSI C136.10 for mounting on a compatible receptacle, listed and labeled as complying with UL 773.
2. Housing: Weatherproof, impact resistant UV stabilized polypropylene, color to be selected.
3. Photo Sensor: Cadmium sulfide.
4. Light Level Activation: 1 to 3 footcandles turn-on and 1.5 to 1 turn-off to turn-on ratio with instant turn-on and delayed turn-off.
5. Voltage: As required to control the load indicated on the drawings.
6. Failure Mode: Fails to the on position.
7. Load Rating: As required to control the load indicated on the drawings.
8. Surge Protection: 160 joule metal oxide varistor.
9. Provide the following accessories where indicated or as required to complete installation:
   a. Receptacle: Complying with ANSI C136.10.
   b. Mounting Bracket.
   c. Shorting Cap: Suitable for replacing locking photo control to complete circuit.

2.08 DAYLIGHTING CONTROLS

A. Manufacturers:
1. Hubbell Control Solutions: www.hubbell.com/hubbellcontrolsolutions/en/#sle.
2. Lutron Electronics Company, Inc: www.lutron.com/#sle.
3. Sensor Switch Inc: www.sensorswitch.com/#sle.
4. WattStopper: www.wattstopper.com/#sle.

B. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.

C. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.
1. Sensor Type: Filtered silicon photo diode.
2. Sensor Range:
   a. Indoor Photo Sensors: 5 to 100 footcandles.
   b. Outdoor Photo Sensors: 5 to 250 footcandles.
   c. Atrium Photo Sensors: 200 to 2,500 footcandles.

d. Skylight Photo Sensors: 1,000 to 6,000 footcandles.
e. Open Loop Photo Sensors: 3 to 6,000 footcandles.

3. Finish: White unless otherwise indicated.
4. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
5. Wireless Daylighting Control Photo Sensors:
   a. RF Range: 30 feet through typical construction materials.
   b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
   c. Power: Battery-operated with minimum ten-year battery life.
   d. Products:
      1) Lutron Radio Powr Savr Wireless Sensors; www.lutron.com/#sle.

D. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.

E. Daylighting Control Switching Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors, for switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
1. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
2. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
3. Control Capability:
   a. Single Zone Switching Modules: Capable of controlling one programmable channel.
   b. Multi-Zone Switching Modules: Capable of controlling up to three separately programmable channels.

F. Daylighting Control Switching Modules for Wireless Sensors:
1. Description: Plenum rated, self-contained relay compatible with specified wireless photo sensors for switching of line voltage loads in response to changes in measured light levels according to selected settings.
2. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
3. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
4. Control Capability: Capable of controlling one programmable channel.
5. Input Supply Voltage: Dual rated for 120/277 V ac.

G. Daylighting Control Dimming Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors and with specified dimming ballasts, for both continuous dimming of compatible dimming ballasts and switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
1. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
2. Control Capability: Capable of controlling up to three separately programmable channels, with up to 50 ballasts per channel.
3. Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
4. Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.

H. Daylighting Control Dimming Modules for Wireless Sensors:

1. Description: Plenum rated control unit compatible with specified wireless photo sensors and with specified dimming ballasts, for continuous dimming of compatible dimming ballasts in response to changes in measured light levels according to selected settings.
2. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
3. Load to be turned off when available daylight is sufficient to fully dim the load, after the selected time delay.
4. Control Capability: Capable of controlling up to 32 ballasts with up to two separately programmable daylighting zones.

I. Power Packs for Low Voltage Daylighting Control Modules:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage daylighting control modules for switching of line voltage loads. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
2. Input Supply Voltage: Dual rated for 120/277 V ac.
3. Load Ratings: As required to control the load indicated on drawings.

J. Accessories:
1. Where indicated, provide compatible accessory wall switches for manual override control.
2. Where indicated, provide compatible accessory wireless controls for manual override control.
a. Products:
1) Lutron Pico Wireless Controls; www.lutron.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of lighting control devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
      b. In-Wall Time Switches: 48 inches above finished floor.
      c. In-Wall Interval Timers: 48 inches above finished floor.
   2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
   3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

C. Install lighting control devices in accordance with manufacturer's instructions.

D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E. Install lighting control devices plumb and level, and held securely in place.

F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 2726.

G. Provide required supports in accordance with Section 26 0529.

H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

I. Identify lighting control devices in accordance with Section 26 0553.

J. Occupancy Sensor Locations:
   1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect.

K. Outdoor Photo Control Locations:
   1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
   2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.

L. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.

M. Daylighting Control Photo Sensor Locations:
   1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect.
   2. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.

3. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.

N. Combination Enclosed Lighting Contactors:
1. Except where indicated to be mounted adjacent to the equipment they supply, mount lighting contactors such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

O. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

P. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

Q. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each lighting control device for damage and defects.

C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

D. Test time switches to verify proper operation.

E. Test outdoor photo controls to verify proper operation, including time delays where applicable.

F. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.

G. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.

D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.

F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.

G. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 COMMISSIONING

A. See Section 01 9113 - General Commissioning Requirements for commissioning requirements.

3.08 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
   4. Location: At project site.

END OF SECTION

SECTION 26 2100
LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical service requirements.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Materials and installation requirements for cast-in-place concrete equipment pads.
B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
C. Section 26 0526 - Grounding and Bonding for Electrical Systems.
D. Section 26 0529 - Hangers and Supports for Electrical Systems.
E. Section 26 0533.13 - Conduit for Electrical Systems.
F. Section 26 0533.23 - Surface Raceways for Electrical Systems: Wireways.
G. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
H. Section 26 2300 - Low-Voltage Switchgear: Service entrance equipment.
I. Section 26 2413 - Switchboards: Service entrance equipment.
J. Section 26 2416 - Panelboards: Service entrance equipment.
K. Section 26 2713 - Electricity Metering: Non-utility electrical metering.

1.03 PRICE AND PAYMENT PROCEDURES

A. Allowances:
    1. See Section 01 2100 - Allowances, for allowances affecting this section.
    2. Include cash allowance for Utility Company charges associated with providing service.
B. Unit Prices:
    1. See Section 01 2200 - Unit Prices, for additional unit price requirements.
    2. Primary:
        a. Basis of Measurement: By the lineal foot, for each configuration.
        b. Basis of Payment: Includes all work designated to be provided by Contractor in "Division of Responsibility" under Part 2 article "Electrical Service Requirements" below, including purchase, delivery, and installation.
    3. Secondary:
        a. Basis of Measurement: By the lineal foot, for each configuration.
        b. Basis of Payment: Includes all work designated to be provided by Contractor in "Division of Responsibility" under Part 2 article "Electrical Service Requirements" below, including purchase, delivery, and installation.
    4. Transformer Pad/Vault:
        a. Basis of Measurement: Per unit, for each type.
        b. Basis of Payment: Includes purchase, delivery, and installation.

1.04 DEFINITIONS

A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.05 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.06 ADMINISTRATIVE REQUIREMENTS

A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.

B. Coordination:
   1. Verify the following with Utility Company representative:
      a. Utility Company requirements, including division of responsibility.
      b. Exact location and details of utility point of connection.
      c. Utility easement requirements.
      d. Utility Company charges associated with providing service.
   2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
   3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.

D. Utility Company charges associated with providing permanent service to be paid by Owner.

E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.

F. Scheduling:
   1. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.07 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.08 QUALITY ASSURANCE

A. Comply with the following:
   1. IEEE C2 (National Electrical Safety Code).
   2. NFPA 70 (National Electrical Code).
   3. The requirements of the Utility Company.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 ELECTRICAL SERVICE REQUIREMENTS

A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.

B. Electrical Service Characteristics: As indicated on drawings.

C. Utility Company: As indicated on drawings.

D. Division of Responsibility: As indicated on drawings.

E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Verify and mark locations of existing underground utilities.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions and Utility Company requirements.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required support and attachment components in accordance with Section 26 0529.

E. Provide grounding and bonding for service entrance equipment in accordance with Section 26 0526.

F. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 0553.

3.04 PROTECTION

A. Protect installed equipment from subsequent construction operations.

END OF SECTION

SECTION 26 2200
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General purpose transformers.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
B. Section 26 0529 - Hangers and Supports for Electrical Systems.
C. Section 26 0533.13 - Conduit for Electrical Systems: Flexible conduit connections.
D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.
E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
F. Section 26 2416 - Panelboards.
G. Section 26 2713 - Electricity Metering: Instrument transformers for electrical metering.

1.03 REFERENCE STANDARDS

A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers; Current Edition.
B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers; 2015.
C. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers; 2013.
D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2015.
F. NEMA ST 20 - Dry Type Transformers for General Applications; 2021.
G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
H. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
J. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.
K. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.
   1. Vibration Isolators: Include attachment method and rated load and deflection.

C. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.

D. Manufacturer's equipment seismic qualification certification.

E. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as design and routine tests.

F. Field Quality Control Test Reports.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Maintenance Data: Include recommended maintenance procedures and intervals.

I. Project Record Documents: Record actual locations of transformers.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Ambient Temperature: Do not exceed the following maximum temperatures during and after installation of transformers.
   1. Greater than 10 kVA: 104 degrees F maximum.
   2. Less than 10 kVA: 77 degrees F maximum.

B. Ambient Temperature: Do not exceed 86 degrees F average or 104 degrees F maximum measured during any 24 hour period during and after installation of transformers.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB/GE: www.geindustrial.com/#sle.

B. Eaton Corporation www.eaton.com/#sle.

C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

D. Siemens Industry, Inc: www.usa.siemens.com/#sle.

E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 TRANSFORMERS - GENERAL REQUIREMENTS

A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
   1. Altitude: Less than 3,300 feet.
   2. Ambient Temperature:
      a. Greater than 10 kVA: Not exceeding 104 degrees F.
      b. Less than 10 kVA: Not exceeding 77 degrees F.
   3. Ambient Temperature: Not exceeding 86 degrees F average or 104 degrees F maximum measured during any 24 hour period.

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E. Basic Impulse Level: 10 kV.

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.03 GENERAL PURPOSE TRANSFORMERS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

B. Primary Voltage: 480 volts delta, 3 phase.

C. Secondary Voltage: 208Y/120 volts, 3 phase.

D. Insulation System and Allowable Average Winding Temperature Rise:
   1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
   2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.

E. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.

F. Winding Taps:
   1. Less than 3 kVA: None.
   2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
   3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
   4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.

G. Energy Efficiency: Comply with 10 CFR 431, Subpart K.

H. Sound Levels: Standard sound levels complying with NEMA ST 20

I. Mounting Provisions:
   1. Less than 15 kVA: Suitable for wall mounting.
   2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
   3. Larger than 75 kVA: Suitable for floor mounting.

J. Transformer Enclosure: Comply with NEMA ST 20.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   2. Construction: Steel.
      a. Less than 15 kVA: Totally enclosed, non-ventilated.
      b. 15 kVA and Larger: Ventilated.
   3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
   4. Provide lifting eyes or brackets.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.

C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Provide seismic restraints.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install products in accordance with manufacturer's instructions.

D. Install transformers in accordance with NECA 409 and IEEE C57.94.

E. Use flexible conduit, under the provisions of Section 26 0533.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

F. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.

G. Install transformers plumb and level.

H. Transformer Support:
   1. Provide required support and attachment in accordance with Section 26 0529, where not furnished by transformer manufacturer.
   2. Use integral transformer flanges to support wall-mounted transformers.
   3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
   4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

I. Provide grounding and bonding in accordance with Section 26 0526.

J. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

K. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.
   1. 167 kVA single phase, 500 kVA three phase and smaller:
      a. Perform turns ratio tests at all tap positions.
   2. Larger than 167 kVA single phase and 500 kVA three phase:
      a. Verify that control and alarm settings on temperature indicators are as specified.
      b. Perform excitation-current tests on each phase.
      c. Measure the resistance of each winding at each tap connection.
      d. Perform an applied voltage test on all high- and low-voltage windings-to-ground.

3.04 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from transformer components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2300
LOW-VOLTAGE SWITCHGEAR

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low-voltage (600 V and less) arc-resistant metal-enclosed drawout switchgear and accessories for service and distribution applications.

B. Low-voltage power circuit breakers for switchgear.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

G. Section 26 2100 - Low-Voltage Electrical Service Entrance.
   1. Includes Utility Company contact information.

H. Section 26 2413 - Switchboards.

I. Section 26 2419 - Motor-Control Centers.

J. Section 26 2513 - Low-Voltage Busways.

K. Section 26 2713 - Electricity Metering: For interface with equipment specified in this section.

L. Section 26 2813 - Fuses: Fuses for fusible switches.
   1. Includes requirements for spare fuses and spare fuse cabinets.

M. Section 26 4300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. ANSI C37.50 - American National Standard for Switchgear - Low Voltage AC Power Circuit Breakers Used In Enclosures - Test Procedures; 2018.

B. ANSI C37.51 - American National Standard for Switchgear - Metal-Enclosed Low Voltage AC Power Circuit Breaker Switchgear Assemblies - Conformance Test Procedures; 2018.

C. IEEE C37.13 - IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures; 2015.

D. IEEE C37.16 - IEEE Standard for Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage AC (635 V and below) and DC (3200 V and below) Power Circuit Breakers; 2009.

E. IEEE C37.17 - IEEE Standard for Trip Systems for Low-Voltage (1000 V and below) AC and General Purpose (1500 V and below) DC Power Circuit Breakers; 2022.
F. IEEE C37.20.1 - IEEE Standard for Metal-Enclosed Low-Voltage (1000 Vac and Below, 3200 Vdc and Below) Power Circuit Breaker Switchgear; 2015, with Amendment (2020).
G. IEEE C37.20.7 - IEEE Guide for Testing Switchgear Rated up to 52 kV for Internal Arcing Faults; 2017 (Corrigendum 2021).
H. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
I. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
J. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
K. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
N. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.
O. UL 1066 - Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures; Current Edition, Including All Revisions.
P. UL 1558 - Switchgear; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
   5. Notify Architect of any conflicts with or deviations Contract Documents. Obtain direction before proceeding with work.
B. Service Entrance Switchgear:
   1. Coordinate with Utility Company to provide switchgear with suitable provisions for electrical service and utility metering, where applicable.
   2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
   3. See Section 26 2100 for Utility Company contact information and additional requirements.
   4. Obtain Utility Company approval of switchgear prior to fabrication.
   5. Preinstallation Meeting: Convene one week prior to commencing work of this section to review requirements with Utility Company representative.
   6. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchgear, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, short-time current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of switchgear and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.
   3. Include documentation demonstrating selective coordination upon request.
   4. Include key-type mechanical interlock scheme with sequence of operations, as applicable.
   5. Include proposed mimic bus single-line diagram arrangement.
   6. Arc-Resistant Switchgear: Include proposed plenum arrangement, where applicable.
   7. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Service Entrance Switchgear: Include documentation of Utility Company approval of switchgear.

F. Source Quality Control Test Reports: Include reports for tests designated in IEEE C37.20.1 as production tests.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Field Quality Control Test Reports.

I. Project Record Documents: Record actual installed locations of switchgear and final equipment settings.

J. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Enclosure Keys: Two of each different key.
   3. Circuit Breakers:
      a. Handles Necessary for Racking of Devices: One for each electrical room containing drawout switchgear.
      b. Lifting Yokes: One of each different yoke required, for each electrical room containing drawout switchgear.
      c. Removable Covers: One for blocking each different opening size when circuit breaker is temporarily removed from its compartment.
   4. See Section 26 2813 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store switchgear in accordance with manufacturer's instructions and IEEE C37.20.1.

B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchgear, which is not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.

C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully to avoid damage to switchgear internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Low-Voltage Switchgear - Basis of Design.

B. Low-Voltage Switchgear - Other Acceptable Manufacturers:
   1. ABB/GE: www.geindustrial.com/#sle.
   2. Eaton Corporation: www.eaton.com/#sle.
   3. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
   4. Siemens Industry, Inc: www.usa.siemens.com/#sle.

C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 LOW-VOLTAGE SWITCHGEAR

A. Provide switchgear assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Dead-front standard (non-arc-resistant) type metal-enclosed drawout switchgear complying with IEEE C37.20.1 and ANSI C37.51; listed and labeled as complying with UL 1558; ratings, configurations and features as indicated on the drawings.

D. Configuration:
   1. Compartmentalization: Provide barriered compartments for each overcurrent protective device, distribution bus, and rear cable connection area.
   2. Arrangement: Rear accessible, front and rear aligned.
   3. Rear Access: Bolted covers.

E. Arc-Resistance Rating:
   1. Passes criteria for arc-resistant functionality when tested in accordance with applicable requirements of IEEE C37.20.7 for Type 2 accessibility.
   2. Arc exhaust gases must be discharged through a plenum into designated area approved by Architect.

3. Arc resistant rating valid through maximum current of not less than the available fault current at the installed location.

F. Service Entrance Switchgear:
   1. Listed and labeled as suitable for use as service equipment according to UL 869A.
   2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
   3. Comply with Utility Company requirements for electrical service.
   4. Utility Metering Provisions: Provide separate barriered compartment complying with Utility Company requirements where indicated or where required by Utility Company. Include hinged sealable door and provisions for Utility Company current transformers (CTs), potential transformers (PTs), or potential taps as required.
   5. See Section 26 2100 for additional requirements.

G. Switchgear With Busway Transitions: Configured for bussed connection to busway provided in accordance with Section 26 2513.

H. Switchgear With Fire Pump Taps: Provide separate bussed vertical section with suitable lugs for fire pump connection to line side of main service disconnect device(s).

I. Provide integral top rail-mounted lifting device where indicated.

J. Seismic Qualification: Provide switchgear and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.

K. Service Conditions:
   1. Provide switchgear and associated components suitable for operation under the following service conditions without derating:
      a. Altitude: Less than 6,600 feet.
      b. Ambient Temperature: Between -22 degrees F and 104 degrees F.
   2. Provide switchgear and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

L. Short Circuit Current Rating:
   1. Provide switchgear with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

M. Short-Time Current (30-Cycle Withstand) Rating: Equivalent to specified short circuit current rating.

N. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.

O. Bussing: Sized in accordance with UL 1558 temperature rise requirements.
   1. Main bus (horizontal cross bus) to be fully rated through full length of switchgear.
   2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   3. Provide solidly bonded equipment ground bus through full length of switchgear, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
   4. Phase and Neutral Bus Material: Copper.
   5. Ground Bus Material: Copper.

P. Conductor Terminations: Suitable for use with the conductors to be installed.
   1. Line Conductor Terminations:
      a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
      b. Main and Neutral Lug Type: Mechanical.

2. Load Conductor Terminations:
    a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
    b. Lug Type:

Q. Enclosures:
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    a. Indoor Clean, Dry Locations: Type 1.
    b. Outdoor Locations: Type 3R.
2. Finish: Manufacturer's standard unless otherwise indicated.
3. Enclosure Space Heaters:
    a. Provide in each switchgear section installed outdoors and in unconditioned indoor spaces.
    b. Size according to manufacturer's recommendations for worst case ambient temperature to prevent condensation.
    c. Heater Control: Thermostat.
    d. Heater Power Source: Provide connection to transformer factory-installed in switchgear or suitable external branch circuit as indicated or as required.
4. Outdoor Enclosures:
    a. Enclosure Type: Non-walk-in type unless otherwise indicated.
    b. Color: Manufacturer's standard.
    c. Access Doors: Lockable, with all locks keyed alike.
    d. Walk-in Enclosure Features:
        1) Personnel Doors: Open to exterior; equipped with panic hardware.
        2) Aisle lighting, with switch at each access door.
        3) GFCI duplex convenience receptacle.

R. Future Provisions:
1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
2. Arrange and equip through bus and ground bus to accommodate future installation of additional switchgear sections.

S. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list switchgear as a complete assembly including surge protective device.

T. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
1. Provide separate neutral current sensor where applicable.

U. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.

V. Owner Metering: Comply with Section 26 2713.

W. Owner Metering:
1. Provide microprocessor-based digital electrical metering system including all instrument transformers, wiring, and connections necessary for measurements specified.
2. Measured Parameters:
    a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
    b. Current (Amps): For each phase and neutral.
    c. Frequency (Hz).
    d. Real power (kW): For each phase, 3-phase total.

e. Reactive power (kVAR): For each phase, 3-phase total.
f. Apparent power (kVA): For each phase, 3-phase total.
g. Power factor.
h. Real energy (kWh).
i. Reactive energy (kVARh).
j. Apparent energy (kVAh).
k. Current demand.
l. Power demand: Real, reactive, and apparent.

3. Meter Accuracy: Plus/minus 1.0 percent.
4. Features:
   a. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.
   b. KYZ pulse output.
   c. Adjustable demand interval.
   d. Remote monitoring capability via PC.

X. Instrument Transformers:
1. Comply with IEEE C57.13.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Connect secondaries to shorting terminal blocks.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.03 LOW-VOLTAGE POWER CIRCUIT BREAKERS

A. Description: Quick-make, quick-break, trip-free low-voltage power circuit breakers with two-step stored energy closing mechanism; 100 percent rated; complying with IEEE C37.13, IEEE C37.16, IEEE C37.17, and ANSI C37.50; listed and labeled as complying with UL 1066; ratings, configurations, and features as indicated on the drawings.

B. Interrupting Capacity: Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.

C. Operation:
1. Provide manually operated circuit breakers unless otherwise indicated.
2. Provide electrically operated circuit breakers where indicated.
3. Pad-Lock Provision: For preventing circuit breaker closing operation.

D. Construction: Drawout.
1. Allows withdrawal of circuit breaker into test and disconnected positions, with racking position indication (connected, test, disconnected, withdrawn).
2. Provide safety interlock to prevent racking of circuit breaker while in the ON position.
3. Pad-Lock Provision: For preventing circuit breaker drawout operation.

E. Fused Circuit Breakers:
1. Fuses: Class L, selected for coordination with circuit breaker trip units.
2. Blown Fuse Protection: Provide blown fuse protection to trip circuit breaker in the event of the opening, or absence, of a fuse and to prevent closing of circuit breaker until reset operation is performed; provide blown fuse status indication.
3. Where fuse is not integral with circuit breaker and mounted in a separate compartment, provide interlock to prevent fuse access with the circuit breaker in the ON position.

F. Trip Units: Solid state, microprocessor-based, true rms sensing.
1. Provide the following field-adjustable trip response settings:
   a. Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
   b. Long time delay.

c. Short time pickup and delay.
d. Instantaneous pickup.
1) Include instantaneous function for feeder circuit breakers.
2) Omit instantaneous function or provide ability to turn instantaneous function off for main and tie circuit breakers.
e. Ground fault pickup and delay where ground fault protection is indicated.

2. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
3. Provide communication capability where indicated: Compatible with system indicated.

G. Provide the following features and accessories where indicated or where required to complete installation:
1. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
2. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
3. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
4. Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.
5. Truck-Operated Cell Switch: For indicating circuit breaker racking position.

2.04 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Factory test switchgear according to IEEE C37.20.1, including the following production tests on each switchgear assembly or component:
1. Dielectric tests.
2. Mechanical operation tests.
3. Grounding of instrument transformer cases test.
4. Electrical operation and control wiring tests, including polarity and sequence tests.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the switchgear and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive switchgear.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install switchgear in accordance with NECA 1 (general workmanship) and IEEE C37.20.1.

C. Arrange equipment to provide required clearances and maintenance access, including accommodations for drawout circuit breakers.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install switchgear plumb and level.

F. Unless otherwise indicated, mount switchgear on properly sized 4 inch high concrete pad constructed in accordance with Section 03 3000.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Install all field-installed devices, components, and accessories.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Set field-adjustable circuit breaker tripping function settings as indicated.

K. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

L. Identify switchgear in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.

C. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Before energizing switchgear, perform preoperation checks in accordance with IEEE C37.20.1.

E. Inspect and test in accordance with NETA ATS, except Section 4.

F. Perform inspections and tests listed in NETA ATS, Section 7.1.

G. Low-Voltage Power Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.2 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.
   1. Perform insulation-resistance tests on all control wiring with respect to ground.
   2. Test functions of the trip unit by means of secondary injection.

H. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
   1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.

I. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.

J. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.

K. Test shunt trips to verify proper operation.

L. Correct deficiencies and replace damaged or defective switchgear assemblies or associated components.

M. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of switchgear covers and doors.

3.05 CLEANING

A. Clean dirt and debris from switchgear enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred surfaces to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Training: Train Owner's personnel on operation, adjustment, and maintenance of switchgear and associated devices.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Manufacturer's authorized representative.
   4. Location: At project site.

3.07 PROTECTION

A. Protect installed switchgear assemblies from subsequent construction operations.

END OF SECTION

SECTION 26 2413
SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.

B. Overcurrent protective devices for switchboards.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

G. Section 26 2100 - Low-Voltage Electrical Service Entrance.
   1. Includes Utility Company contact information.

H. Section 26 2300 - Low-Voltage Switchgear.

I. Section 26 2513 - Low-Voltage Busways.

J. Section 26 2813 - Fuses: Fuses for fusible switches.
   1. Includes requirements for spare fuses and spare fuse cabinets.

K. Section 26 4300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).

B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

D. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

G. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.

H. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 1000 Volts or Less; 2023.

I. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

N. UL 891 - Switchboards; Current Edition, Including All Revisions.

O. UL 977 - Fused Power-Circuit Devices; Current Edition, Including All Revisions.

P. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the electrical outage time with the school district for crossover of power when the new switchboard is installed. Do not discionnect power from the school without written authorization.Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   3. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   5. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
   6. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Service Entrance Switchboards:
   1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
   2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
   3. Obtain Utility Company approval of switchboard prior to fabrication.
   4. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.
   1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.

C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.
   3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
   4. Include documentation of listed series ratings upon request.
   5. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.

F. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 2 as production (routine) tests.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Field Quality Control Test Reports.

I. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.

J. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Enclosure Keys: Two of each different key.
   3. Electronic Trip Circuit Breakers: Provide one portable test set.
   4. Drawout Devices:
      a. Handles Necessary for Racking of Devices: One for each electrical room containing switchgear with drawout devices.
      b. Lifting Yokes: One of each different yoke required, for each electrical room containing drawout devices.
      c. Portable Lifting Devices: One for each electrical room containing switchboards with drawout devices and no integral top rail-mounted lifting device.
      d. Removable Covers: One for blocking each different opening size when device is temporarily removed from its compartment.
   5. See Section 26 2813 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.

B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.

C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Switchboards:
   1. ABB/GE; _____: www.geindustrial.com/#sle.
   2. Eaton Corporation; _____: www.eaton.com/#sle.
   3. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
   4.

B. Substitutions: See Section 01 6000 - Product Requirements.

C. Products by Siemens Industry are not permitted.

D. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

E. Source Limitations: Furnish switchboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 SWITCHBOARDS

A. Switchboard shall be provided with weatherproof enclosure suitable for outdoor location as required.

B. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.

E. Front-Connected Switchboards:

1. Main Device(s): Individually-mounted.
2. Feeder Devices: Panel/group-mounted.
3. Arrangement: Front accessible only (not rear accessible), rear aligned.
4. Gutter Access: Bolted covers.

F. Service Entrance Switchboards:
1. Listed and labeled as suitable for use as service equipment according to UL 869A.
2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
3. Comply with Utility Company requirements for electrical service.
4. Utility Metering Provisions: Provide separate barriered compartment complying with Utility Company requirements where indicated or where required by Utility Company. Include hinged sealable door and provisions for Utility Company current transformers (CTs), potential transformers (PTs), or potential taps as required.
5. See Section 26 2100 for additional requirements.

G. Switchboards With Busway Transitions: Configured for bussed connection to busway provided in accordance with Section 26 2513.

H. Switchboards With Fire Pump Taps: Provide separate bussed vertical section with suitable lugs for fire pump connection to line side of main service disconnect device(s).

I. Switchboards With Drawout Devices: Provide integral top rail-mounted lifting device where indicated.

J. Seismic Qualification: Provide switchboards and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.

K. Service Conditions:
1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
a. Altitude: Less than 6,600 feet.
b. Ambient Temperature:
1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F and 104 degrees F.
2) Switchboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.
2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

L. Short Circuit Current Rating:
1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
2. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.
3. Minimum Rating: 65,000 rms symmetrical amperes.
4. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
5. Label equipment utilizing series ratings as required by NFPA 70.

M. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

N. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.

O. Bussing: Sized in accordance with UL 891 temperature rise requirements.
   1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
   2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   3. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
   4. Phase and Neutral Bus Material: Aluminum.
   5. Ground Bus Material: Aluminum.

P. Conductor Terminations: Suitable for use with the conductors to be installed.
   1. Line Conductor Terminations:
      a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
      b. Main and Neutral Lug Type: Mechanical.
   2. Load Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
      b. Lug Type:
         1) Provide mechanical lugs unless otherwise indicated.
         2) Provide compression lugs where indicated.

Q. Enclosures:
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1 or Type 2 (drip-proof).
      b. Outdoor Locations: Type 3R.
   2. Finish: Manufacturer's standard unless otherwise indicated.
   3. Enclosure Space Heaters:
      a. Size according to manufacturer's recommendations for worst case ambient temperature to prevent condensation.
      b. Heater Control: Thermostat.
      c. Heater Power Source: Provide connection to transformer factory-installed in switchboard or suitable external branch circuit as indicated or as required.
   4. Outdoor Enclosures:
      a. Enclosure Type: Non-walk-in type unless otherwise indicated.
      b. Color: Manufacturer's standard.
      c. Access Doors: Lockable, with all locks keyed alike.
      d. Walk-in Enclosure Features:
         1) Personnel Doors: Open to exterior; equipped with panic hardware.
         2) Aisle lighting, with switch at each access door.
         3) GFCI duplex convenience receptacle.

R. Future Provisions:
   1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
   2. Equip distribution sections with full height vertical bussing to accommodate maximum utilization of space for devices.

S. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list switchboards as a complete assembly including surge protective device.

T. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
   1. Where overcurrent protective devices equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
   2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
      a. Use zero sequence or residual ground fault detection method unless otherwise indicated.
      b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
      c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.

U. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.

V. Instrument Transformers:
   1. Comply with IEEE C57.13.
   2. Select suitable ratio, burden, and accuracy as required for connected devices.
   3. Current Transformers: Connect secondaries to shorting terminal blocks.
   4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Fusible Devices:
   1. Fusible Switches:
      a. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
      b. Fuse Clips: As required to accept indicated fuses.
         1) Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
      c. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
   2. Fused Power-Circuit Devices:
      a. Description: Quick-make, quick-break, dead-front bolted-pressure contact switches and high-pressure butt contact switches listed and labeled as complying with UL 977; ratings, configurations, and features as indicated on the drawings.
      b. Bolted-Pressure Contact Switches: Devices with additional pressure or clamping action provided at both ends of switch blades when blades are in the fully closed position.
      c. High-Pressure Butt Contact Switches: Devices with butt-type contacts and spring-charged mechanism.
      d. Minimum Short Circuit Current Rating: 200,000 rms symmetrical amperes when protected by Class L fuses.

e. Fuse Clips: As required to accept Class L fuses.
f. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
g. Provide the following features and accessories where indicated or where required to complete installation:
1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating switch position.
3) Blown fuse protection and indication.

B. Circuit Breakers:
1. Interrupting Capacity:
a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
2. Molded Case Circuit Breakers:
a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
1) Provide thermal magnetic circuit breakers unless otherwise indicated.
2) Provide electronic trip circuit breakers where indicated.
b. Minimum Interrupting Capacity:
1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
2) 14,000 rms symmetrical amperes at 480 VAC.
c. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
2) Provide interchangeable trip units where indicated.
d. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
1) Provide the following field-adjustable trip response settings:
(a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
(b) Long time delay.
(c) Short time pickup and delay.
(d) Instantaneous pickup.
(e) Ground fault pickup and delay where ground fault protection is indicated.
2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.

3) Provide communication capability where indicated: Compatible with system indicated.

e. Provide the following circuit breaker types where indicated:
1) 100 Percent Rated Circuit Breakers: Listed for application within the switchboard where installed at 100 percent of the continuous current rating.
2) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.

f. Provide the following features and accessories where indicated or where required to complete installation:
1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
2) Pad-Lock Provision: For locking circuit breaker handle in OFF position.
3) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
4) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
5) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

3. Insulated Case Circuit Breakers:
a. Description: Quick-make, quick-break, trip-free circuit breakers with two-step stored energy closing mechanism; standard 80 percent rated unless otherwise indicated; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
b. Operation:
1) Provide manually operated circuit breakers unless otherwise indicated.
2) Provide electrically operated circuit breakers where indicated.
3) Pad-Lock Provision: For preventing circuit breaker closing operation.
c. Construction:
1) Provide fixed-mount circuit breakers unless otherwise indicated.
2) Provide drawout circuit breakers where indicated.
d. Drawout Circuit Breakers:
1) Allows withdrawal of circuit breaker into test and disconnected positions, with racking position indication (connected, test, disconnected, withdrawn).
2) Provide safety interlock to prevent racking of circuit breaker while in the ON position.
3) Pad-Lock Provision: For preventing circuit breaker drawout operation.
e. Minimum Interrupting Capacity:
1) 42,000 rms symmetrical amperes at 240 VAC or 208 VAC.
2) 65,000 rms symmetrical amperes at 480 VAC.
f. Trip Units: Solid state, microprocessor-based, true rms sensing.
1) Provide the following field-adjustable trip response settings:
(a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
(b) Long time delay.
(c) Short time pickup and delay.
(d) Instantaneous pickup.
(e) Ground fault pickup and delay where ground fault protection is indicated.

2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
3) Provide communication capability where indicated: Compatible with system indicated.

g. Provide the following circuit breaker types where indicated:
1) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.

h. Provide the following features and accessories where indicated or where required to complete installation:
1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
3) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
4) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

2.04 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
1. Dielectric tests.
2. Mechanical operation tests.
3. Grounding of instrument transformer cases test.
4. Electrical operation and control wiring tests, including polarity and sequence tests.
5. Ground-fault sensing equipment test.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive switchboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.

C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.

D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch between switchboard and wall.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Provide required seismic controls in accordance with Section 26 0548.

G. Install switchboards plumb and level.

H. Unless otherwise indicated, mount switchboards on properly sized 4 inch high concrete pad constructed in accordance with Section 03 3000.

I. Provide grounding and bonding in accordance with Section 26 0526.

J. Install all field-installed devices, components, and accessories.

K. Provide fuses complying with Section 26 2813 for fusible switches as indicated.

L. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

M. Set field-adjustable circuit breaker tripping function settings as indicated.

N. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

O. Provide filler plates to cover unused spaces in switchboards.

P. Identify switchboards in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.

C. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.

E. Inspect and test in accordance with NETA ATS, except Section 4.

F. Perform inspections and tests listed in NETA ATS, Section 7.1.

G. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

H. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.

I. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
   1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.

J. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.

K. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.

L. Test shunt trips to verify proper operation.

M. Correct deficiencies and replace damaged or defective switchboards or associated components.

N. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of switchboard covers and doors.

3.05 CLEANING

A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

B. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.

C. Repair scratched or marred surfaces to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Training: Train Owner's personnel on operation, adjustment, and maintenance of switchboard and associated devices.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Manufacturer's authorized representative.
   4. Location: At project site.

3.07 PROTECTION

A. Protect installed switchboards from subsequent construction operations.

END OF SECTION

SECTION 26 2416
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

G. Section 26 2200 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.

H. Section 26 2813 - Fuses: Fuses for fusible switches and spare fuse cabinets.

I. Section 26 4300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

G. NEMA PB 1 - Panelboards; 2011.

H. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.

I. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

L. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

M. UL 67 - Panelboards; Current Edition, Including All Revisions.

N. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

O. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

P. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

Q. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

R. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

S. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
   4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.
   3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
   4. Include documentation of listed series ratings upon request.
   5. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.

F. Field Quality Control Test Reports.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

I. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:
   1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB/GE: www.geindustrial.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

D. Substitutions: See Section 01 6000 - Product Requirements.

E. Products by Siemens Industry are not permitted

F. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Seismic Qualification: Provide panelboards and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

D. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

E. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

F. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

G. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

H. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   2. Provide 200 percent rated neutral bus and lugs where indicated, where oversized neutral conductors are provided, or where panelboards are fed from K-rated transformers.
   3. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
   4. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.

I. Conductor Terminations: Suitable for use with the conductors to be installed.

J. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   2. Boxes: Galvanized steel unless otherwise indicated.
      a. Provide wiring gutters sized to accommodate the conductors to be installed.
      b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
      c. Provide removable end walls for NEMA Type 1 enclosures.
      d. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.
   3. Fronts:
      a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.

b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.

4. Lockable Doors: All locks keyed alike unless otherwise indicated.

K. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

L. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list and label panelboards as a complete assembly including surge protective device.

M. Panelboard Contactors: Where panelboard contactors are indicated, provide electrically operated, mechanically held magnetic contactor complying with NEMA ICS 2.
1. Ampere Rating: Not less than ampere rating of panelboard bus.
2. Short Circuit Current Rating: Not less than the panelboard short circuit current rating.
3. Coil Voltage: As required for connection to control system indicated.

N. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
a. Use zero sequence ground fault detection method unless otherwise indicated.
b. Provide test panel and field-adjustable ground fault pick-up and delay settings.

O. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

P. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

Q. Provide the following features and accessories where indicated or where required to complete installation:
1. Feed-through lugs.
2. Sub-feed lugs.

2.03 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
1. Phase and Neutral Bus Material: Aluminum.
2. Ground Bus Material: Aluminum.

D. Circuit Breakers:
1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
2. Provide thermal magnetic circuit breakers unless otherwise indicated.
3. Provide electronic trip circuit breakers where indicated.

E. Enclosures:
   1. Provide surface-mounted enclosures unless otherwise indicated.
   2. Fronts: Provide trims to cover access to load terminals, wiring gutters, and other live parts, with exposed access to overcurrent protective device handles.
   3. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
   4. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
   5. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
   1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
   2. Phase and Neutral Bus Material: Aluminum.
   3. Ground Bus Material: Aluminum.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:
   1. Provide surface-mounted or flush-mounted enclosures as indicated.
   2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
   3. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 OVERCURRENT PROTECTIVE DEVICES

A. Fusible Switches:
   1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
   2. Fuse Clips: As required to accept indicated fuses.
   3. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
   4. Conductor Terminations:
      a. Provide compression lugs unless otherwise indicated.
      b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

B. Molded Case Circuit Breakers:
   1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.

2. Interrupting Capacity:
   a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
      1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
      2) 14,000 rms symmetrical amperes at 480 VAC.
   b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
   a. Provide compression lugs unless otherwise indicated.
   b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
   b. Provide interchangeable trip units where indicated.
5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   a. Provide the following field-adjustable trip response settings:
      1) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
      2) Long time delay.
      3) Short time pickup and delay.
      4) Instantaneous pickup.
      5) Ground fault pickup and delay where ground fault protection is indicated.
   b. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
   c. Provide communication capability where indicated: Compatible with system indicated.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
   a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
   b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
   c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
   d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
   e. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
8. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
9. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.
10. Do not use tandem circuit breakers.
11. Do not use handle ties in lieu of multi-pole circuit breakers.

12. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
13. Provide the following features and accessories where indicated or where required to complete installation:
    a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
    b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.
    c. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
    d. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
    e. Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

2.06 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.
B. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive panelboards.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).
B. Install products in accordance with manufacturer's instructions.
C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
E. Provide required support and attachment in accordance with Section 26 0529.
F. Install panelboards plumb.
G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
I. Mount floor-mounted power distribution panelboards on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
J. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
K. Provide grounding and bonding in accordance with Section 26 0526.
    1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.

2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.

L. Install all field-installed branch devices, components, and accessories.

M. Provide fuses complying with Section 26 2813 for fusible switches as indicated.

N. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

O. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

P. Set field-adjustable circuit breaker tripping function settings as indicated.

Q. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 0573.

R. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

S. Provide filler plates to cover unused spaces in panelboards.

T. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
1. Emergency and night lighting circuits.
2. Fire detection and alarm circuits.
3. Communications equipment circuits.
4. Intrusion detection and access control system circuits.
5. Video surveillance system circuits.

U. Identify panelboards in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.
1. Perform insulation-resistance tests on all control wiring with respect to ground.
2. Test functions of the trip unit by means of secondary injection.

E. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

F. Test GFCI circuit breakers to verify proper operation.

G. Test AFCI circuit breakers to verify proper operation.

H. Test shunt trips to verify proper operation.

I. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

J. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2713
ELECTRICITY METERING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment for Owner electricity metering:
   1. Single circuit electricity meters.
   2. Multi-circuit electricity meters.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0533.16 - Boxes for Electrical Systems: Cabinets and enclosures for metering system components.

D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 2100 - Low-Voltage Electrical Service Entrance: Requirements for Utility Company electricity metering.

F. Section 26 2300 - Low-Voltage Switchgear: For interface with meters specified in this section.

G. Section 26 2413 - Switchboards: For interface with meters specified in this section.

H. Section 26 2416 - Panelboards: For interface with meters specified in this section.

I. Section 26 2419 - Motor-Control Centers: For interface with meters specified in this section.

J. Section 26 2813 - Fuses.
   1. Includes requirements for spare fuses and spare fuse cabinets.

1.03 REFERENCE STANDARDS

A. ANSI C12.1 - Electric Meters - Code for Electricity Metering; 2022.

B. ANSI C12.20 - American National Standard for Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes; 2018, with Errata.

C. IEC 62053-21 - Electricity Metering Equipment - Particular Requirements - Part 21: Static Meters for AC Active Energy (Classes 0,5, 1 and 2); 2020.

D. IEC 62053-22 - Electricity Metering Equipment - Particular Requirements - Part 22: Static Meters for AC Active Energy (Classes 0,1S,0,2S and 0,5S); 2020.

E. IEC 62053-23 - Electricity Metering Equipment - Particular Requirements - Part 23: Static Meters for Reactive Energy (Classes 2 and 3); 2020.

F. IEEE 1459 - IEEE Standard Definitions for the Measurement of Electric Power Quantities Under Sinusoidal, Nonsinusoidal, Balanced, or Unbalanced Conditions; 2010.

G. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.

H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

I. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

J. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate work to provide equipment suitable for interface with electricity metering systems to be provided.
   2. Coordinate the work with other installers to provide communication lines required for electricity metering system interface.
   3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Conduct meeting with facility representative and other related equipment manufacturers to discuss electricity metering system interface requirements.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for electricity metering systems and associated components and accessories. Include ratings, configurations, standard wiring diagrams, dimensions, service condition requirements, and installed features.

C. Shop Drawings: Include system interconnection schematic diagrams showing all factory and field connections. Include requirements for interface with other systems.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Field Quality Control Test Reports.

F. Project Record Documents: Record actual installed locations of meters and final equipment settings.

G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Enclosure Keys: Two of each different key.
   3. See Section 26 2813 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Electricity Meters - Basis of Design: Veris Industries as indicated under product description below;

B. Electricity Meters - Other Acceptable Manufacturers:
   1. Veris Industries; E5x Series Enhanced Power and Energy Meter:
   2. Same as manufacturer of electrical distribution equipment used for this project.
      a. ABB/GE: www.geindustrial.com/#sle.
      b. Eaton Corporation: www.eaton.com/#sle.
      c. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
      d. Siemens Industry, Inc: www.usa.siemens.com/#sle.

C. Substitutions: See Section 01 6000 - Product Requirements.

D. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

E. Source Limitations: Furnish electricity meters produced by a single manufacturer and obtained from a single supplier.

2.02 EQUIPMENT FOR OWNER ELECTRICITY METERING

A. Provide microprocessor-based digital electricity metering systems including all instrument transformers, wiring, and connections necessary for measurements specified.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Provide electricity metering systems and associated components compatible with the equipment and associated circuits to be metered.

D. Service Conditions: Provide electricity meters suitable for operation under the service conditions at the installed location.

E. Enclosures:
   1. Where not furnished by manufacturer, provide required cabinets and enclosures in accordance with Section 26 0533.16.
   2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R or Type 4.
   3. Provide lockable door(s) for outdoor locations.

4. Finish: Manufacturer's standard unless otherwise indicated.

F. Instrument Transformers:
1. Comply with IEEE C57.13, where applicable.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Compatible with connected meters; replace meters damaged by connection of incompatible current transformers. Provide shorting terminal blocks for connection of secondaries where applicable.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

G. Interface with Other Work:
1. Interface with electrical power monitoring system.
2. Interface with building automation system.

2.03 SINGLE CIRCUIT ELECTRICITY METERS

A. Single Circuit Electricity Meter - Basis of Design: Veris Industries; E5x Series Enhanced Power and Energy Meter with LCD screen interface; 5-year warranty; utilizes voltage mode CTs that do not require terminal shorting blocks; compatible with solid-core, split-core, and rope CTs.
1. Accuracy:
a. Real/Active Power/Energy: Revenue grade; plus/minus 0.2 percent, complying with ANSI C12.20 accuracy and IEC 62053-22, Class 0.2S.
b. Reactive Power/Energy: Plus/minus 2.0 percent, complying with IEC 62053-23, Class 2.
2. Measured Parameters:
a. Real/active energy (kWh); per phase and total of all phases.
b. Reactive energy (kVARh) and apparent energy (kVAh); total of all phases.
c. Net present demand over a user-specified interval (block or sliding window); real/active power (kW), reactive power (kVAR), and apparent power (kVA).
d. Maximum (peak) demand intervals; real/active power (kW), reactive power (kVAR), and apparent power (kVA).
e. Real/active power (kW), reactive power (kVAR), and apparent power (kVA); per phase and total of all phases.
f. Models Available with Bi-directional Energy Measurements:
1) Real/active energy (kWh) and apparent energy (kVAh); imported (from the grid), exported (to the grid), and signed net total.
2) Reactive energy (kVARh); imported (from the grid) and exported (to the grid), per quadrant as defined by IEEE 1459.
3) Maximum demand; real/active power (kW), reactive power (kVAR), and apparent power (kVA); imported (from the grid) and exported (to the grid).
g. Current; per phase and average of all phases.
h. Voltage; line-to-line and line-to-neutral; per phase and average of all phases.
i. Power factor; per phase and average of all phases.
j. Frequency.
3. Models Available with Data Logging: Logs and retains in non-volatile memory up to 5760 measurement records at time intervals determined by Demand Interval duration setting (up to 60 days of readings at 15 minute intervals).
4. Alarm capability, with configurable setpoints.
a. Low power factor.
b. Current over range.
c. Voltage over range.
d. Frequency out of range.

e. Models available with pulse output overrun.

5. Models Available with Pulse Contact Accumulator Input(s): Up to two; user-configurable to support measurement of other related energy values (gas, water, steam, etc.) using pulse-output transducers.
6. Outputs:
   a. Models Available with Phase Loss Alarm Output: One; user-configurable phase loss threshold.
   b. Models Available with Pulse Output(s): Up to two.
7. Communications: Compatible with connected systems. Provide all accessories necessary for proper interface.
   a. Models available with Serial Communications:
      1) RS-485, 2-wire; support for Modbus RTU protocol.
      2) RS-485, 2-wire; support for BACnet MS/TP protocol.
      3) LON FT, 2-wire; support for LonTalk protocol.

2.04 MULTI-CIRCUIT ELECTRICITY METERS

A. Multi-Circuit Electricity Meter - Basis of Design: Veris Industries; E3x Series Panelboard Monitoring System; 5-year warranty; utilizes voltage mode CTs that do not require shorting terminal blocks.
   1. Metering Capacity: As indicated or as required for circuits to be monitored (configurations available for monitoring up to 84 branch circuits, two 3-phase main devices, and two neutrals with one meter).
   2. Accuracy:
      a. Real/Active Power/Energy (for models that measure this parameter): Revenue grade; plus/minus 1.0 percent (including branch CTs); complying with ANSI C12.1 and IEC 62053-21, Class 1.
      b. Voltage (for models that measure this parameter): Plus/minus 0.5 percent.
      c. Current: Plus/minus 0.5 percent.
   3. Measured Parameters at Main Device:
      a. Current; per phase and average of all phases.
      b. Maximum current; per phase and maximum average of all phases.
      c. Current demand; per phase and average of all phases.
      d. Maximum current demand; per phase and maximum average of all phases.
      e. Models available with measurements for:
         1) Current phase angle.
         2) Real/active energy (kWh); per phase and total of all phases.
         3) Snapshot of total energy as of the completion of the most recent demand interval; per phase and total of all phases.
         4) Real/active power (kW); per phase and total of all phases; available signed to indicate whether energy is being imported or exported.
         5) Apparent power (kVA); per phase and total of all phases.
         6) Power factor; per phase and total, based on three-phase breaker rotation, signed, to indicate leading or lagging current.
         7) Voltage, line-to-line and line-to neutral; per phase and average of all phases.
         8) Voltage phase angle.
         9) Frequency; phase A.
   4. Measured Parameters at Branch Circuits:
      a. Current; per branch and average of all phases for multi-phase logical circuits.

b. Maximum current; per branch and maximum average of all phases for multi-phase logical circuits.
c. Current demand; per branch and average of all phases for multi-phase logical circuits.
d. Maximum current demand; per branch and maximum average of all phases for multi-phase logical circuits.
e. Models available with measurements for:
    1) Current phase angle.
    2) Real/active power (kW); per branch and total of all phases for multi-phase logical circuits; available signed to indicate whether energy is being imported or exported.
    3) Real/active power (kW) demand; per branch and total of all phases for multi-phase logical circuits.
    4) Real/active power (kW) demand maximum; per branch and total of all phases for multi-phase logical circuits.
    5) Real/active energy (kWh); per branch and total of all phases for multi-phase logical circuits.
    6) Snapshot of total energy as of the completion of the most recent demand interval; per branch and total of all phases for multi-phase logical circuits.
    7) Apparent power (kVA); per branch and total of all phases for multi-phase logical circuits.
    8) Power factor; per branch and average of all phases for multi-phase logical circuits, signed to indicate leading or lagging current.

5. Alarm capability, with configurable setpoints.
    a. Current over/under range.
    b. Models available with voltage over/under range.
6. Communications: Compatible with connected systems. Provide all accessories necessary for proper interface.
    a. Models Available with Serial Communications:
        1) RS-485, 2-wire or 4-wire; support for Modbus RTU protocol.
        2) RS-485, 2-wire; support for Modbus RTU and BACnet MS/TP protocols.
    b. Models Available with Ethernet Communications:
        1) Without RJ-45 10/100 Mbit; requires Modbus TCP Gateway; support for Modbus TCP protocol.
        2) With RJ-45 10/100 Mbit; support for Modbus TCP, BACnet IP, and SNMP protocols.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of metering systems and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive meters.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).
B. Install products in accordance with manufacturer's instructions.
C. Provide required support and attachment components in accordance with Section 26 0529.
D. Provide grounding and bonding in accordance with Section 26 0526.
E. Provide fuses complying with Section 26 2813 as required.
F. Identify meters and associated wiring in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.
B. Inspect and test in accordance with NETA ATS, except Section 4.
C. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
D. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
E. Correct deficiencies and replace damaged or defective metering system components.
F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 ADJUSTING

A. Program system parameters according to requirements of Owner.

3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
B. See Section 01 7900 - Demonstration and Training, for additional requirements.
C. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
    1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
    2. Provide minimum of two hours of training.
    3. Instructor: Manufacturer's authorized representative.
    4. Location: At project site.

3.07 PROTECTION

A. Protect installed system components from subsequent construction operations.

END OF SECTION

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SECTION 26 2726
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.
B. Wall dimmers.
C. Fan speed controllers.
D. Receptacles.
E. Wall plates.
F. Floor box service fittings.
G. Poke-through assemblies.
H. Access floor boxes.

1.02 RELATED REQUIREMENTS

A. Section 09 6900 - Access Flooring.
B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
C. Section 26 0526 - Grounding and Bonding for Electrical Systems.
D. Section 26 0533.16 - Boxes for Electrical Systems.
E. Section 26 0533.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.
F. Section 26 0539 - Underfloor Raceways for Electrical Systems.
G. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
H. Section 26 0583 - Wiring Connections: Cords and plugs for equipment.
I. Section 26 0923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.
J. Section 27 1000 - Structured Cabling: Voice and data jacks.

1.03 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
L. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.
M. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
   3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
   4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
   5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
   6. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
B. Sequencing:
   1. Do not install wiring devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
   1. Wall Dimmers: Include derating information for ganged multiple devices.
   2. Surge Protection Receptacles: Include surge current rating, voltage protection rating (VPR) for each protection mode, and diagnostics information.
C. Samples: One for each type and color of device and wall plate specified.
D. Certificates for Surge Protection Receptacles: Manufacturer's documentation of listing for compliance with UL 1449.
E. Field Quality Control Test Reports.
F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
G. Operation and Maintenance Data:
   1. Wall Dimmers: Include information on operation and setting of presets.
   2. GFCI Receptacles: Include information on status indicators.
   3. Surge Protection Receptacles: Include information on status indicators.

H. Project Record Documents: Record actual installed locations of wiring devices.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Screwdrivers for Tamper-Resistant Screws: Two for each type of screw.
   3. Extra Keys for Locking Switches: Two of each type.
   4. Extra Surge Protection Receptacles: Two of each type.
   5. Extra Wall Plates: One of each style, size, and finish.
   6. Extra Flush Floor Service Fittings: Two of each type.
   7. Extra Poke-Through Core Hole Closure Plugs: Two for each core size.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Products: Listed, classified, and labeled as suitable for the purpose intended.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.

C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.

D. Provide tamper resistant receptacles for receptacles installed in dwelling units.

E. Provide GFCI protection for receptacles installed within 6 feet of sinks.

F. Provide GFCI protection for receptacles installed in kitchens.

G. Provide GFCI protection for receptacles serving electric drinking fountains.

H. Provide isolated ground receptacles for receptacles serving computers and electronic cash registers.

I. Unless noted otherwise, do not use combination switch/receptacle devices.

J. For flush floor service fittings, use tile rings for installations in tile floors.

K. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.02 WIRING DEVICE FINISHES

A. Provide wiring device finishes as described below unless otherwise indicated.

B. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.

C. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.

D. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.

E. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.

F. Wiring Devices Installed _____: White with white nylon wall plate.

G. Isolated Ground Convenience Receptacles: Orange.

H. Surge Protection Receptacles: Blue.

I. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.

J. Above-Floor Service Fittings: Gray wiring devices with satin aluminum housing.

K. Flush Floor Box Service Fittings: Gray wiring devices with aluminum cover and ring/flange.

L. Flush Poke-Through Service Fittings: Gray wiring devices with aluminum cover and aluminum flange.

M. Access Floor Boxes: Gray wiring devices with gray steel cover with insert to match floor covering.

2.03 WALL SWITCHES

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell.com/#sle.
   2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
   3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20and where applicable FS W-S-896; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

D. Lighted Wall Switches: Industrial specification grade, 20 A, 120/277 V with illuminated standard toggle type switch actuator and maintained contacts; illuminated with load off; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

E. Pilot Light Wall Switches: Industrial specification grade, 20 A, 120/277 V with red illuminated standard toggle type switch actuator and maintained contacts; illuminated with load on; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

F. Locking Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed switch actuator and maintained contacts; switches keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

G. Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with toggle type three position switch actuator and momentary contacts; single pole double throw, off with switch actuator in center position.

H. Locking Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed three position switch actuator and momentary contacts; switches keyed alike; single pole double throw, off with switch actuator in center position.

2.04 WALL DIMMERS

A. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

B. Control: Slide control type with separate on/off switch.

2.05 RECEPTACLES

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell.com/#sle.
   2. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
   3. Lutron Electronics Company, Inc; Designer Style: www.lutron.com/#sle.
   4. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.
   6. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
   2. NEMA configurations specified are according to NEMA WD 6.
   3. Hospital Grade Receptacles: Listed as complying with UL 498 Supplement SD, with green dot hospital grade mark on device face.

C. Convenience Receptacles:
   1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
   2. Automatically Controlled Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.
   3. Isolated Ground Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, with ground contacts isolated from mounting strap; isolated ground triangle mark on device face; single or duplex as indicated on the drawings.
   4. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
   5. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.

6. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
7. Illuminated Convenience Receptacles: Hospital grade, 20A, 125V, NEMA 5-20R; illuminated face or indicator light to indicate power is being supplied to receptacle; single or duplex as indicated on the drawings.

D. GFCI Receptacles:
1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
5. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.06 WALL PLATES

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
3. Lutron Electronics Company, Inc: www.lutron.com/#sle.
4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard.
3. Screws: Metal with slotted heads finished to match wall plate finish.
4. Provide screwless wallplates with concealed mounting hardware where indicated.

C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

E. Brass Wall Plates: Brushed satin finish, factory-coated to inhibit oxidation.

F. Aluminum Wall Plates: Smooth satin finish, clear anodized, factory-coated to inhibit oxidation.

G. Chrome Wall Plates: Smooth finish, chrome plated steel.

H. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

I. Premarked Wall Plates: Factory labeled as indicated; hot stamped for nylon wall plates and engraved for metal wall plates.

J. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.

K. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

2.07 FLOOR BOX SERVICE FITTINGS

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Thomas & Betts Corporation: www.tnb.com/#sle.
3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: Service fittings compatible with floor boxes provided under Section 26 0533.16 with components, adapters, and trims required for complete installation.

C. Above-Floor Service Fittings:
1. Single Service Pedestal Convenience Receptacles:
a. Configuration: One standard convenience duplex receptacle.
2. Single Service Pedestal Communications Outlets:
a. Configuration: One 1 inch bushed opening.
b. Voice and Data Jacks: As specified in Section 27 1000.
3. Single Service Pedestal Furniture Feed:
a. Configuration: One 3/4 inch knockout.
4. Dual Service Pedestal Combination Outlets:
a. Configuration:
1) Power: One standard convenience duplex receptacle.
2) Communications: One 1 inch bushed opening.
3) Voice and Data Jacks: As specified in Section 27 1000.
b. Provide barrier to separate line and low voltage compartments.

D. Flush Floor Service Fittings:
1. Single Service Flush Convenience Receptacles:
a. Cover: Rectangular.
b. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).
2. Single Service Flush Communications Outlets:
a. Cover: Rectangular.
b. Configuration: _____.
c. Voice and Data Jacks: As specified in Section 27 1000.
3. Single Service Flush Furniture Feed:
a. Cover: Rectangular.
b. Configuration: One 2-1/8 inch by 3/4 inch combination threaded opening(s).
4. Dual Service Flush Combination Outlets:
a. Cover: Rectangular.
b. Configuration:
1) Power: One standard convenience duplex receptacle(s) with duplex flap opening(s).
2) Communications:
3) Voice and Data Jacks: As specified in Section 27 1000.

4) Voice and Data Jacks: Provided by others.

5. Dual Service Flush Furniture Feed:
   a. Cover: Rectangular.
   b. Configuration:
      1) Power: One 2-1/8 inch by 3/4 inch combination threaded opening(s).
      2) Communications: One 2-1/8 inch by 1 inch combination threaded opening(s).
6. Accessories:
   a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.
   b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.
7. Products:
   a. Hubbell Incorporated: www.hubbell.com/#sle.

2.08 POKE-THROUGH ASSEMBLIES

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell.com/#sle.
   2. Thomas & Betts Corporation: www.tnb.com/#sle.
   3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.

C. Above-Floor Service Fittings:
   1. Single Service Pedestal Convenience Receptacles:
      a. Configuration: One standard convenience duplex receptacle.
   2. Single Service Pedestal Communications Outlets:
      a. Configuration: One 1 inch bushed opening.
      b. Voice and Data Jacks: As specified in Section 27 1000.
   3. Single Service Pedestal Furniture Feed:
      a. Configuration: One 3/4 inch knockout.
   4. Dual Service Pedestal Combination Outlets:
      a. Configuration:
         1) Power: One standard convenience duplex receptacle.
         2) Communications: One 1 inch bushed opening.
         3) Voice and Data Jacks: As specified in Section 27 1000.
      b. Provide barrier to separate line and low voltage compartments.
   5. Products:
      a. Hubbell Incorporated: www.hubbell.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

D. Flush Floor Service Fittings:
   1. Single Service Flush Convenience Receptacles:
      a. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).
   2. Single Service Flush Communications Outlets:
      a. Configuration: _____.
      b. Voice and Data Jacks: As specified in Section 27 1000.
   3. Single Service Flush Furniture Feed:

a. Configuration: One 2 inch by 1-1/4 inch combination threaded opening(s).

4. Dual Service Flush Combination Outlets:
   a. Cover: Hinged door(s).
   b. Configuration:
      1) Power: One standard convenience duplex receptacle(s).
      2) Communications:
      3) Voice and Data Jacks: As specified in Section 27 1000.
5. Dual Service Flush Furniture Feed:
   a. Configuration:
      1) Power: One 3/4 inch threaded opening(s).
      2) Communications: Two 1/2 inch threaded opening(s).
6. Accessories:
   a. Closure Plugs: Size and fire rating as required to seal unused core hole and maintain fire rating of floor.

2.09 ACCESS FLOOR BOXES

A. Manufacturers - Access Floor Boxes:
   1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
   2. Thomas & Betts Corporation: www.tnb.com/#sle.
   3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Manufacturers - Access Floor Boxes with Pre-wired Connectors for Manufactured Wiring Systems:
   1. AFC Cable Systems Inc: www.afcweb.com/#sle.
   2. RELOC Wiring Solutions, a brand of Acuity Brands, Inc: www.relocwiring.com/#sle.
   3. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.
   5. Source Limitations: Provide access floor boxes with pre-wired connectors produced by the same manufacturer as the manufactured wiring system used for this project.

C. Description: Metallic multi-service box suitable for mounting in access floor system specified in Section 09 6900.

D. Access floor boxes with pre-wired connectors for manufactured wiring systems are permitted only where manufactured wiring systems are permitted as specified in Section 26 0519.

E. Configuration:
   1. Power: Two standard convenience duplex receptacle(s).
   2. Communications:
   3. Voice and Data Jacks: Provided by others.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that floor boxes are adjusted properly.

F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

G. Verify that core drilled holes for poke-through assemblies are in proper locations.

H. Verify that openings in access floor are in proper locations.

I. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switches: 48 inches above finished floor.
      b. Wall Dimmers: 48 inches above finished floor.
      c. Receptacles: 18 inches above finished floor or 6 inches above counter.
   2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
   3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
   4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
   5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.

I. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

J. Unless otherwise indicated, GFCI receptacles may be connected to provide feed-through protection to downstream devices. Label such devices to indicate they are protected by upstream GFCI protection.

K. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.

L. Install wiring devices plumb and level with mounting yoke held rigidly in place.

M. Install wall switches with OFF position down.

N. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

O. Do not share neutral conductor on branch circuits utilizing wall dimmers.

P. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

Q. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

R. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

S. Identify wiring devices in accordance with Section 26 0553.

T. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each wiring device for damage and defects.

C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

D. Test each receptacle to verify operation and proper polarity.

E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

F. Inspect each surge protection receptacle to verify surge protection is active.

G. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

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SECTION 26 2813
FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuses.

B. Spare fuse cabinet.

1.02 RELATED REQUIREMENTS

A. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

B. Section 26 2413 - Switchboards: Fusible switches.

C. Section 26 2416 - Panelboards: Fusible switches.

D. Section 26 2419 - Motor-Control Centers: Fusible switches.

E. Section 26 2513 - Low-Voltage Busways: Fusible switches.

F. Section 26 2816.16 - Enclosed Switches: Fusible switches.

G. Section 26 2913 - Enclosed Controllers: Fusible switches.

1.03 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.

D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.

E. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses; Current Edition, Including All Revisions.

F. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.

G. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

H. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
    a. Fusible Switches for Switchboards: See Section 26 2413.
    b. Fusible Switches for Panelboards: See Section 26 2416.

c. Fusible Switches for Motor Control Centers: See Section 26 2419.
d. Fusible Switches for Busway: See Section 26 2501.
e. Fusible Enclosed Switches: See Section 26 2816.16.
f. Fusible Switches for Enclosed Motor Controllers: See Section 26 2913.

2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
1. Spare Fuse Cabinet: Include dimensions.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Fuses: One set(s) of three for each type and size installed.
3. Fuse Pullers: One set(s) compatible with each type and size installed.
4. Spare Fuse Cabinet Keys: Two.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/#sle.

B. Littelfuse, Inc: www.littelfuse.com/#sle.

C. Mersen: ep-us.mersen.com/#sle.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 APPLICATIONS

A. Service Entrance:
1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

B. Feeders:
1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

C. General Purpose Branch Circuits: Class RK1, time-delay.

D. Individual Motor Branch Circuits: Class RK1, time-delay.
E. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.
F. Primary Protection for Control Transformers: Class CC, time-delay.

2.03 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.
B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
C. Provide fuses of the same type, rating, and manufacturer within the same switch.
D. Comply with UL 248-1.
E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
F. Voltage Rating: Suitable for circuit voltage.
G. Class R Fuses: Comply with UL 248-12.
H. Class L Fuses: Comply with UL 248-10.
I. Class CC Fuses: Comply with UL 248-4.

2.04 SPARE FUSE CABINET

A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.
B. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
B. Verify that mounting surfaces are ready to receive spare fuse cabinet.
C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.
B. Install fuses with label oriented such that manufacturer, type, and size are easily read.
C. Install spare fuse cabinet where indicated.
D. Identify spare fuse cabinet in accordance with Section 26 0553.

END OF SECTION

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SECTION 26 2816.13
ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed circuit breakers.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
B. Section 26 0529 - Hangers and Supports for Electrical Systems.
C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.
D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
E. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
J. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
K. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.
   1. Include characteristic trip curves for each type and rating of circuit breaker upon request.

C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of enclosed circuit breakers and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.
   3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
   4. Include documentation of listed series ratings upon request.
   5. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Field Quality Control Test Reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

G. Project Record Documents: Record actual installed locations of enclosed circuit breakers.

H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed circuit breaker internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature between 23 degrees F and 104 degrees F during and after installation of enclosed circuit breakers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB/GE: www.geindustrial.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

D. Siemens Industry, Inc: www.usa.siemens.com/#sle.

E. Substitutions: See Section 01 6000 - Product Requirements.

F. Source Limitations: Furnish enclosed circuit breakers and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED CIRCUIT BREAKERS

A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Seismic Qualification: Provide enclosed circuit breakers and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.

D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature: Between 23 degrees F and 104 degrees F.

E. Short Circuit Current Rating:
   1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location indicated on the drawings.
   2. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.
   3. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
   4. Label equipment utilizing series ratings as required by NFPA 70.

F. Enclosed Circuit Breakers Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

H. Provide thermal magnetic circuit breakers unless otherwise indicated.

I. Provide electronic trip circuit breakers where indicated.

J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

K. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.

L. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
   3. Provide surface-mounted enclosures unless otherwise indicated.

M. Provide externally operable handle with means for locking in the OFF position.

N. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
   1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
   2. Where accessory ground fault sensing and relaying equipment is used, equip companion circuit breakers with ground-fault shunt trips.
      a. Use zero sequence ground fault detection method unless otherwise indicated.
      b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
      c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.

O. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

2.03 MOLDED CASE CIRCUIT BREAKERS

A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.

B. Interrupting Capacity:
   1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
      a. 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
      b. 14,000 rms symmetrical amperes at 480 VAC.
   2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
   3. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.

C. Conductor Terminations:

1. Provide compression lugs unless otherwise indicated.
2. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

D. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   1. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
   2. Provide interchangeable trip units where indicated.

E. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   1. Provide the following field-adjustable trip response settings:
      a. Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
      b. Long time delay.
      c. Short time pickup and delay.
      d. Instantaneous pickup.
      e. Ground fault pickup and delay where ground fault protection is indicated.
   2. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
   3. Provide communication capability where indicated: Compatible with system indicated.

F. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

G. Provide the following circuit breaker types where indicated:
   1. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
   2. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
   3. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.

H. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.

I. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.

J. Provide the following features and accessories where indicated or where required to complete installation:
   1. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
   2. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
   3. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
   4. Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed circuit breakers are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed circuit breakers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Provide required seismic controls in accordance with Section 26 0548.

F. Install enclosed circuit breakers plumb.

G. Install flush-mounted enclosed circuit breakers so that trims fit completely flush to wall with no gaps and rough opening completely covered.

H. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

I. Provide grounding and bonding in accordance with Section 26 0526.

J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

K. Set field-adjustable circuit breaker tripping function settings as indicated.

L. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

M. Identify enclosed circuit breakers in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with manufacturer's instructions and NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers used for service entrance and for circuit breakers larger than _____ amperes. Tests listed as optional are not required.

D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
   1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.

E. Test GFCI circuit breakers to verify proper operation.

F. Test shunt trips to verify proper operation.

G. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from circuit breaker enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 2816.16
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
B. Section 26 0529 - Hangers and Supports for Electrical Systems.
C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
E. Section 26 2813 - Fuses.
F. Section 26 2913 - Enclosed Controllers: Manual motor controllers.
G. Section 26 3600 - Transfer Switches: Automatic and non-automatic switches listed for use as transfer switch equipment.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.
   3. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Field Quality Control Test Reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

G. Project Record Documents: Record actual locations of enclosed switches.

H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. See Section 26 2813 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

B. General Electric Company: www.geindustrial.com/#sle.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB/GE: www.geindustrial.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

D. Siemens Industry, Inc: www.usa.siemens.com/#sle.

E. Substitutions: See Section 01 6000 - Product Requirements.

F. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Seismic Qualification: Provide enclosed safety switches suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.

D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

E. Horsepower Rating: Suitable for connected load.

F. Voltage Rating: Suitable for circuit voltage.

G. Short Circuit Current Rating:
   1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
   2. Minimum Ratings:
      a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
      b. General Duty Single Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
      c. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
      d. Double Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.

H. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

I. Provide with switch blade contact position that is visible when the cover is open.

J. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
   1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

K. Conductor Terminations: Suitable for use with the conductors to be installed.

L. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

M. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

N. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

O. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

P. Heavy Duty Switches:
   1. Comply with NEMA KS 1.
   2. Conductor Terminations:
      a. Provide mechanical lugs unless otherwise indicated.
      b. Provide compression lugs where indicated.
      c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
      a. Provide means for locking handle in the ON position where indicated.

Q. General Duty Switches:
   1. Conductor Terminations:
      a. Provide mechanical lugs.
      b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   2. Provide externally operable handle with means for locking in the OFF position, capable of accepting two padlocks.

R. Provide the following features and accessories where indicated or where required to complete installation:
   1. Hubs: As required for environment type; sized to accept conduits to be installed.
   2. Integral fuse pullers.
   3. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.
   4. Viewing Window: Positioned over switch blades for visual confirmation of contact position with door closed.

5. Interlocked Receptacle: Integral pre-wired three phase, three wire, grounded type receptacle interlocked with switch mechanism to prevent insertion or removal of plug with switch in the ON position and to prevent switch from being placed in the ON position without matching plug inserted. Provide receptacle configuration as required to accept plug as indicated on the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Identify enclosed switches in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2913
ENCLOSED CONTROLLERS

PART 2 PRODUCTS

1.01 ENCLOSED CONTROLLERS

A. Provide enclosed controller assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Enclosed controllers complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; ratings, configurations and features as indicated on the drawings.

D. Service Conditions:
   1. Provide controllers and associated components suitable for operation under the following service conditions without derating:
      a. Altitude:
         1) Class 1 Km Equipment (devices utilizing power semiconductors, e.g. variable frequency controllers): Less than 3,300 feet.
         2) Class 2 Km Equipment (electromagnetic and manual devices): Less than 6,600 feet.
      b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
   2. Provide controllers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

E. Short Circuit Current Rating:

F. Conductor Terminations: Suitable for use with the conductors to be installed.

G. Enclosures:
   1. Comply with NEMA ICS 6.
   2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   3. Finish: Manufacturer's standard unless otherwise indicated.

H. Instrument Transformers:
   1. Comply with IEEE C57.13.
   2. Select suitable ratio, burden, and accuracy as required for connected devices.
   3. Current Transformers: Connect secondaries to shorting terminal blocks.
   4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

1.02 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:
   1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
   2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.

3. Trip-free operation.
4. Visible trip indication.
5. Resettable.
    a. Employ manual reset unless otherwise indicated.
    b. Do not employ automatic reset with two-wire control.

END OF SECTION

SECTION 26 2923
VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Variable frequency controllers.

1.02 RELATED REQUIREMENTS

A. Section 26 0529 - Hangers and Supports for Electrical Systems.

B. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 2813 - Fuses.

1.03 REFERENCE STANDARDS

A. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems; 2022.

B. NEMA ICS 7 - Industrial Control and Systems: Adjustable-Speed Drives; 2020.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
   1. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Test Reports: Indicate field test and inspection procedures and test results.

F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Manufacturer's Field Reports: Indicate start-up inspection findings.

H. Operation Data: NEMA ICS 7.1. Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.

I. Maintenance Data: NEMA ICS 7.1. Include routine preventive maintenance schedule.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Air Filters: Two of each type.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Variable Frequency Motor Controllers:
   1. ABB/GE: www.geindustrial.com/#sle.
   2. Danfoss: www.danfoss.com/#sle.
   3. Eaton Corporation: www.eaton.com/#sle.
   4. Rockwell Automation, Inc.; Allen-Bradley Products: ab.rockwellautomation.com/#sle.
   5. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
   6. Siemens Industry, Inc: www.usa.siemens.com/#sle.

B. Substitutions: See Section 01 6000 - Product Requirements.

C. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

D. Source Limitations: Furnish variable frequency motor controllers and associated components produced by a single manufacturer and obtained from a single supplier.

2.02 DESCRIPTION

A. Variable Frequency Controllers: Enclosed controllers suitable for operating the indicated loads, in conformance with requirements of NEMA ICS 7. Select unspecified features and options in accordance with NEMA ICS 3.1.
   1. Employ microprocessor-based inverter logic isolated from power circuits.
   2. Employ pulse-width-modulated inverter system.
   3. Design for ability to operate controller with motor disconnected from output.
   4. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.

B. Seismic Qualification: Provide variable frequency controllers and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.

C. Enclosures: NEMA 250, Type 1, suitable for equipment application in places regularly open to the public.

D. Finish: Manufacturer's standard enamel.

2.03 OPERATING REQUIREMENTS

A. Rated Input Voltage: 208 volts, three phase, 60 Hertz.

B. Motor Nameplate Voltage: 200 volts, three phase, 60 Hertz.

C. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.

D. Operating Ambient: 0 degrees C to 40 degrees C.

E. Volts Per Hertz Adjustment: Plus or minus 10 percent.

F. Current Limit Adjustment: 60 to 110 percent of rated.

G. Acceleration Rate Adjustment: 0.5 to 30 seconds.

H. Deceleration Rate Adjustment: 1 to 30 seconds.

I. Input Signal: 4 to 20 mA DC.

2.04 COMPONENTS

A. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.

B. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.

C. Furnish HAND-OFF-AUTOMATIC selector switch and manual speed control.

D. Include undervoltage release.

E. Control Power Source: Separate circuit.

F. Door Interlocks: Furnish mechanical means to prevent opening of equipment with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified persons.

G. Safety Interlocks: Furnish terminals for remote contact to inhibit starting under both manual and automatic mode.

H. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.

I. Manual Bypass: Furnish contactor, motor running overload protection, and short circuit protection for full voltage, non-reversing operation of the motor. Include isolation switch to allow maintenance of inverter during bypass operation.

J. Emergency Stop: Use dynamic brakes for emergency stop function.

K. Disconnecting Means: Include integral fused disconnect switch on the line side of each controller.

L. Wiring Terminations: Match conductor materials and sizes indicated.

2.05 SOURCE QUALITY CONTROL

A. Shop inspect and perform standard productions tests for each controller.

B. Make completed controller available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner at least 7 days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Owner at least 7 days before inspections and tests are scheduled.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surface is suitable for controller installation.

B. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.

C. Verify that field measurements are as indicated on shop drawings.

3.02 INSTALLATION

A. Install in accordance with NEMA ICS 7.1 and manufacturer's instructions.

B. Provide required support and attachment in accordance with Section 26 0529.

C. Provide required seismic controls in accordance with Section 26 0548.

D. Tighten accessible connections and mechanical fasteners after placing controller.

E. Provide fuses in fusible switches; refer to Section 26 2813 for product requirements.

F. Select and install overload heater elements in motor controllers to match installed motor characteristics.

G. Identify variable frequency controllers in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. Provide the service of the manufacturer's field representative to prepare and start controllers.

B. Perform field inspection and testing in accordance with Section 01 4000.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Perform inspections and tests listed in NETA ATS, Section 7.17. The insulation-resistance test on control wiring listed as optional is not required.

3.04 ADJUSTING

A. Make final adjustments to installed controller to assure proper operation of load system. Obtain performance requirements from installer of driven loads.

3.05 CLOSEOUT ACTIVITIES

A. Demonstrate operation of controllers in automatic and manual modes.

3.06 MAINTENANCE

A. See Section 01 7000 - Execution Requirements, for additional requirements relating to maintenance service.

B. Provide a separate maintenance contract for specified maintenance service.

C. Provide service and maintenance of controllers for one year from Date of Substantial Completion.

END OF SECTION

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SECTION 26 3323
CENTRAL BATTERY EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Emergency power supply.
B. Uninterruptible power supply (UPS) centralized emergency lighting inverters.
C. Remote trouble alarm indicator.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
B. Section 26 0529 - Hangers and Supports for Electrical Systems.
C. Section 26 5100 - Interior Lighting:
D. Section 26 5600 - Exterior Lighting: Luminaires for interface with centralized emergency lighting inverters.

1.03 REFERENCE STANDARDS

A. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).

1.04 EMERGENCY POWER SUPPLY

A. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 RATINGS

A. NFPA 111 - Standard on Stored Electrical Energy Emergency and Standby Power Systems; 2022.
B. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
C. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

1.06 ADMINISTRATIVE REQUIREMENTS

A. Inverter Output Frequency: 60 Hz plus 1 percent.
B. Coordination:
C. Efficiency: 90 percent minimum.
D. Maximum Recharge Time: 12 hours following 1.5 hour discharge.
E. Total Harmonic Distortion: Less than 10 percent at full resistive load.
F. Battery: Nickel cadmium, sealed type battery.
G. Accessories: Provisions for remote battery alarm.

H. Instrumentation and Alarms: NFPA 111.

I. Charger: Dual rate, designed to maintain battery in full-charge condition during normal conditions.

J. Coordination:
   1. Coordinate compatibility of centralized emergency lighting inverters to be installed with work provided under other sections or by others.
   2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   3. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.07 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.

C. Shop Drawings: Indicate dimensions, input/output voltages, power ratings, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, and installed features and accessories.

D. Specimen Warranty: Submit sample of manufacturer's warranty.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

F. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
   1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

G. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

H. Maintenance contracts.

I. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Enclosure Keys: Two of each different key.
   3. Battery Fuses: See Section 26 2813 for requirements for spare fuses and spare fuse cabinets.

1.08 QUALITY ASSURANCE

A. Comply with the following:
   1. NFPA 70 (National Electrical Code).

2. NFPA 101 (Life Safety Code).
3. NFPA 111; meet requirements for Level 1 system.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with centralized emergency lighting inverter systems of similar size, type, and complexity; manufacturer's authorized installer.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to inverter system components, enclosure, and finish.

D. Do not exceed maximum ambient temperature requirements for batteries at any time, which reduces battery service life. Replace batteries exposed to temperatures in excess of manufacturer's requirements.

1.10 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.11 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Inverter Assemblies: Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

C. Batteries: Provide pro-rata warranty for the duration of rated design life.

PART 2 PRODUCTS

2.01 CENTRALIZED EMERGENCY LIGHTING INVERTERS - GENERAL REQUIREMENTS

A. Provide complete centralized emergency lighting inverter system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Inverter Assemblies: Manufactured units consisting of inverters, batteries, enclosures, and associated components specifically designed for emergency lighting applications; microprocessor-based utilizing pulse width modulation (PWM) with insulated gate bipolar transistors (IGBT's); listed and labeled as complying with UL 924.
   1. Battery Run Times of 90 Minutes: Listed as complying with UL 924 for "emergency lighting and power equipment".
   2. Battery Run Times Other than 90 Minutes: Listed as complying with UL 924 for "auxiliary lighting and power equipment".

D. Provide inverters and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

E. Increase indicated power ratings as required to accommodate any applicable inverter load restrictions.

F. Inverters Installed in Spaces Used for Environmental Air: Plenum rated; listed and labeled as complying with UL 2043, suitable for use in air-handling spaces.

G. Battery System:
   1. Provide battery capacity as required for achieving battery run time indicated.
   2. Battery Charger: Microprocessor-controlled, temperature compensated; capable of returning supplied battery(s) from fully discharged to fully charged condition within time required by NFPA 111 and UL 924 unless otherwise indicated.
   3. Provide automatic low voltage battery disconnect to prevent battery "deep discharge" damage.

H. Enclosures:
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   2. Hinged Doors: Lockable, with all locks keyed alike.
   3. Finish: Manufacturer's standard unless otherwise indicated.

I. Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category B.

J. Automatic Sequence of Operations:
   1. Upon failure or degradation of primary/normal input power, transfer load to battery power.
   2. When primary/normal input power has been restored, retransfer load to primary/normal power and recharge battery.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of inverter assemblies are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive inverter assemblies.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install inverter assemblies in accordance with applicable requirements of NECA 416.

C. Install products in accordance with manufacturer's instructions.

D. Arrange equipment to provide minimum clearances and required maintenance access.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install inverter assemblies plumb and level.

G. Unless otherwise indicated, mount floor-mounted inverter assemblies on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.

C. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

D. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank.

E. Prepare and start system in accordance with manufacturer's instructions.

F. Perform acceptance test in accordance with NFPA 111.

G. Inspect and test in accordance with NETA ATS, except Section 4.

H. Perform inspections and tests listed in NETA ATS, Section 7.22.2.

I. Batteries and Charger: Perform inspections and tests listed in NETA ATS, Section 7.18.

J. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of emergency lighting inverter system to Owner, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of emergency lighting inverter system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Location: At project site.

3.06 PROTECTION

A. Protect installed inverter assemblies from subsequent construction operations.

3.07 MAINTENANCE

A. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of emergency lighting inverter system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.

END OF SECTION

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SECTION 26 4300
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surge protective devices for service entrance locations.
B. Surge protective devices for distribution locations.
C. Surge protective devices for branch panelboard locations.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
B. Section 26 2300 - Low-Voltage Switchgear.
C. Section 26 2413 - Switchboards.
D. Section 26 2416 - Panelboards.
E. Section 26 2419 - Motor-Control Centers.
F. Section 26 2513 - Low-Voltage Busways.

1.03 ABBREVIATIONS AND ACRONYMS

A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.
B. SPD: Surge Protective Device.

1.04 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
C. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
E. UL 1283 - Standard for Electromagnetic Interference Filters; Current Edition, Including All Revisions.
F. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

C. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.

D. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
   1. UL 1449.
   2. UL 1283 (for Type 2 SPDs).

E. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.

F. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

G. Project Record Documents: Record actual connections and locations of surge protective devices.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.09 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

C. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Factory-installed, Internally Mounted Surge Protective Devices:
   1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.

B. Substitutions: See Section 01 6000 - Product Requirements.

C. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

2.02 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.

B. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   1. Indoor clean, dry locations: Type 1.
   2. Outdoor locations: Type 3R.

C. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:
   1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.
   2. Provide flush-mounted SPD where mounted in public areas or adjacent to flush-mounted equipment.

D. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.

2.03 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.

B. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.

D. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.

E. Repetitive Surge Current Capacity: Not less than 5,000 impulses.

F. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.04 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.

B. List and label as complying with UL 1449, Type 1 or Type 2.

C. Distribution locations include SPDs connected to distribution panelboards, motor control centers, and busway.

D. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.

E. Surge Current Rating: Not less than 80 kA per mode/160 kA per phase.

F. Repetitive Surge Current Capacity: Not less than 3,500 impulses.

G. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.05 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.

B. List and label as complying with UL 1449, Type 1 or Type 2.

C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.

D. Surge Current Rating: Not less than 60 kA per mode/120 kA per phase.

E. Repetitive Surge Current Capacity: Not less than 2,000 impulses.

F. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.

C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.

D. Verify system grounding and bonding is in accordance with Section 26 0526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.

E. Provide conductors with minimum ampacity as indicated on the drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.

F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.

G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS Section 7.19.1.

D. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

3.04 CLEANING

A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 5100
INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior luminaires.
B. Emergency lighting units.
C. Exit signs.
D. Drivers.
E. Luminaire accessories.

1.02 RELATED REQUIREMENTS

A. Section 26 0529 - Hangers and Supports for Electrical Systems.
B. Section 26 0533.16 - Boxes for Electrical Systems.
C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
E. Section 26 0923 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
F. Section 26 2726 - Wiring Devices: Manual wall switches and wall dimmers.
G. Section 26 5600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.
B. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).
C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
D. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019.
E. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
F. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
H. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems; 2006.
I. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
J. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.

K. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012 (Reaffirmed 2018).

L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

M. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

O. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

P. UL 1598 - Luminaires; Current Edition, Including All Revisions.

Q. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
   2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
   3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
   4. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
   2. Provide photometric calculations where luminaires are proposed for substitution upon request.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.
      b. Include IES LM-79 test report upon request.
   2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.

D. Samples:
   1. Provide one sample(s) of each luminaire where indicated.

E. Field quality control reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
   3. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.

I. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide three year manufacturer warranty for LED luminaires, including drivers.

C. Provide ten year pro-rata warranty for batteries for self-powered exit signs.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the source and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.

H. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. Tested in accordance with IES LM-79 and IES LM-80.
   3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

I. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
   1. LED Tape - General Requirements:
      a. Listed.
      b. Designed for field cutting in accordance with listing.
      c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.
   2. White LED Tape:
      a. Color Rendering Index (CRI): Not less than 90.

J. Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.

K. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.03 EMERGENCY LIGHTING UNITS

A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

C. Battery:
   1. Sealed maintenance-free lead calcium unless otherwise indicated.
   2. Size battery to supply all connected lamps, including emergency remote heads where indicated.

D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

G. Where indicated, provide units with integral time delay to maintain emergency illumination for 15 minutes after restoration of normal power source.

H. Accessories:
   1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
   2. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
   3. Provide compatible accessory wire guards where indicated.
   4. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.04 EXIT SIGNS

A. Description: Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
   1. Number of Faces: Single or double as indicated or as required for the installed location.
   2. Directional Arrows: As indicated or as required for the installed location.

2.05 LED DRIVERS

A. LED Drivers - General Requirements:
   1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
   2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
   3. LED Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.

B. Dimmable LED Drivers:
   1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
   2. Control Compatibility: Fully compatible with the dimming controls to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install products in accordance with manufacturer's instructions.

D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).

E. Provide required support and attachment in accordance with Section 26 0529.

F. Provide required seismic controls in accordance with Section 26 0548.

G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

H. Suspended Ceiling Mounted Luminaires:
   1. Do not use ceiling tiles to bear weight of luminaires.
   2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
   3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
   4. Secure pendant-mounted luminaires to building structure.
   5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
   6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
   7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

I. Recessed Luminaires:
   1. Install trims tight to mounting surface with no visible light leakage.
   2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
   3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

J. Suspended Luminaires:
   1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
   2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
   3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.
   4. Install canopies tight to mounting surface.
   5. Unless otherwise indicated, support pendants from swivel hangers.

K. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

L. Install accessories furnished with each luminaire.

M. Bond products and metal accessories to branch circuit equipment grounding conductor.

N. Emergency Lighting Units:
   1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
   2. Install lock-on device on branch circuit breaker serving units.

O. Exit Signs:
   1. Unless otherwise indicated, connect unit to unswitched power from circuit indicated. Bypass local switches, contactors, or other lighting controls.
   2. Install lock-on device on branch circuit breaker serving units.

P. Identify luminaires connected to emergency power system in accordance with Section 26 0553.

Q. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.

E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.06 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting) and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

D. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 26 5600
EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior luminaires.
B. Poles and accessories.
C. Luminaire accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
C. Section 26 0529 - Hangers and Supports for Electrical Systems.
D. Section 26 0533.16 - Boxes for Electrical Systems.
E. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
F. Section 26 0923 - Lighting Control Devices: Automatic controls for lighting including outdoor motion sensors, time switches, and outdoor photo controls.
G. Section 26 2726 - Wiring Devices: Receptacles for installation in poles.
H. Section 26 2813 - Fuses.
I. Section 26 5100 - Interior Lighting.

1.03 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.
B. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals; 2013, with Editorial Revision (2025).
C. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2023.
D. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).
E. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.
F. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
G. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019.
H. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
I. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.

J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
K. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2000 (Reaffirmed 2006).
L. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012 (Reaffirmed 2018).
M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
N. UL 1598 - Luminaires; Current Edition, Including All Revisions.
O. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.
P. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
2. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings:
1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
2. Provide photometric calculations where luminaires are proposed for substitution upon request.
3. Provide structural calculations for each pole proposed for substitution.
C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
1. LED Luminaires:
a. Include estimated useful life, calculated based on IES LM-80 test data.
b. Include IES LM-79 test report upon request.
2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
3. Lamps: Include rated life and initial and mean lumen output.
4. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.
D. Sustainable Design Documentation: Submit manufacturer's product data on lamp mercury content and rated lamp life, showing compliance with specified requirements.
E. Samples:
1. Provide one sample(s) of each specified luminaire where indicated.

F. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.

G. Field Quality Control Reports.
   1. Include test report indicating measured illumination levels.

H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

I. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
   3. Extra Ballasts: Two percent of total quantity installed for each type, but not less than one of each type.
   4. Extra Fuses: Five percent of total quantity installed for each type, but not less than two of each type.
   5. Touch-Up Paint: 2 gallons, to match color of pole finish.

K. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide three year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

H. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. Tested in accordance with IES LM-79 and IES LM-80.
   3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

I. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
   1. LED Tape - General Requirements:
      a. Listed.
      b. Designed for field cutting in accordance with listing.
      c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.
   2. White LED Tape:
      a. Color Rendering Index (CRI): Not less than 90.

J. Exposed Hardware: Stainless steel.

2.03 LED DRIVERS

A. Ballasts/Drivers - General Requirements:
   1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
   2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

B. Dimmable LED Drivers:
   1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
   2. Control Compatibility: Fully compatible with the dimming controls to be installed.

2.04 POLES

A. All Poles:
   1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
   2. Structural Design Criteria:
      a. Comply with AASHTO LTS.
      b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
   3. Material: Steel, unless otherwise indicated.
   4. Shape: Square straight, unless otherwise indicated.
   5. Finish: Match luminaire finish, unless otherwise indicated.
   6. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
   7. Unless otherwise indicated, provide with the following features/accessories:
      a. Top cap.
      b. Anchor bolts with leveling nuts or leveling shims.
      c. Anchor base cover.
      d. Provision for pole-mounted weatherproof GFI receptacle where indicated.
      e. Hinged base.

B. Metal Poles: Provide ground lug, accessible from handhole or transformer base.

2.05 ACCESSORIES

A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install products in accordance with manufacturer's instructions.

D. Install luminaires in accordance with NECA/IESNA 501.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Provide required seismic controls in accordance with Section 26 0548.

G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

H. Recessed Luminaires:
   1. Install trims tight to mounting surface with no visible light leakage.
   2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
   3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

I. Suspended Luminaires:
   1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
   2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
   3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet in length, with no more than 4 feet between supports.
   4. Install canopies tight to mounting surface.
   5. Unless otherwise indicated, support pendants from swivel hangers.

J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

K. Pole-Mounted Luminaires:
   1. Maintain the following minimum clearances:
      a. Comply with IEEE C2.
      b. Comply with utility company requirements.
   2. Foundation-Mounted Poles:
      a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 03 3000.
         1) Install anchor bolts plumb per template furnished by pole manufacturer.
         2) Position conduits to enter pole shaft.
      b. Install foundations plumb.
      c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
      d. Tighten anchor bolt nuts to manufacturer's recommended torque.
      e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.
      f. Install anchor base covers or anchor bolt covers as indicated.
   3. Embedded Poles: Install poles plumb as indicated.
   4. Grounding:
      a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.

b. Provide supplementary ground rod electrode as specified in Section 26 0526 at each pole bonded to grounding system as indicated.

5. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
6. Install non-breakaway in-line fuse holders and fuses complying with Section 26 2813 in pole handhole or transformer base for each ungrounded conductor.
7. Install weather resistant GFI duplex receptacle with weatherproof cover as specified in Section 26 2726 in designated poles.

L. Install accessories furnished with each luminaire.

M. Bond products and metal accessories to branch circuit equipment grounding conductor.

N. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

E. Measure illumination levels at night with calibrated meters to verify conformance with performance requirements. Record test results in written report to be included with submittals.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect.

3.06 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

D. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

3.09 ATTACHMENTS

A. Luminaire schedule.

B. Luminaire cut sheets.

END OF SECTION

SECTION 27 0500
BASIC COMMUNICATIONS SYSTEMS REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Basic Communications Systems Requirements specifically applicable to Division 27 sections, in addition to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.02 REFERENCES

A. CCR California Code of Regulation

B. CBC California Building Code

C. CFC California Fire Code

D. CEC California Electric Code

E. CMC California Mechanical Code

F. CPC California Plumbing Code

G. California Title 24 - Building Energy Efficiency Standards

H. SCAQMD Southern California Air Quality Management Division

1.03 SCOPE OF WORK

A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Communications Systems.

B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make the portion of the Communications Work a finished and working system.

C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.

D. Description of Systems include, but are not limited to, the following:

1. Complete Structured Cabling System including, but not limited to:
    a. Backbone cabling and terminations.
    b. Horizontal cabling and terminations.
    c. Information outlets (IOes) including faceplates, jacks and labeling.
    d. Equipment, cabinets, cable management, and equipment.
    e. Telecommunication Room equipment including patch panels, optical distribution cabinets, and termination blocks.
    f. Cabling pathways.
    g. Grounding and Bonding
    h. Testing
2. Complete Data Communications Equipment Systems.
3. Complete Voice Communications Equipment Systems.
4. Complete Audio/Visual Systems.
5. Complete Paging Systems.

6. Complete Clock Systems.
7. Mounting and patching of wireless access points provided by others.
8. Removal/demolition work and/or relocation and reuse of existing systems and equipment.
9. Low Voltage Communications Wiring (less than +120VAC) as specified and required for proper system control and communications.
10. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the "Suggested Matrix of Scope Responsibility".
11. Firestopping of penetrations as described in Division 7 Section 27 0503.
12. Seismic requirements as described in Section 26 0548 "Seismic Requirements for Equipment and Supports".

1.04 OWNER FURNISHED PRODUCTS

A. Wireless access points and network equipment

1.05 DIVISION OF WORK BETWEEN ELECTRICAL AND COMMUNICATIONS CONTRACTORS

A. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.

B. Definitions:
   1. "Electrical Contractor" as referred to herein refers to the Contractors listed in Division 26 of this Specification.
   2. "Electrical Contractor" shall also refer to the Contractor listed in Division 27 of this specification when the "Suggested Matrix of Scope Responsibility" indicates the work shall be provided by the EC. Refer to the Contract Documents for the "Suggested Matrix of Scope Responsibility".
   3. "Technology Contractor" as referred to herein refers to the Contractors listed in Division 27 of this Specification.
   4. Low Voltage Technology Wiring: The wiring (less than 120VAC) associated with the Technology Systems, used for analog and/or digital signals between equipment.
   5. Telecommunications/Technology Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation and mounting of the telecommunications/technology outlet. Rough-in shall include conduit from the information outlet backbox to above the lay-in ceiling. Where surface mounted backboxes are required, conduit shall be routed to above the lay-in ceiling.

C. General:
   1. The purpose of these specifications is to outline typical Electrical and Technology Contractor's work responsibilities as related to technology systems including telecommunications rough-in, audio/visual systems rough-in, conduit, power wiring, and low voltage communications and technology wiring. The prime contractor is responsible for all divisions of work.

2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the technology drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the technology drawings but required for the successful operation of the systems shall be the responsibility of the Technology Contractor and included in the Contractor's bid.
3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of technology systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Technology Contractor has convened to determine the exact location and requirements of the installation.
4. This Contractor shall establish electrical and technology utility elevations prior to fabrication and installation. The Technology Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
    a. Lighting Fixtures
    b. Gravity Flow Piping, including Steam and Condensate
    c. Sheet Metal
    d. Electrical Busduct
    e. Sprinkler Piping and other Piping
    f. Conduit and Wireway
    g. Open Cabling

D. Electrical Contractor's Responsibility:
1. Assumes all responsibility for all required conduit and power connections when shown on the "Suggested Matrix of Scope Responsibility" to be provided by the Electrical Contractor.
2. Assumes all responsibility for providing and installing cable tray.
3. Responsible for Communications Systems grounding and bonding.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Technology Contractor's Responsibility:
1. Assumes all responsibility for the low voltage technology wiring of all systems, including cable support where open cable is specified.
2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility."
3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).
4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of technology equipment which is required to be bonded to the technology bonding system.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.06 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
    a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
    b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
    c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
    d. Maintenance clearances and code-required dedicated space shall be included.
    e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify Architect/Engineer of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to Owner.
    a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.
3. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:
1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
    a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
2. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of applicable drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:
1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
    a. Scale of drawings:
        1) General plans: 1/4 Inch = 1 '-0" (minimum).
        2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
        3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
        4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).
        5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the Architect/Engineer for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:
1. Coordination drawing files shall be made available to the Architect/Engineer and Owner's Representative. The Architect/Engineer will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The Architect/Engineer reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the Architect/Engineer.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
    a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
    b. Potential layout changes shall be made to avoid additional access panels.
    c. Additional access panels shall not be allowed without written approval from the Architect/Engineer at the coordination drawing stage.
    d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the Architect/Engineer and the Owner's Representative.
    e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain signoff of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.07 QUALITY ASSURANCE

A. Telecommunications Structured Cabling System Standards:
1. All work and equipment shall conform to the most current ratified version of the following published standards unless otherwise indicated that draft standards are to be followed:

a. ANSI/NECA/BICSI 568 - Standard for Installing Commercial Building Telecommunications Cabling
b. ANSI/TIA-568-C.0 - Generic Telecommunications Cabling for Customer Premises
    1) C.1 - Commercial Building Telecommunications Standard
    2) C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standard
    3) C.3 - Optical Fiber Cabling Components Standard
c. ANSI/TIA-569-C - Telecommunications Pathways and Spaces
d. ANSI/TIA-606-B - Administration Standard for Commercial Telecommunications Infrastructure
e. ANSI/TIA-607-B - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
f. ANSI/TIA-758-B - Customer-Owned Outside Plant Telecommunications Standard
g. ANSI/TIA-1152 - Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
h. ANSI/TIA/EIA-598-C - Optical Fiber Cable Color Coding
i. NFPA 70 (NEC) - National Electrical Code (Current Edition)
j. UL 444 - Standard for Safety for Communications Cable
k. California Electrical Code Article 725

B. Refer to individual sections for additional Quality Assurance requirements.

C. Qualifications:
1. Only products of reputable manufacturers as determined by the Architect/Engineer will be acceptable.
2. The installing Contractor shall be certified by the manufacturer of the structured cabling system. Certification of Contractor shall have been in place for a minimum of one (1) year prior to bidding this project. Documentation of certification is required at the time of bid. Shop drawings will not be approved until proof of certification is submitted. Refer to the end of this specification section for certification documentation requirements.
3. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the termination of cabling shall be individually certified by the manufacturer.
4. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.
5. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and copper structured cabling systems and have personnel adequately trained in the use of such tools and equipment.
6. The Contractor shall have certified BICSI installation technicians or CNet CNIT (Certified Network Infrastructure Technician) on staff to perform the following tasks on the project:
    a. Act as the field superintendent or job foreman with the responsibility of monitoring the daily work of each technician.
    b. Oversee all testing and termination of cabling.
7. The Contractor shall have certified BICSI Installer 2 or CNet CNCI (Certified Network Cabling Installer) on staff to perform the following tasks:
    a. Installation and termination of copper cable.
    b. Installation and termination of optical fiber.
8. A resume of qualification shall be submitted with the Contractor's bid indicating the following:
    a. Documentation of certification of This Contractor by the proposed structured cabling system manufacturer as required at the end of this specification section.

D. Compliance with Codes, Laws, Ordinances:

1. In the event there are no local codes having jurisdiction over this job, the current issue of the National Electrical Code shall be followed.
2. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, Architect/Engineer shall determine the method or equipment used.
3. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which are not in accordance with the applicable codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, he shall submit with the proposal a separate price required to make the system shown on the drawings comply with the codes and regulations.
4. Verify the installation environment prior to purchasing or installing any cable. Cable installed in a plenum environment shall be appropriately rated. Bring all discrepancies between the contract documents and installation conditions to the attention of the Architect/Engineer prior to purchase or installation.
5. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

E. Permits, Fees, Taxes, Inspections:
1. Procure all applicable permits and licenses.
2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.
3. Pay all applicable charges for such permits or licenses that may be required.
4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized independent agency/consultant.
7. Pay any charges by the service provider related to the service or change in service to the project.
8. All equipment and materials shall be as approved or listed by the following (unless approval or listing is not applicable to an item by all acceptable manufacturers):
   a. Factory Mutual
   b. Underwriters' Laboratories, Inc.

F. Service Provider Requirements:
1. Secure from the telecommunications service provider all applicable requirements.
2. Comply with all service provider requirements.
3. The Owner shall make application for and pay for new telecommunications service equipment and installation. The Contractor shall coordinate schedule and requirements with the Owner and service provider.

G. Examination of Drawings:
1. The drawings for the technology systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and the exact routing of cabling to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.

3. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
4. If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.
5. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.
6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.

H. Electronic Media/Files:
1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
4. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
5. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
6. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
7. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

I. Field Measurements:
1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.
2. Field conditions that will result in telecommunications drops that exceed the length limitations identified in the contract documents shall be brought to the attention of the Architect/Engineer prior to installation. The cost of reworking cabling that is too long, that was not brought to the written attention of the Architect/Engineer will be borne entirely by the Contractor.
3. This Contractor shall provide the Architect/Engineer with written documentation of any cabling drops that will not be able to use the cable tray (where cable tray is available) due to the resulting cabling lengths. This documentation shall be submitted prior to installation and installation shall not commence until approved by the Architect/Engineer.

1.08 WEB-BASED PROJECT SOFTWARE

A. At project completion, provide digital archive of entire project in format that is readable by common desktop software applications in format acceptable to Architect/Engineer. Provide data in locked format to prevent further changes.

1.09 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

Referenced Specification Section	Submittal Item
27 05 03	Through Penetration Firestopping
27 05 26	Communications Bonding
27 05 28	Interior Communications Pathways
27 05 43	Exterior Communications Pathways
27 05 53	Identification and Administration
27 11 00	Communication Equipment Rooms
27 13 00	Backbone Cabling Requirements
27 15 00	Horizontal Cabling Requirements
27 17 10	Testing
27 41 00	Professional Audio Video System
27 51 13	Paging Systems

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:
   1. Transmittal: Each transmittal shall include the following:
      a. Date
      b. Project title and number
      c. Contractor's name and address
      d. Description of items submitted and relevant specification number
      e. Notations of deviations from the contract documents
      f. Other pertinent data
   2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
      a. Date
      b. Project title and number
      c. Architect/Engineer
      d. Contractor and subcontractors' names and addresses
      e. Supplier and manufacturer's names and addresses
      f. Description of item submitted (using project nomenclature) and relevant specification number
      g. Notations of deviations from the contract documents
      h. Other pertinent data
      i. Provide space for Contractor's review stamps
   3. Composition:
      a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
      b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
      c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
    a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
    b. Unstamped submittals will be rejected.
    c. The Contractor's review shall include, but not be limited to, verification of the following:
        1) Only approved manufacturers are used.
        2) Addenda items have been incorporated.
        3) Catalog numbers and options match those specified.
        4) Performance data matches that specified.
        5) Electrical characteristics and loads match those specified.
        6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
        7) Dimensions and service clearances are suitable for the intended location.
        8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
        9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
    d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
    e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
6. Submittal Identification and Markings:
    a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
    b. The Contractor shall clearly indicate the size, finish, material, etc.
    c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
    d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.

12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
    a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal.
16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

C. Electronic Submittal Procedures:
1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
    a. Submittal file name: 27 XX XX.description.YYYYMMDD
    b. Transmittal file name: 27 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.10 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:
1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:
1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
2. Break down all costs into:
    a. Material: Delivered cost of product with taxes paid.
    b. Labor: Labor cost, excluding overhead and profit.
3. Itemize the cost for each of the following:
    a. Overhead and profit.

b. Bonds.
c. Insurance.
d. General Requirements: Itemize all requirements.

4. For each line item having an installed cost of more than $5,000, break down costs to list major products or operations under each item. At a minimum, provide material and labor cost line items for the following:
   a. Structured cabling
   b. Overhead paging/intercom systems
   c. Security systems
      1) Surveillance
      2) Access control
      3) Intrusion
   d. Audio/video systems

D. Update Schedule of Values when:
   1. Indicated by Architect/Engineer.
   2. Change of Subcontractor or supplier occurs.
   3. Change of product or equipment occurs.

1.11 CHANGE ORDERS

A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.

B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.

C. Change order work shall not proceed until authorized.

1.12 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a representative of the manufacturer has inspected the installation and certified that the equipment is properly installed and that the equipment is ready for operation:
   1. Firestopping, including mechanical firestop systems.

1.13 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.

B. Store materials on the site to prevent damage.

C. Keep fixtures, equipment and materials clean, dry and free from deleterious conditions.

1.14 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.15 WARRANTY

A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 27 may require additional warranty requirements for specific equipment or systems.

B. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.

C. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.16 INSURANCE

A. Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.17 MATERIAL SUBSTITUTION

A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The Architect/Engineer shall make the final determination of whether a product is equivalent.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor bears full responsibility for the unnamed manufacturers equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.

D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

PART 2 PRODUCTS

2.01 CABLE JACKET RATING

A. This project requires all cable jackets to carry a plenum rating.

2.02 Refer to individual sections.

PART 3 EXECUTION

3.01 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 26 0533. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.

B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.

C. The Contractor shall be responsible for identifying and reporting to the Architect/Engineer any existing conditions including but not limited to damage to walls, flooring, ceiling and furnishings prior to start of work. All damage to interior spaces caused by this Contractor shall be repaired at this Contractor's expense to pre-existing conditions, including final colors and finishes.

D. All cables and devices installed in damp or wet locations, including any underground or underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

3.03 FIELD QUALITY CONTROL

A. General:
   1. Refer to specific Division 27 sections for further requirements.
   2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.

3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.
4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.
5. All communications cable tests that fail, including those due to excessive cabling lengths, shall be remedied by the Contractor without cost to the project.

B. Protection of cable from foreign materials:
1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
2. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

3.04 PROJECT CLOSEOUT

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:
1. The Architect/Engineer will not perform a final job site observation until the project is ready. This is not dictated by schedule, but rather by completeness of the project.
2. Refer to the end of this specification section for a "STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION."
3. The Contractor shall sign this form and return it to the Architect/Engineer so that the final observation can commence.

C. Before final payment will be authorized, this Contractor must have completed the following:
1. Submitted operation and maintenance manuals to the Architect/Engineer for review.
2. Submitted bound copies of approved shop drawings.
3. Record documents including edited drawings and specifications accurately reflecting field conditions, inclusive of all project revisions, change orders, and modifications.
4. Submitted a report stating the instructions given to the Owner's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representative as having received the instructions.
5. Submitted testing reports for all systems requiring final testing as described herein.

6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.
7. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site; submit receipt to Architect/Engineer prior to final payment being approved.
8. Provide System Assurance Warranty certificate for the telecommunications system.

3.05 OPERATION AND MAINTENANCE MANUALS

A. General:
   1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
   2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:
   1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
   2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
   3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
   4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
      a. O&M file name: O&M.div27.contractor.YYYYMMDD
      b. Transmittal file name: O&Mtransmittal.div27.contractor.YYYYMMDD
   5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
   6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
   7. All text shall be searchable.
   8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:
   1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
   2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
   3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
   4. Copies of all factory inspections and/or equipment startup reports.

5. Copies of warranties.
6. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
7. Dimensional drawings of equipment.
8. Capacities and utility consumption of equipment.
9. Detailed parts lists with lists of suppliers.
10. Operating procedures for each system.
11. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
12. Repair procedures for major components.
13. List of lubricants in all equipment and recommended frequency of lubrication.
14. Instruction books, cards, and manuals furnished with the equipment.

3.06 INSTRUCTING THE OWNER'S REPRESENTATIVE

A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.

B.

C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.

D. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Owner's representative so that their representative can be present if desirable.

E. Refer to the individual specification sections for minimum hours of instruction time for each system.

F. Operating Instructions:
   1. The Contractor is responsible for all instructions to the Owner and/or Owner's operating staff on the Communications Systems.
   2. If the Contractor does not have Engineers and/or Technicians on staff who can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, they shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.07 SYSTEM STARTING AND ADJUSTING

A. The Communications Systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.

B. All operating conditions and control sequences shall be simulated and tested during the start-up period.

C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to ensure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.08 RECORD DOCUMENTS

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.

C. This Contractor shall maintain at the job site, a separate and complete set of technology drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Technology Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.

D. Record actual routing of all conduits sized 2" or larger.

E. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.

F. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

3.09 ADJUST AND CLEAN

A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.

B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.

C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

3.10 SPECIAL REQUIREMENTS

A. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards: CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.

B. South Coast Air Quality Management District Rule 1168 - Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

C. South Coast Air Quality Management District Rule SCAQMD 1113 - Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION

To assist the contractor in a timely close-out of the project, it is crucial that the final jobsite observation is not conducted prior to the project being ready. The contractor is required to review the completion status of the project at the time the observation is scheduled. This review, and the subsequent submittal of this form to the Architect/Engineer, shall indicate the contractor's agreement that the area of the project being requested for final observation is ready as defined below. The following list represents the degree of completeness required prior to requesting a final observation:

1. All cabling pathways (cable tray, ladder rack, conduit sleeves, etc.) are installed and all cabling has been pulled through them.
2. All mechanical firestop products are installed and all other penetrations have been sealed.
3. All telecommunications jacks are installed in the faceplates.
4. All telecommunications cabling is pulled and at least 90% of all jacks have been terminated at the jack and at the telecom room.
5. Telecommunications testing is in progress and at least 50% of testing has been completed.
6. Telecommunications labeling has been provided on at least 50% of each type of component requiring a label.
7. All telecommunications related grounding is complete.
8. All Audio/Visual components, cabling and control systems are installed, programmed and operational.
9. All overhead or integrated paging systems, including speakers, back boxes, cabling, and power supplies, and all headend equipment is installed, programmed and operational.
10. All CCTV cameras, mounts, cabling and all headend equipment are installed, programmed and operational.
11. All access control system equipment, including card readers, conduits, cabling, electronic locks, controllers and all headend equipment, is installed, programmed and operational.

Prime Contractor: _____ By: _____

Requested Observation Date _____ Today's Date: _____

Contractor shall sign this readiness statement and transmit to Architect/Engineer at least 10 days prior to the requested date of observation.

It is understood that if the Architect/Engineer finds that the project is not complete as defined above and that the final jobsite observation cannot be completed on the requested date, the Architect/Engineer will return to the site at a later date. All additional visits to the site for the purposes of completing the final observation will be billed T&M to the Contractor at our standard hourly rates, including travel expenses or the contractor's retainage may be deducted for the same amount.

TELECOMMUNICATIONS - PROOF OF CERTIFICATION

There are specific Contractor qualification requirements for this project as defined in Section 27 0500, which may include Manufacturer Certification and RCDD or CNIDP credentials. This Proof of Certification document, and the supporting documentation require herein, is required to be submitted at the time of bid to show compliance with the requirements of 27 05 00.

Statement of Compliance:
The named Contractor's base bid is a structured cabling solution from the connectivity manufacturer: _____. Named Contractor is trained and certified, under the named manufacturer's formal certification program to provide and install all materials and work required by this project. Further, said Contractor is authorized, by the named manufacturer, to offer all product, labor and system assurance warranties required for this project by these contract documents.

The certification of this named manufacturer is valid, current and in effect as of the bid day of this project, the _____ day of _____, 20____.

The named Contractor is not employing any other sub-contractor on the telecommunications portion of this project that does not also meet this certification requirement.

Contractor Company Name: _____

Authorized Representative: (print) _____

Date: _____
Manufacturer Certification Number (if any): _____

If this project requires RCDD certification, complete the following:

RCDD or CNIDP Name: _____
RCDD #: _____ Expiration: _____

Submit the following with the bid:
This form.
Proof of Manufacturer Certification indicated above.
Proof of RCDD or CNIDP status.

END OF SECTION

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SECTION 27 0503
THROUGH PENETRATION FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Through-Penetration Firestopping.

1.02 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.03 REFERENCES

A. UL 263 - Fire Tests of Building Construction and Materials

B. UL 723 - Surface Burning Characteristics of Building Materials

C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops

D. UL 2079 - Tests for Fire Resistance of Building Joint Systems

E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)

F. Intertek / Warnock Hersey - Directory of Listed Products

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops

I. CBC California Building Code

J. The Building Officials and Code Administrators National Building Code

K. 1997 Uniform Building Code

L. 2021 International Building Code

M. NFPA 5000 Ó Building Construction Safety Code

1.04 SUBMITTALS

A. Submit under provisions of Section 27 0500.

B. Submit Firestopping Installers Certification for all installers on the project.

C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer's installation instructions, and UL or Intertek / Warnock Hersey Assembly number.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
   1. Types of penetrating items.
   2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
   3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
   4. F ratings for each firestop system.

E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

F. Submit VOC rating of firestopping material in g/L (less water) with documentation that it meets the limits set forth in SCAQMD Rule 1168.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

B. Install material prior to expiration of product shelf life.

1.06 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
   1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
   2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:
   1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
   2. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 5.0 CFM/sq.ft. at both ambient temperature and 400°°F.

C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

F. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.
   2. South Coast Air Quality Management District Rule 1168 - Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.
   3. South Coast Air Quality Management District Rule SCAQMD 1113 - Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

1.07 WARRANTY

A. Provide one year warranty on parts and labor.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.
   1. 3M; Fire Protection Products Division
   2. Hilti, Inc.
   3. RectorSeal Corporation, Metacaulk
   4. Tremco; Sealant/Weatherproofing Division
   5. Johns-Manville
   6. Specified Technologies Inc. (S.T.I.)
   7. Spec Seal Firestop Products
   8. AD Firebarrier Protection Systems
   9. Wiremold/Legrand: FlameStopper
   10. Dow Corning Corp.
   11. Fire Trak Corp.
   12. International Protective Coating Corp.
   13. HoldRite

2.02 THROUGH PENETRATION FIRESTOP SYSTEMS

A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.

B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.

C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.

D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.

E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.

F. Provide firestopping systems allowing continuous insulation for all insulated pipes.

G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:
   1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated:
      a. F Rating = Floor/Wall Rating
b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated:
   a. F Rating = Wall Rating
   b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated:
   a. F Rating = Wall/Floor Rating
   b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.

I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.

C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.

D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.02 INSTALLATION

A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.

B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.03 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.04 IDENTIFICATION

A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:
   1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
   2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.05 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The Contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the Contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The Contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the Contractor's expense.

END OF SECTION

SECTION 27 0526
COMMUNICATIONS BONDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bonding Conductors
B. Bonding Connectors
C. Grounding Busbar (PBB and SBB)
D. Rack-mount Telecommunications Grounding Busbar

1.02 RELATED WORK

A. Section 26 0533 - Conduit and Boxes
B. Section 26 0536 - Cable Trays
C. Section 26 0513 - Wire and Cable
D. Section 26 0526 - Grounding and Bonding
E. Section 26 4100 - Lightning Protection Systems
F. Section 27 0500 - Basic Communications Systems Requirements
G. Section 27 0503 - Through Penetration Firestopping
H. Section 27 1100 - Communication Equipment Rooms
I. Section 27 0528 - Interior Communication Pathways
J. Section 27 0553 - Identification and Administration

1.03 QUALITY ASSURANCE

A. Refer to Section 27 0500 for relevant standards.
B. Communications bonding system component, device, equipment, and material manufacturer(s) shall have a minimum of five (5) years documented experience in the manufacture of communications bonding products.
C. The entire installation shall comply with all applicable electrical codes, safety codes, and standards. All applicable components, devices, equipment, and material shall be listed by Underwriters' Laboratories, Inc.

1.04 REFERENCES

A. ANSI/IEEE 1100 - Recommended Practice for Power and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems
B. ANSI/TIA 568-C - Commercial Building Telecommunications Cabling Standard
C. ANSI/TIA 569-A - Commercial Building Standard for Telecommunications Pathways and Spaces
D. ANSI/TIA 606 - Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
E. ANSI/TIA 758 - Customer Owned Outside Plant

F. ANSI/TIA-607-D - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

G. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements

H. IEEE 837 - IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding

I. NFPA 70 - National Electrical Code

J. NFPA 780 - Standard for the Installation of Lightning Protection Systems

K. UL 96 - Lightning Protection Components

L. UL 96A - Installation Requirements for Lightning Protection Systems

M. UL 467 - Grounding and Bonding Equipment

1.05 SUBMITTALS

A. Submit product data and shop drawings under provisions of Section 27 0500 and Division 1.

B. Provide manufacturer's technical product specification sheet for each individual component type. Submitted data shall show the following:
   1. Compliance with each requirement of these documents. The submittal shall acknowledge each requirement of this section, item-by-item, including construction, materials, ratings, and all other parameters identified in Part 2 - Products.
   2. Manufacturer's installation instructions indicating application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

C. Provide CAD-generated, project-specific system shop drawings as follows:
   1. Provide a system block diagram indicating system configuration, system components, interconnection between components, and conductor routing. The diagram shall clearly indicate all wiring and connections required in the system. When multiple devices or pieces of equipment are required in the exact same configuration (e.g., multiple identical equipment racks or sections of ladder tray), the diagram may show one device and refer to the others as "typical" of the device shown. The diagram shall list room numbers where system equipment will be located.

D. Provide system checkout test procedure to be performed at acceptance.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under the provisions of Section 27 0500.

B. Store and protect products under the provisions of Section 27 0500.

C. Contractor shall exercise care to prevent corrosion of any products prior to installation. Corroded products shall not be acceptable for use on this project.

1.07 SYSTEM DESCRIPTION

A. This section describes the requirements for the furnishing, installation, adjusting, and testing of a complete turnkey communications bonding system, including connection to the electrical ground grid.

B. Performance Statement: This specification section and the accompanying drawings are performance based, describing the minimum material quality, required features, operational requirements, and performance of the system. These documents do not convey every wire that must be installed, every equipment connection that must be made, or every feature and function that must be configured. Based on the equipment constraints described and the performance required of the system as presented in these documents, the Contractor is solely responsible for determining all components, devices, equipment, wiring, connections, and terminations required for a complete and operational system that provides the required performance.

C. This document describes the major components of the system. All additional hardware, subassemblies, supporting equipment, and other miscellaneous equipment required for complete, proper system installation and operation shall be provided by the Contractor.

D. Basic System Requirements:
   1. A complete communications bonding infrastructure is required for this project. Refer to the drawings and the requirements of ANSI-J-STD-607-**D** and NFPA 70 for complete information.
   2. The bonding system shall include, but not be limited to, the following major components:
      a. Telecommunications Bonding Conductor (TBC)
      b. Primary Bonding Busbar (PBB)
      c. Telecommunications Bonding Backbone (TBB)
      d. Secondary Bonding Busbar(s) (SBB)
      e. Rack mount Telecommunications Grounding Busbar(s)
      f. Bonding Conductor(s) (BC)
      g. Bonding Connectors
      h. Bonding system labeling and administration as defined in Section 27 0553.

1.08 PROJECT RECORD DOCUMENTS

A. Submit documents under the provisions of Section 27 0500.

B. Provide final system block diagram showing any deviations from approved shop drawing submittal.

C. Provide floor plans that document the following:
   1. Actual locations of system components, devices, and equipment.
   2. Actual conductor routing.
   3. Actual system component, device, equipment, and conductor labels.

D. Provide statement that system checkout test, as outlined in the approved shop drawing submittal, is complete and test results were satisfactory.

E. Complete all operation and maintenance manuals as described below.

1.09 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 27 0500.

B. Submitted data shall include:
   1. Approved shop drawings.
   2. Descriptions of recommended system maintenance procedures, including:
      a. Inspection
      b. Periodic preventive maintenance
      c. Fault diagnosis
      d. Repair or replacement of defective components

PART 2 PRODUCTS

2.01 BONDING CONDUCTORS

A. Bare Copper:
   1. Annealed uncoated stranded conductor.
   2. Minimum size 6 AWG.

B. Insulated Copper:
   1. Annealed uncoated stranded conductor.
   2. Insulation:
      a. PVC insulation with nylon outer jacket.
      b. Rated at 600 volts.
      c. Green.
   3. Minimum size 6 AWG.

C. All bonding conductors shall be listed and recognized by a nationally recognized testing laboratory as being suitable for the intended purpose and for installation in the space in which they are installed.

D. Bonding Conductor Sizing:
   1. All communications bonding system conductors shall be sized by length as follows:

Length Linear ft (m)	Size (AWG)
Less than 13 (4)	6
14 - 20 (4 - 6)	4
21 - 26 (6 - 8)	3
27 - 33 (8 - 10)	2
34 - 41 (10 - 13)	1
42 - 52 (13 - 16)	1/0
53 - 66 (16 - 20)	2/0
67 - 84 (20 - 26)	3/0
85 - 105 (26 - 32)	4/0
106 - 125 (32 - 38)	250 kcmil
126 - 150 (38 - 46)	300 kcmil
151 - 175 (46 - 53)	350 kcmil
176 - 250 (53 - 76)	500 kcmil
251 - 300 (76 - 91)	600 kcmil
Greater than 301 (91)	750 kcmil

   2. The TBC shall be the same size as the TBB or larger.

2.02 BONDING CONNECTORS

A. Acceptable Types:
   1. Two-hole compression lug
   2. Exothermic weld
   3. Irreversible compression

B. Connectors shall be provided in kit form and selected per manufacturer's written instructions.

C. Connectors shall comply with IEEE 837 and UL 467 and be listed for use for specific types, sizes, and combinations of conductors and connected items.

2.03 GROUNDING BUSBAR (PBB AND SBB)

A. Features:
   1. Wall-mount configuration.
   2. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended purpose.
   3. Hole patterns compliant with BICSI recommendations and ANSI-J-STD-607-D standards.
   4. Predrilled holes.
   5. Integral insulators.
   6. Stainless steel offset mounting brackets.

B. Specifications:
   1. Material: Electrolytic tough pitch copper bar with tin plating.
   2. Refer to drawings for grounding busbar size(s).
      a. Minimum Dimensions: Refer to drawings.
      b. Increase dimensions and/or quantity furnished and installed as required to accommodate all terminations required by the project, plus 20% spare capacity.
      c. Hole patterns on busbars accommodate two-hole lugs per the recommendation of ANSI/BICSI N3-20 and ANSI/TIA-607 standards.

2.04 RACK-MOUNT TELECOMMUNICATIONS GROUNDING BUSBAR

A. Features:
   1. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended purpose.
   2. Predrilled holes.
   3. Mounts in a standard 19" equipment rack.

B. Specifications:
   1. Material: Electrolytic tough pitch copper bar with tin plating.
   2. Minimum Dimensions: 3/16" thick x 3/4" high x 19" long.
      a. Increase dimensions and/or quantity furnished and installed as required to accommodate all terminations required by the project, plus 20% spare capacity.
   3. Hole pattern shall include:
      a. A minimum of eight (8) 6-32 tapped lug mounting holes on 1" centers.
      b. A minimum of two (2) pairs of 5/16" diameter holes spaced 3/4" apart.

PART 3 EXECUTION

3.01 INSTALLATION

A. General Bonding Requirements:
   1. The communications bonding system shall be a complete system. Contractor shall furnish and install all necessary miscellaneous components, devices, equipment, material, and hardware, including, but not limited to, lock washers, paint-piercing washers, hex nuts, compression lugs, insulators, mounting screws, lugs, etc., to provide a complete system.
   2. A licensed electrician shall perform all bonding.
   3. Comply with the manufacturer's instructions and recommendations for installation of all products.

B. Main Cross Connect and Service Entrance Room Bonding Requirements:
   1. Locate the PBB in the service entrance room unless otherwise noted on the drawings.

2. The location of the PBB shall be the shortest practical distance from the telecommunications primary lightning protection devices.
3. Bond the telecommunications primary protectors to the PBB. Maintain a minimum 1 foot separation of the bonding conductor from all DC power cables, switchboard cable, and high frequency cable.
4. In service entrance rooms where the entrance pathway contains an isolation gap, the pathway on the facility side of the gap shall be bonded to the PBB.

C. Where the service entrance cable contains a shield, the shield(s) shall be bonded to the PBB using manufacturer-approved hardware.

D. Primary Bonding Busbar (PBB) Requirements:
1. Install PBB such that it is insulated from its support with a minimum 2" standoff.
2. Bond the PBB to the electrical service ground via the TBC.
   a. A minimum of 1 foot separation shall be maintained between the TBC and any DC power cables, switchboard cable, or high frequency cables.
3. Where backbone or horizontal cabling contains a shield, the shield(s) shall be bonded to the PBB.
4. PBB shall be bonded to all electrical panels located in the same room or space as the PBB. PBB shall be bonded to all electrical panels providing electrical power to communications equipment located in the same room or space as the PBB.
5. PBB shall be bonded to accessible metallic building structure located within the same room or space as the PBB.
6. All metallic continuous cable pathways, including, but not limited to, cable trays, basket trays, ladder racks, raceways, conduits, conduit sleeves, and fire-rated cable pathway devices, located within the same room or space as the PBB, shall be bonded to the PBB.
7. All metallic communications equipment, including, but not limited to, cable pair protectors, surge suppressors, cross-connect frames, patch panels, equipment cabinets, etc., located within the same room or space as the PBB, shall be bonded to the PBB.

E. Secondary Bonding Busbar (SBB) Requirements:
1. Provide an SBB in each telecommunications equipment room.
2. Install SBB such that it is insulated from its support with a minimum 2" standoff.
3. Bond each SBB to the PBB via the TBB.
   a. A minimum of 1 foot separation shall be maintained between the TBB and any DC power cables, switchboard cable, or high frequency cables.
   b. The TBB may be routed from PBB to SBB or as a radial feed to each SBB as the layout requires.
4. When two or more TBBs are used within a multi-story building, the TBBs shall be bonded together with a BBC at the top floor and at a minimum of every third floor in between the lowest floor level.
5. If more than one (1) SBB is provided within the same room or space, they shall all be bonded together via a BC the same size as the TBB.
6. Where horizontal cabling contains a shield, the shield(s) shall be bonded to the SBB.
7. SBBs shall be bonded to accessible metallic building structure located within the same room or space as the SBBs.
8. SBBs shall be bonded to all electrical panels located in the same room or space as the SBB. SBBs shall be bonded to all electrical panels providing electrical power to communications equipment located in the same room or space as the SBB.
9. All metallic continuous cable pathways, including, but not limited to, cable trays, basket trays, ladder racks, raceways, conduits, conduit sleeves, and fire-rated cable pathway devices, located within the same room or space as the SBB, shall be bonded to the SBB.

10. All metallic communications equipment, including, but not limited to, cable pair protectors, surge suppressors, cross-connect frames, patch panels, equipment cabinets, etc., located within the same room or space as the SBB, shall be bonded to the SBB.

F. Rack Bonding Busbar Requirements (RBB):
   1. Provide a rack-mount telecommunications ground bar in each equipment rack and equipment cabinet.
   2. Install RBB such that it is electrically bonded to the rack. Where necessary, remove paint and/or use paint-piercing washers to provide proper electrical bond between RBB and equipment rack.
   3. Bond each RBB to the PBB/SBB via a telecommunications equipment bonding conductor (TEBC).
   4. If more than one (1) RBB is provided within the same room or space, they shall all be bonded together via a TEBC.
   5. Where horizontal cabling containing a shield is terminated on rack-mounted termination hardware, the shield(s) shall be bonded to the RBB.
   6. All contractor-furnished and/or contractor-installed metallic communications equipment, including, but not limited to patch panels, fiber optic distribution enclosures, splice enclosures, active electronics, uninterruptible power supplies, etc., mounted within the same equipment rack as the RBB, shall be bonded to the RBB. Where necessary, remove paint and/or use paint-piercing washers to provide proper electrical bond between equipment rack and installed metallic communications equipment. Active electronics and uninterruptible power supplies shall be bonded to the RBB via a dedicated unit bonding conductor (UBC) for each device.

G. Metallic Interior Communication Pathway Bonding Requirements:
   1. All metallic interior continuous communication cable pathways, including, but not limited to, conduit, conduit sleeves, fire-rated cable pathway devices, cable tray, basket tray, and ladder rack, shall be bonded to the communications bonding system.

H. Bonding Conductor Requirements:
   1. Bonding conductors shall be green or marked with a distinctive green color.
   2. Bonding conductors shall be routed parallel and perpendicular to building structure along shortest and straightest paths possible. Number of bends and changes in direction should be minimized. Install and secure conductors in a manner that protects the conductors from impact and from physical or mechanical strain or damage.
   3. Bonding conductors shall not be installed in metallic conduit.
   4. All conductors, including, but not limited, to the TBC, TBB, BBC, and TEBC(s), shall be installed splice-free. If the Contractor believes that site conditions do not allow a splice-free installation, the Contractor may request permission from the Architect/Engineer to splice a specific communications bonding system conductor.
      a. Where documented permission to splice a conductor is granted:
         1) The number of splices shall be limited to as few as possible.
         2) Splices shall be made using exothermic welding or irreversible compression-type connections only. Splice hardware shall be listed for grounding and bonding. Solder is not an acceptable means of splicing conductors.
         3) Splices shall be made in telecommunications spaces in accessible locations to facilitate future inspection and maintenance.
         4) Splices shall be adequately supported and protected from impact and from physical or mechanical strain or damage.
   5. All bonding conductors shall be labeled in accordance with the requirements of Section 27 0553. In addition to the requirements of Section 27 0553:
      a. Labels shall be nonmetallic.
      b. Labels shall be printer-generated.

c. Labels shall be located on conductors as close as is practical to their point of termination in a readable position.
d. Additionally, conductors shall be labeled as follows:
1) "IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER."

6. Interior water piping is not acceptable for use as a communications bonding system bonding conductor.
7. Metallic cable shields are not acceptable for use as communications bonding system bonding conductors.

I. Bonding Connection Requirements:
1. Make all connections in accessible locations to facilitate future inspection and maintenance.
2. Communications bonding system connections shall be made using exothermic welding, two-hole compression lugs, or other irreversible compression-type connections. The use of 1-hole lugs is prohibited, except for connections to a rack-mount telecommunications ground bar. Connection hardware shall be listed for grounding and bonding. Sheet metal screws shall not be used to make communications bonding system connections.
3. Thoroughly clean conductors before installing lugs and connectors.
4. Install and tighten all connectors in accordance with manufacturer's instructions, using the appropriate purpose-designed tool(s) recommended by the manufacturer for that purpose. Exercise care not to tighten connectors beyond manufacturer's recommendations.
5. Where necessary, remove paint and/or use paint-piercing washers to provide proper electrical bond at all connections.
6. All bonding connections shall be coated in anti-oxidant joint compound that is purpose-designed and purpose-manufactured for that use. Anti-oxidant joint compound shall be applied in accordance with manufacturer's recommendations and instructions.
7. All installed connectors on conductors installed in damp locations shall be sealed with dielectric grease and then covered with heat shrink tubing to protect against moisture ingress. Applied heat shrink tubing shall overlap conductor's outer jacket a minimum of four (4) inches past connector and be installed in accordance with manufacturer's recommendations and instructions.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of Section 27 0500.

B. Where these specifications require a product or assembly without the use of a brand or trade name, provide a product from a reputable manufacturer that meets the requirements of the specifications.

C. Periodic observations will be performed during construction to verify compliance with the requirements of the specifications. These services do not relieve the Contractor of responsibility for compliance with the contract documents.

3.03 ADJUSTING

A. Adjust work under provisions of Section 27 0500.

B. Contractor shall make any and all adjustments to the communications bonding system necessary to ensure that the installed system meets all requirements listed herein. Modifications necessary to comply with listed requirements or to provide specified performance shall be completed by the Contractor at no additional cost to the Owner.

3.04 TESTING

A. Measure and document resistance to ground at PBB, each SBB, each RBB, and each electrical distribution panel bonded to the PBB or an SBB.
   1. Measurements shall be made not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage, and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the fall-of-potential method according to IEEE 81.
   2. The preferred measured resistance to ground for the grounding electrode system is **15** ohms or less. Refer to Division 26 for exact project requirements.
   3. Under no circumstances shall any point in the communications bonding system have a lower resistance to ground than that of nearby electrical distribution system components that it is bonded to.

B. Two-point Ground/Continuity Test:
   1. Two-point ground continuity test shall be performed per TIA-607D standards.
   2. Contractor shall use an earth ground resistance tester to confirm a resistance of less than 100 milliohms between the building's electrical grounding electrode system and any other point in the telecommunications bonding system.
   3. At a minimum, perform tests in the following areas:
      a. PBB to the electrical ground in distributors
      b. Each SBB to the electrical ground in distributors
      c. PBB/SBB to the structural metal (if present)
      d. PBB to SBB(s)
      e. Structural metal (if present) to the electrical ground
   4. Complete testing prior to installation of Owner-provided equipment.

C. Measure and document voltage between screen of installed and terminated ScTP, FTP, and/or SSTP horizontal cables and electrical ground of electrical outlet(s) serving the information outlet location area.
   1. The voltage between the screen and the ground wire shall not exceed 1.0 V rms, and 1.0 V dc for any installed and terminated ScTP, FTP, and/or SSTP horizontal cables.

D. Include measurement documentation in test data submitted at completion of project under provisions of Section 27 1710.

END OF SECTION

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SECTION 27 0528
INTERIOR COMMUNICATION PATHWAYS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install complete cable hook support systems, conduits, sleeves, etc. for an interior cabling plant as shown on the drawings.

1.02 RELATED WORK

A. Section 26 0533 - Conduit and Boxes
B. Section 27 0500 - Basic Communications Systems Requirements
C. Section 27 0526 - Communications Bonding

1.03 QUALITY ASSURANCE

A. Refer to Section 27 0500 for requirements.

1.04 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code

1.05 SUBMITTALS

A. Under the provisions of Section 27 0500 and Division 1, prior to the start of work the Contractor shall submit:
   1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
   2. Manufacturer's installation instructions.
B. Coordination Drawings:
   1. Include cable tray and conduit sleeve layout in composite electronic coordination files. Refer to Section 27 0500 for coordination drawing requirements.

1.06 DRAWINGS

A. The drawings, which constitute a part of these specifications, indicate the general route of the cable hook support systems, conduit, sleeves, etc. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

PART 2 PRODUCTS

2.01 CONDUIT

A. Refer to Section 26 0533 for conduit requirements for this project.

2.02 CABLE HANGERS AND SUPPORTS

A. Provide a non-continuous cable support system suitable for use with open cable.

B. Cable Hooks:
   1. Construction: Flat bottom design with a minimum cable bearing surface of 1-5/8". Hooks shall have 90-degree radius edges.
   2. All cable hook mounting hardware shall be recessed to prevent damage to cable during installation. Installed cabling shall be secured using a cable latch retainer that shall be removable and reusable.
   3. Finish: Pre-galvanized steel, ASTM A653 suitable for general duty use zinc plated steel, ASTM B633 SC3 suitable for heavy duty use. Provide stainless steel AISI Type 304 hooks for corrosive locations.

C. Cable Hangers:
   1. Adjustable, non-continuous cable support slings for use with low voltage cabling.
   2. Steel and woven laminate construction, rated for indoor non-corrosive use. Laminate material shall be suitable for use in plenum environments.
   3. Sling length shall be adjustable to a capacity of 425 4-pair UTP cables.
   4. Cabling hanger load limit shall be 100 lbs per foot.
   5. Manufacturer:
      a. Erico Caddy
      b. CableCat CAT425
      c. Arlington Fittings Tl Series
      d. Or approved equal.

PART 3 EXECUTION

3.01 CABLE HOOK SUPPORT SYSTEM

A. In areas where cabling is not supported by cable tray, ladder rack, enclosed wireway or installed in conduit, such cabling shall be supported by an approved cable hook support system.

B. Refer to manufacturer's requirements for allowable fill capacity for selected cable hook. In no case shall a 40% fill capacity be exceeded.

C. Cable hooks shall be securely mounted per manufacturer's instructions. In no case shall the side-to-side travel of any cable hook exceed 6".

D. Cable hooks shall be selected based on the contractor's cable routing. Hooks shall be capable of supporting a minimum of 30 pounds with a safety factor of 3.

E. J-hook support spans shall be based on the smaller of the manufacturer's load ratings and code requirements. In no case shall horizontal spans exceed 5 feet and vertical spans exceed 4 feet.

F. The resting and supporting of cabling on structural members shall not meet the requirements for cabling support specified herein.

G. The use of tie-wraps or hook and loop type fasteners is specifically prohibited as a substitute for cable hooks specified herein.

3.02 CONDUIT AND CABLE ROUTING

A. Refer to Section 26 0533 for additional requirements.

B. All conduits shall be reamed and shall be installed with a nylon bushing.

C. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of less than 2", maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter 2" or greater, maintain a bend radius of at least 10 times the internal diameter.

D. No conduit or sleeve containing more than two (2) cables shall exceed 40% fill ratio, regardless of length.

E. Any conduit exceeding 90' in length or containing more than two (2) 90-degree bends shall contain a pull box sized per ANSI/TIA/EIA 569 requirements.
   1. A separate pull box is required for each 90' (or greater) length section.
   2. A separate pull box is required after any two (2) consecutive 90-degree bends.
   3. Pull box shall be located in an area that maintains accessibility of box, including the ability to remove box lid without removal or relocation of any other materials.

F. Any conduit with bends totaling 90 degrees or more shall have the fill capacity derated by 15% for each 90 degrees of cumulative bend.

G. Cables installed in any conduits that do not meet the above requirements shall be replaced at the Contractor's expense, after the conduit condition has been remedied.

3.03 ATTACHMENT TO METAL DECKING

A. Where supports for cable trays and cable hook systems attach to metal roof decking, excluding concrete on metal decking, do not exceed 25 lbs. per hangar and a minimum spacing of 2'-0" on center. This 25-lb. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

END OF SECTION

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SECTION 27 0543
EXTERIOR COMMUNICATION PATHWAYS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section describes the products and execution requirements relating to furnishing and installing exterior racks, ladders, conduits, sleeves, innerduct, etc. for an exterior cabling plant.

1.02 QUALITY ASSURANCE

A. Refer to Section 27 0500 for relevant standards.

B. Precast Manufacturer (if applicable): Company specializing in precast concrete structures with three (3) years documented experience.

1.03 REFERENCES

A. Section 27 0500 - Basic Communications Systems Requirements.

B. ANSI/ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ANSI/ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled, Commercial Quality.

D. ASTM A48 - Gray Iron Castings.

E. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.

1.04 SUBMITTALS

A. Under the provisions of Section 27 0500 and Division 1, prior to the start of work the Contractor shall submit:
   1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
   2. Manufacturer's installation instructions.

B. Manhole submittal (if applicable): Indicate material specifications, dimensions, capacities, size and location of openings, reinforcing details, and accessory locations.
   1. Provide product data for manhole accessories.

C. Submit shop drawings and product data under provisions of Section 27 0500.

D. Submit manufacturer's installation instructions under provisions of Section 27 0500.

E. Coordination Drawings:
   1. Include manholes, hand holes, and conduits 1.5" and larger in coordination files. Include all in-floor and underfloor conduit in coordination files. Refer to Section 27 0500 for coordination drawing requirements.

1.05 REGULATORY REQUIREMENTS

A. Equipment and material shall be UL (Underwriters Laboratory) listed and labeled.

PART 2 PRODUCTS

2.01 OUTSIDE PLANT CONDUIT

A. High-Density Polyethylene (HDPE) Conduit:
   1. Minimum Size: 2 inches, unless noted otherwise.
   2. Acceptable Manufacturers:
      a. Carlon
      b. Chevron Phillips Chemical Company
      c. or pre-approved equal.
   3. Materials used for the manufacture of polyethylene pipe and fittings shall be extra high molecular weight, high-density polyethylene resin. The material shall be listed by PPI (Plastic Pipe Institute) and shall meet the following resin properties:

ASTM Test	Description	Values HDPE
D-1505	Density g/CM 3	Less than 0.941
D-1238	Melt Index, g/10 min Condition E	Greater than 0.55 grams/10 min.
D-638	Tensile Strength at yield (psi)	3000 min.
D-1693	Environmental Stress Crack Resistance Condition B, F 20	96 hrs.
D-790	Flexural Modulus, MPa (psi)	Less than 80,000
D-746	Brittleness Temperature	-75°C Max

   4. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same raw material, including both the base resin and coextruded resin. The pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.
   5. Fitting and Conduit Bodies:
      a. Directional Bore and Plow Type Installation: Electrofusion or universal aluminum threaded couplings. Tensile strength of coupled pipe must be greater than 2,000 lbs.
      b. For All Other Types of Installation: Coupler must provide a watertight connection. The tensile strength of coupled pipe must be greater than 1,000 lbs.
      c. E-loc type couplings are not acceptable in any situations.
      d. Acceptable Manufacturers:
         1) ARCON
         2) Carlon
         3) or approved equal.

B. Fittings:
   1. Sweeps: Factory manufactured RMC wrapped with 4 mil vinyl tape with a bend radius as follows:
      a. Conduit internal diameter of 2" or less is 6 times the internal conduit diameter.
      b. Conduit internal diameter of more than 2" is 10 times the internal conduit diameter.
   2. End Caps (Plugs): Pre-manufactured and watertight. Tape is not an acceptable end cap or cover.

2.02 HAND-HOLES

A. Type:
   1. Polymer concrete
   2. Dimensions: As indicated on the drawings.

B. Requirements:
   1. Includes traffic-rated steel cover.
C. Acceptable Manufacturers
   1. Quazite
   2. Old Castle Precast Christy®
   3. New Basis.

2.03 TEXTILE INNERDUCT

A. Contractor shall provide and install innerduct in each conduit identified to have copper and fiber optic cable installed.
B. Innerduct shall have an 18 gauge solid copper core tracer wire installed into each cell to allow for detection by industry standard toning equipment.
C. Each innerduct cell shall have a pull tape installed.
D. Acceptable Manufacturers:
   1. Maxcell
   2. or pre-approved equal.

2.04 UNDERGROUND WARNING TAPE

A. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, compounded for direct-burial service.
B. Overall Thickness: 5 mils.
C. Foil Core Thickness: 0.35 mil.
D. Orange colored tape 3-wide with 1-inch high black letters permanently imprinted with "CAUTION - BURIED COMMUNICATIONS LINE BELOW". Printing on tape shall be permanent and shall not be damaged by burial operations.
E. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
F. Comply with ANSI Z535.1 through ANSI Z535.5.

2.05 FOUNDATION - UNDERGROUND SLEEVES AND SEALS

A. Refer to Division 26 for additional information on foundation sleeves and seals.

PART 3 EXECUTION

3.01 INSTALLATION - HAND-HOLES

A. Install gravel drainage bed a minimum of 6" depth below hand-hole using a minimum gravel size of 1 inch.
B. Provide units and/or extensions as required by conduit depth for hand-hole cover to be flush with finished grade.
C. Slope grade away from cover with a slope of approximately 1 inch in 3 feet.
D. Conduit entry penetrations shall not exceed 25% of side wall area.

3.02 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:
   1. The Contractor shall do all necessary excavating, securing, filling, backfilling, compacting, and restoration in connection with their work.

B. Excavation:
   1. Excavations for trenches shall be excavated to proper dimensions to permit installation and inspection of work.
   2. Where excavations are carried in error below indicated levels, thoroughly compacted sand-gravel fill, shall be placed in such excess excavations.
   3. Excavations shall be protected against frost action and freezing.
   4. Care shall be exercised in excavating so as to not damage surrounding structures, equipment, and buried utilities. In no case shall any major structural footing or foundation be undermined.
   5. Excavation shall be performed in all ground characteristics, including rock, if encountered. Each bidder shall visit the premises and determine, by actual observations, borings, or other means, the nature of the soil conditions. The cost of all such inspections, borings, etc., shall be borne by the bidder.
   6. In the case where the trench is excavated in rock, a compacted bed with a depth of 3" (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.
   7. Where satisfactory bearing soil is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately and no further work shall be done until further instructions are given.
   8. Mechanical excavation of the trench to line and grade of the conduit, unless otherwise indicated on the drawings.

C. Dewatering:
   1. The Contractor shall be responsible for the furnishing, installation, operation and removal of all dewatering pumps and lines necessary to keep the excavation free of water at all times.

D. Underground Obstructions:
   1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811. The Contractor is responsible for obtaining all utility locates for all trades on the project to determine obstructions indicated. The Contractor shall use great care in installing in the vicinity of underground obstruction.

E. Fill and Backfilling:
   1. No rubbish or waste material shall be permitted in excavations for trench fill and backfill.
   2. The Contractor shall provide the necessary sand for backfilling.
   3. Dispose of the excess excavated earth as directed.
   4. Soils for backfill shall be suitable for required stability and compaction, clean and free from perishable materials, frozen earth, debris or earth with an exceptionally high void content, and free from stones greater than 4 inches in diameter. Under no circumstances shall water be permitted to rise in unbackfilled trenches after installation has been placed.
   5. All trenches shall be backfilled immediately after installation of conduit, unless other protection is directed.
   6. All conduit shall be laid on a compacted bed of sand at least 3" deep. Backfill around the conduit with sand, spread in 6" layers, then compact each layer.

7. Use sand for backfill up to grade for all conduit located under building slabs or paved areas. Native soil materials may be used as backfill if approved by the Geotechnical Engineer. All other conduit shall have sand backfill to 6" above the top of the conduit.
8. The backfilling above the sand shall be placed in uniform layers not exceeding 6" in depth. Each layer shall be placed, then carefully and uniformly tamped, so as to eliminate the possibility of lateral or vertical displacement.
9. Install a warning tape approximately 12 inches below finished grade over all underground duct banks. The identifying warning tape shall be as specified above.
10. Where the fill and backfilling will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.
11. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the backfill until a period of 48 hours has elapsed.

3.03 RESTORATION REQUIREMENTS

A. Where soil and sod has been removed, it shall be replaced as soon as possible after backfilling is completed. All areas disturbed by work shall be restored to their original condition. The restoration shall include any necessary topsoiling, fertilizing, liming, seeding, or mulching,

END OF SECTION

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SECTION 27 0553
IDENTIFICATION FOR COMMUNICATION SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section describes the identification and administration requirements relating to the structured cabling system and its termination components and related subsystems.

B. Identification and labeling.

1.02 RELATED WORK

A. Section 27 0500 - Basic Communications Systems Requirements

1.03 QUALITY ASSURANCE

A. Refer to Section 27 0500 for relevant standards.

B. Perform all work in accordance with City of Inglewood standard.

1.04 SUBMITTALS

A. Under the provisions of Section 27 0500 and Division 1, prior to the start of work the Contractor shall submit:
   1. Documentation of labeling scheme.
   2. Complete documentation of nomenclature for all Administration components.

PART 2 PRODUCTS

2.01 ADMINISTRATION

A. Administrative requirements include identifiers, records, record linkages and labeling for the purposes of administering building cabling, pathways and spaces and grounding/bonding within a facility.

B. The administrative system shall be developed in Microsoft Word format or other electronics program approved by the Architect/Engineer. Should the Contractor elect to provide documentation of the administrative system in a proprietary format, the owner shall be provided with a retail licensed version of the software by the Contractor allowing the full editing and reading the documentation.

C. Refer to the Administrative System Outline below for minimum requirements.

D. Identifiers:
   1. Identifiers shall be marked at the equipment to be administered.
   2. Identifiers shall be unique for each type of equipment. For example, in no case shall the identifier for a cable be the same as the identifier for a pathway.

E. Records:
   1. Provides descriptive information about the identified equipment.

F. Linkages:
   1. To be used to describe the connection between an identifier and a record. In addition, a linkage is used to point from one record to another record.

G. Presentation of Administrative System:
   1. Provide reports cataloging the records for all equipment.
   2. Sample reports shall be provided to show explanations of the meaning of all information in the record.
   3. Provide reports showing the labeling scheme for all components of the Administrative system.

H. Administrative System Outline:
   1. The format of the outline is as follows:
      a. Subsystem:
         1) Required identifiers.
         2) Linked records.
   2. Pathways:
      a. Pathway identifier, type, fill, loading.
      b. Cable records, space records, pathway records, grounding records.
   3. Spaces:
      a. Space identifier, space type.
      b. Pathway records, cable records, grounding records.
   4. Cable:
      a. Cable identifier, cable type, total pair count, damaged pair count, unterminated pair count.
      b. Termination records, splice records, pathway records, grounding records.
   5. Cabling Termination Hardware:
      a. Termination identifier, hardware type, damaged position numbers.
      b. Termination position records, space records, grounding records.
   6. Termination Position:
      a. Termination position identifier, termination type.
      b. Cable records, termination hardware records, space records.
   7. Splice:
      a. Splice identifier, splice type.
      b. Cable records, space records.
   8. Primary Bonding Busbar:
      a. PBB identifier, busbar type, grounding conductor identifier.
      b. Bonding conductor records, space records.
   9. Secondary Bonding Busbar:
      a. SBB identifier, busbar type.
      b. Bonding conductor records, space records.
   10. Bonding Conductors:
      a. Bonding conductor identifier, conductor type, busbar identifier.
      b. Grounding busbar records, pathway records.

2.02 LABELING

A. Adhesive labels shall meet the requirements of UL 969 (Ref D-16) for legibility, defacement and adhesion. Exposure requirements of UL 969 for indoor and outdoor (as applicable) use shall be met.

B. Insert labels shall meet the requirements of UL 969 for legibility, defacement and general exposure.

C. Labeling shall be consistent for all common elements in the project. This consistency shall include label size, color, typeface and attachment method.

D. Labels incorporating bar codes shall be either Code 39 conforming to USS-39 or Code 128 conforming to USS-128.
   1. All Code 39 bar codes shall have a ratio between 2.5:1 and 3.0:1. Provide a minimum "quite zone" of 0.25" on each side of the bar code.
   2. A descriptive label for reading by personnel shall be provided with any bar code. Bar codes by themselves are not acceptable.

E. Color Code: Observe the following requirements for color coding:
   1. Labels on each end of a cable shall be the same color for each termination.
   2. Labels for cross-connects shall be two different colors at each termination fields, representative of the color of that field.
   3. Orange (Pantone 15C) shall be used for the demarcation point.
   4. Green (Pantone 353C) shall be used for the termination point of network connection on the facility side of the demarc.
   5. Purple (Pantone 264C) shall be used to identify the termination of cables from common equipment (PBX, computers, LANS, etc.)
   6. White shall be used to identify the first-level backbone termination in the main cross-connect.
   7. Gray (Pantone 422C) shall be used to identify the second-level backbone termination in the main cross-connect.
   8. Blue (Pantone 291C) shall be used to identify the termination of station cabling at the telecommunications closet and/or equipment room end of the cable.
   9. Brown (Pantone 465C) shall be used to identify the termination of the interbuilding backbone cable terminations.
   10. Yellow (Pantone 101C) shall be used to identify the termination of auxiliary circuits, alarms, maintenance, security, etc.
   11. Red (Pantone 184C) shall be used to identify the termination of key telephone systems.
   12. In facilities that do not contain a main cross-connect, the color white may be used to identify second-level backbone terminations.

F. Tag all CAT 6, CAT 6A, and optical fiber cables at both the Communications Equipment Room and the information outlets using the following alphanumeric labeling system:
   1. (Room Number) - (Outlet Number) - (Jack Number) - (Use).
   2. "Outlet Number" shall start with 1 in each room, with additional outlets in each room numbered sequentially.
   3. "Jack Number" shall start with 1 for the upper left jack in each outlet, increasing sequentially from left to right and top to bottom across the outlet face.
   4. "Use" shall be designated by the following:
      a. "V" for voice (RJ-45)
      b. "D" for data (RJ-45)
      c. "C" for video (coax)
      d. "M" for multimedia retrieval (coax)
      e. "S" for speaker (RCA)
   5. Example #1: "106-1-1-V" indicates the top left voice jack in outlet #1 in Room 106.
   6. Example #2: "109-3-4-D" indicates the bottom right data jack (assuming a 4-port faceplate) in outlet #3 in Room 109.

G. Tag all CAT 6, CAT 6A, and optical fiber cables at both the Communications Equipment Room and the information outlets using the following alphanumeric labeling system:
   1. (Telecom Room Number) - (Patch Panel Letter) - (Patch Panel Port Number).
   2. "Telecom Room Number" shall be as indicated on the drawings.

3. "Patch Panel Letter" shall start with 'A' for the top modular patch panel, increasing sequentially from top to bottom across the equipment rack.
4. "Patch Panel Port Number" shall start with '1' for the upper left port in each modular patch panel, increasing sequentially from left to right and top to bottom across the modular patch panel face.
5. Example #1: MC/1-A3 indicates the third modular patch panel port in modular patch panel 'A' in Main Equipment Room (MC/1).
6. Example #2: HC/2-C39 indicates the thirty-ninth modular patch panel port in modular patch panel C in Horizontal Cross-Connect room (HC/2).

2.03 DOCUMENTATION/AS-BUILTS/RECORDS

A. General:
   1. Upon completion of the installation, the Contractor shall submit as-builts per the requirements of Section 27 0500 and Division 1. Documentation shall include the items detailed in the subsections below.
   2. All documentation, including hard copy and electronic forms shall become the property of the Owner.

B. Record Drawings:
   1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.

PART 3 EXECUTION

3.01 IDENTIFICATION AND LABELING

A. Cable Labeling:
   1. Horizontal cables shall be labeled at each end.
      a. Cables that differ only by performance class shall have a suitable marking or label to indicate the higher performance class. For example, station cabling utilizing the blue color may include blue with a white stripe to indicate the higher performance class station cabling.
   2. Backbone cables shall be labeled at each end.
      a. Provide additional cable labeling at each manhole and pull box.
      b. Cables that are routed through multiple pathway segments shall contain reference to all pathway segments in the pathway linkage field.
      c. Cables that differ only by performance class shall have a suitable marking or label to indicate the higher performance class. For example, station cabling utilizing the blue color, may include blue with a white stripe to indicate the higher performance class station cabling.

B. Information Outlet Labeling: Tag all voice and data jacks as defined herein.

C. Termination Hardware Labeling:
   1. An identifier shall be provided at each termination hardware location or its label.

D. Grounding/Bonding Labeling:
   1. The PBB shall be labeled "PBB." There shall be only one PBB in the facility.
   2. Label all TBB conductors connecting to the PBB with a unique label, located at both ends of the TBB.
   3. Each SBB shall be labeled with a unique label.

4. All TBB conductors connecting to the SBB shall be labeled uniquely at each end of the cable.

3.02 ADMINISTRATION

A. Records:
   1. Cable Records: Provide cable identifier, cable type, conductor quantity, damaged conductor quantity, unterminated conductor quantity, available conductor quantity.
      a. The cable type field shall include the manufacturer and manufacturer's catalog designations, including ratings.
      b. Termination position linkage fields shall be included.
   2. Termination Hardware Records: Provide hardware identifier, hardware type, damaged position numbers, available position numbers.
      a. Provide linkages to termination position records, space records, and grounding records.
   3. Termination Position Records: Provide termination position identifier, cable conductor numbers.
      a. Provide linkages to cable records, termination position records, termination hardware records and space records.
   4. Splice Records: Indicate the splice identifier and the type.
      a. Provide linkages to cable records and space records.
   5. Grounding/Bonding Records:
      a. PBB Record: Provide PBB identifier, busbar type, grounding conductor identifier.
         1) Provide linkage to bonding conductor records and space records.
      b. TBB Records: Provide TBB identifier, conductor type, and busbar identifier.
         1) Provide linkage to busbar and pathway records.
      c. SBB Records: Provide SBB identifier, busbar type.
         1) Provide linkage to bonding conductor records and space records.

END OF SECTION

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SECTION 27 1100
COMMUNICATION EQUIPMENT ROOMS (CER)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section describes the products and execution requirements related to furnishing and installing equipment for communication equipment rooms.

1.02 RELATED WORK

A. Section 27 0500 - Basic Communications Systems Requirements
B. Section 27 0526 - Communications Bonding
C. Section 27 0528 - Interior Communication Pathways
D. Section 27 1500 - Horizontal Cabling Requirements

1.03 QUALITY ASSURANCE

A. Refer to Section 27 0500 for applicable standards.

1.04 SUBMITTALS

A. Under the provisions of Section 27 0500 and Division 1, prior to the start of work the Contractor shall submit:
   1. Manufacturer's data covering all products including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
   2. Manufacturer's installation instructions.
B. Coordination Drawings:
   1. Include ladder racking, equipment racks, cable tray and conduit sleeve layout in composite electronic coordination files. Refer to Section 27 0500 for coordination drawing requirements.

PART 2 PRODUCTS

2.01 EQUIPMENT GROUNDING

A. Refer to specification section 27 0526 for grounding requirements.
B. All equipment required to be grounded shall be provided with a grounding lug suitable for termination of the specified size electrode conductor.

2.02 EQUIPMENT RACKS AND CABINETS

A. Where identified on the drawings in Communication Equipment Rooms, equipment racks and/or equipment cabinets shall be furnished and installed by the Contractor to house cable termination components (e.g., copper, optical fiber, coax) and network electronics.
   1. Standard TIA/EIA 19" Floor Cabinet:
      a. The equipment cabinets shall be constructed of painted steel or aluminum and offer a usable mounting height of 45 RU. Rack shall be a minimum of 31 inches deep.

b. The equipment cabinet shall be equipped with a lockable steel front door and furnished with two (2) keys that shall be usable on all cabinets furnished under this Contract.
c. The equipment cabinet shall be configured to allow for adjustment of the channel uprights (front to rear) in 1-inch increments and be spaced to accommodate industry standard 19-inch mounting. Cabinet shall be tapped to accept 12-24 screws.
d. The equipment cabinet shall be vented to allow for airflow through the cabinet.

2. Standard TIA/EIA 19" Wall Cabinet:
a. The equipment cabinets shall be constructed of painted steel or aluminum and offer a usable mounting height of 15 RU. Racks shall be a minimum of 21 inches deep. Access to the rear of the cabinet-mounted equipment shall be by a hinged arrangement.
b. The equipment cabinet shall be equipped with a lockable steel front door and furnished with two (2) keys that shall be usable on all cabinets furnished under this Contract.
c. The equipment cabinet shall be configured to allow for adjustment of the channel uprights (front to rear) in 1-inch increments and be spaced to accommodate industry standard 19-inch mounting. The cabinet shall be tapped to accept 12-24 screws.
d. The equipment cabinet shall be vented to allow for airflow through the cabinet.

2.03 CABLE MANAGEMENT - VERTICAL AND HORIZONTAL

A. Equipment Racks:
1. Equipment racks shall be equipped with vertical and horizontal cable management hardware in the form of rings and guides. Racks shall incorporate vertical and horizontal covers, to allow an orderly, hidden, routing of copper, and optical fiber, from the modular patch panels to the customer provided network electronics. Vertical and horizontal cable management hardware shall be as follows:
a. Horizontal cable management hardware shall be 16 gauge cold rolled steel construction with six (6) pass-thru holes and seven (7) front-mounted 3.5" steel rod D-rings. Provide with cover designed to conceal and protect cable.
b. At a minimum, horizontal cable management hardware shall be positioned above and below (a) each grouping of two rows of jacks on modular patch panels, and (b) above and below each optical fiber patch panel and (c) each grouping of two rows of F-type connectors on coax patch panels.
c. Vertical cable management hardware shall provide for cable routing on front and rear of each rack and be 14" deep x 6" wide (minimum). Where multiple equipment racks are to be installed, this hardware shall be mounted between the uprights of adjacent equipment racks. Equipment rack uprights and the spacers shall be secured together per manufacturer's recommendations. Provide with cover designed to conceal and protect cable.
2. Each equipment rack shall be supplied with a minimum of 12 releasable (e.g., "hook and loop") cable support ties.
3. Where cable termination hardware is wall-mounted, the Contractor shall be responsible for establishing a cable pathway for jumpers routed from the equipment rack(s) to the wall. This shall be in the form of slotted ducts or troughs. Routing of jumpers via the overhead cable tray or ladder rack system is NOT acceptable. The proposed method shall be included in the submittals required by this document and shall be approved by the Architect/Engineer prior to installation.

B. Equipment Cabinets
   1. Equipment cabinets shall be equipped with vertical and horizontal cable management hardware, in the form of rings and guides, to allow an orderly routing of optical fiber and copper jumpers from the modular patch panel to the customer provided network electronics. At a minimum, one such horizontal cable management panel shall be provided with each equipment cabinet. Horizontal cable management panels shall be 3.5" in height and have a minimum of five (5) jumper distribution rings.

2.04 PATCH PANELS

A. Where identified on the drawings in Communication Equipment Rooms, modular patch panels shall be furnished and installed by the Contractor for termination of copper cable.

B. Copper cabling shall be terminated in Communication Equipment Rooms on modular patch panels consisting of a modular connector system incorporating modular jacks meeting the specifications for the jacks detailed in Section 27 1500.

C. Wall-mounted modular patch panels shall incorporate a standoff bracket to allow copper cabling to be routed behind the modular patch panel.

D. The largest single modular patch panel configuration shall not exceed 48-Ports. Modular patch panels shall be fully populated (all ports occupied by jacks) and be provided in increments of no less than 12 jacks. High-density modular patch panels will not be accepted.

E. The modular patch panel blocks shall have the ability to seat and cut eight (8) conductors (4 pairs) at a time and shall have the ability of terminating 22- through 26-gauge plastic insulated, solid and stranded copper conductors. Modular patch panel blocks shall be designed to maintain the cables' pair twists as closely as possible to the point of mechanical termination.

F. Modular patch panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers minimum bend radius specifications are adhered to.

2.05 OPTICAL FIBER PANELS

A. All terminated optical fibers shall be mated to simplex LC-type couplings mounted on enclosed fiber distribution cabinets. Couplings shall be mounted on a panel that, in turn, snaps into the enclosure. The proposed enclosure shall be designed to accommodate a changing variety of connector types including SC, ST, Fixed Shroud Duplex (e.g., "FDDI Connector"), Biconic, FC, and MT-RJ by changing panels on which connector couplings are mounted.

B. The fiber distribution cabinet shall be sized to accommodate the total fiber count to be installed at each location as defined in the specifications and drawings, including those not terminated (if applicable). Connector panels and connector couplings (sleeves, bulkheads, etc.) adequate to accommodate the number of fibers to be terminated shall be furnished and installed by the Contractor.

C. The fiber distribution cabinet shall be an enclosed assembly affording protection to the cable subassemblies and to the terminated ends. The enclosures shall incorporate a hinged or retractable front cover designed to conceal and protect the optical fiber couplings, connectors, and cable.

D. Access to the inside of the fiber distribution cabinet's enclosure during installation shall be from the front and/or rear. Panels that require any disassembly of the fiber distribution cabinet to gain entry will not be accepted.

E. The fiber distribution cabinet's enclosure shall provide for strain relief of incoming optical fiber cables and shall incorporate radius control mechanisms to limit bending of the optical fiber to the manufacturer's recommended minimums or ½½", whichever is larger.

F. All fiber distribution cabinets shall provide protection to both the "facilities" and "user" side of the coupling. The fiber distribution cabinet's enclosure shall be configured to require front access only when patching. The incoming optical fiber cables (e.g., backbone, riser, horizontal, etc.) shall not be accessible from the patching area of the panel. The fiber distribution cabinet's enclosure shall provide a physical barrier to access such optical fiber cables.

G. Where "Loose Buffered" cables are installed, the 250 µµm coated optical fibers contained in these cables may be terminated either by (1) splicing of factory-terminated cable assemblies ("pigtails") or (2) the use of a "fan-out" kit. In the latter approach, individual fibers are to be secured in a protective covering, an Aramid (e.g., Kevlar¢¢) reinforced tube for example, with connectors mated to the resulting assembly. In both instances, the proposed termination hardware shall incorporate a mechanism by which cable and subassemblies are secured to prevent damage. Splicing shall be by the "fusion" method. Individual splice loss shall not exceed 0.3 dB for multi-mode fibers. Direct termination of 250 µµm coated optical fibers shall not be permitted.

H. Fiber distribution cabinets for horizontal cabling: Where optical fiber horizontal cabling is to be terminated, the enclosure shall be compliant to all the above requirements plus the enclosure shall incorporate a storage mechanism designed to allow simplified identification, access to and termination of individual optical fibers. This may be in the form of a storage cassette, tray or other appropriate mechanism.

2.06 OPTICAL FIBER COUPLERS/ADAPTERS

A. Optical Fiber Couplings (LCtype) (Multimode/Singlemode):
1. LC-type optical fiber couplings shall be used to terminate optical fiber backbone cable on fiber distribution cabinet panels in communication equipment rooms. Horizontal optical fiber cables shall also be terminated using optical fiber couplings at their designated work area locations on information outlet faceplates for "fiber to the desk."
2. LC-type optical fiber couplings shall be snap-type with locking washer and nut.
3. LC-type optical fiber couplings shall incorporate domed zirconia ferrule and shall utilize a PC polish to ensure fiber-to-fiber physical contact for low loss and reflections.
4. LC-type optical fiber couplings shall accept 125-micron outside diameter multimode fiber.
5. The attenuation per mated pair shall not exceed 0.7 dB (individual) and 0.5 dB (average). Connectors shall sustain a minimum of 200 mating cycles per TIA/EIA-455-21 without violating specifications.
6. LC-type optical fiber couplings shall meet the following performance criteria:

Test Procedure	Maximum Attenuation Change
Cable Retention (FOTP-6)	0.2 dB
Durability (FOTP-21)	0.2 dB
Impact (FOTP-2)	0.2 dB
Thermal Shock (FOTP-3)	0.2 dB
Humidity (FOTP-5)	0.2 dB

7. Performance Requirements:
   a. Length: 2 inches
   b. Operating Temperature: -40 to 85 degrees C
8. Basis of Design:
   a. Hubbell

2.07 LADDER RACK

A. Provide complete ladder rack system including metallic ladder rack, splice connectors, fastening hardware and other miscellaneous materials as required for a complete installation per manufacturer's recommendations.

B. Tubing Style Ladder Rack:
   1. Rolled steel siderail stringer, minimum 1.5" stringer height, 9" spaced welded rungs.
   2. Steel shall meet the requirements of ASTM A1011 SS Grade 33.
   3. Loading limits shall be 185 lbs/ft for 4 ft spans.

C. Ladder rack finish shall be flat black powder coat.

2.08 D-RINGS

A. Rounded edge D-rings for support of cabling in vertical and horizontal configurations.

B. EIA 310D compliant, manufactured from materials meeting UL94-V0 specifications.

C. Provide 1/4" screw holes for wall mounting.

2.09 COPPER PATCH CORDS

A. Modular Patch Panel:
   1. Provide Category 6 copper patch cords for all assigned ports on the modular patch panel. Of these cords, 60% shall be 3' in length and 40% shall be 5' in length. These patch cords shall be the cross-connect between the network electronics and the horizontal RJ-45 modular patch panel. Copper patch cords shall be equipped with a 4-pair RJ-45 connector on each end.
   2. Refer to Section 27 1500 for cable and connector performance requirements.
   3. Patch cords shall not be made-up in the field.
   4. Basis of Design (Refer to 27 17 20 for Acceptable Manufacturers):
      a. Hubbell HC Series

2.10 FIBER PATCH CORDS

A. Optical Fiber Patch Cords (Multimode):
   1. Provide 50/125 mm multimode (MM) optical fiber utilizing tight buffer construction for 50% of all assigned ports on the fiber distribution cabinet. These patch cords shall be the cross-connect between the backbone fiber distribution cabinet and the Owner's network electronics (hub/switch). Optical fiber patch cords shall be equipped with a ceramic tipped LC-type connector on each end and shall be a minimum of 5 feet in length. Connector body shall be of materials similar to that used in the proposed couplings. Provide required lengths as determined on the plans.
   2. Channels shall be of equal length.
   3. Refer to Section 27 1500 for cable and connector performance requirements.
   4. Basis of Design (Refer to 27 17 20 for Acceptable Manufacturers):
      a. Hubbell DFPC Series

B. Optical Fiber Patch Cords (Singlemode):
   1. The optical fiber patch cord shall be 8.3/3 mm singlemode (SM) optical fiber, utilizing tight buffer construction. The optical fiber patch cords shall be a minimum of 5 feet in length.

2. Provide 8.3/3 mm singlemode (SM) optical fiber utilizing tight buffer construction for 50% of all assigned ports on the fiber distribution cabinet. These patch cords shall be the cross-connect between the backbone fiber distribution cabinet and the Owner's network electronics (hub/switch). Optical fiber patch cords shall be equipped with a ceramic tipped LC-type connector on each end and shall be a minimum of 5 feet in length. Connector body shall be of materials similar to that used in the proposed couplings. Provide required lengths as determined on the plans.
3. Channels shall be of equal length.
4. Refer to Section 27 1500 for cable and connector performance requirements.
5. Basis of Design (Refer to 27 17 20 for Acceptable Manufacturers):
   a. Hubbell DFPC Series

2.11 DEMARCATION REQUIREMENTS

A. Contractor shall coordinate all requirements for the demarcation point with the Owner's selected service provider.

B. The Contractor shall not proceed with any installation without written communication with the Architect/Engineer should the service provider's requirements differ from the work shown on the contract documents.

C. Refer to the drawings for further requirements.

PART 3 EXECUTION

3.01 EQUIPMENT RACKS

A. Equipment racks shall be furnished and installed as shown on the drawings.

B. The Contractor shall bolt the rack to the floor as recommended by the manufacturer. Multiple racks shall be joined and the ground made common on each. The rack shall be stabilized by extending a brace to the wall. Alternately, overhead ladder rack by which the cabling accesses the equipment rack(s) may provide this function.

C. A space between the rack upright and the wall (approximately 4") should be provided to allow for cabling in that area. The rear of the rack should be approximately 40" from the wall to allow for access by maintenance personnel. In all cases, a minimum of 40" workspace in front of the rack is also required. Locations where these guidelines cannot be followed should be brought to the attention of the Architect/Engineer for resolution prior to installation.

D. All hardware and equipment is to be mounted between 18" and 79" above floor level. This is to afford easy access and, in the case of the lower limit, prevent damage to the components. Positioning of hardware should be reviewed and approved by the Architect/Engineer and Site Coordinator(s) prior to installation.

E. Equipment racks shall be equipped with cable management hardware as to allow an orderly and secure routing of optical fiber and/or copper cabling to the optical fiber distribution cabinets and/or modular patch panels. At minimum, one such horizontal jumper management panel shall be placed below each optical fiber distribution cabinet installed by the Contractor. Additional Jumper Management panels may be required pending installation of other cable types on the equipment rack.

F. Each rack shall be grounded to the Telecommunications Ground Bar (GND) using a #6 AWG (or larger) insulated stranded copper conductor (GREEN jacket) directly or via an adjacent grounded equipment rack. Refer to grounding requirements below.

3.02 LADDER RACK

A. Provide support for ladder rack on 4 ft centers.

B. Maintain a 1.5 safety factor on all load limits specified herein.

C. Ladder rack support shall be by 5/8" diameter threaded rod when ceiling mounted. Ladder rack requiring wall mounting shall utilize accessories supplied by the ladder rack manufacturer specifically for the purpose of wall mounting ladder rack.

3.03 D-RINGS

A. Provide D-rings for cable routing and management in all areas where open cabling is routed along the wall in an Equipment Room.

B. Locate D-rings on 24" centers vertically and horizontally.

C. Securely attach D-rings to the wall as required by the manufacturer.

3.04 GROUNDING

A. Provide a complete grounding system in accordance with the requirements of Section 27 0526.

3.05 CROSS CONNECT INSTALLATION

A. Bend radius of cable shall not exceed 4 times the outside cable diameter or manufacturer's recommendation, whichever is less.

B. Cables shall be neatly bundled and dressed to their respective panels and/or blocks. Each shall be fed by an individual bundle separated and dressed to the point of cable entrance into the rack and/or frame.

C. The cable jacket shall be maintained as close as possible to the termination point.

D. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that is visible without removing the bundle support.

3.06 OPTICAL FIBER TERMINATION

A. All fiber slack shall be neatly coiled within fiber splice enclosures or splice trays. No slack loops shall be allowed external to the enclosure.

B. Each cable shall be individually attached to the respective fiber enclosure by mechanical means. The cable strength member shall be securely attached to the cable strain relief bracket in the enclosure.

C. Each cable shall be clearly labeled at the entrance to all enclosures.

D. A maximum of 12 strands shall be spliced in any tray.

3.07 CONDUITS AND CABLE ROUTING

A. Refer to Section 26 0533 for additional requirements.

B. Where conduits enter a telecommunications room, conduits shall be terminated on the wall where shown on the contract documents. Conduits entering the room from the floor shall extend 3" above the floor slab.

C. Where cabling rises vertically in a telecommunications rooms, provide vertical cable management to support the cabling from floor to ceiling level.

D. All conduits shall be reamed and shall be installed with a nylon bushing.

E. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of 2" or less, maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter greater than 2", maintain a bend radius of at least 10 times the internal diameter.

END OF SECTION 27 1100

SECTION 27 1300
BACKBONE CABLING REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section describes the products and execution requirements relating to furnishing and installing backbone communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of both optical fiber and/or copper cabling.

1.02 RELATED WORK

A. Section 27 0500 - Basic Technology Systems Requirements.

B. Section 27 1500 - Horizontal Cabling Requirements.

C. Section 27 1720 - Structured Cabling System Warranty.

1.03 QUALITY ASSURANCE

A. Refer to Section 27 0500 for relevant standards.

1.04 SUBMITTALS

A. Under the provisions of Section 27 0500 and Division 1, prior to the start of work the Contractor shall submit:
   1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
   2. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 GENERAL

A. The basis of design is listed herein. Refer to Section 27 1720 for additional acceptable manufacturers.

2.02 OPTICAL FIBER BACKBONE - INSIDE PLANT

A. Multimode (MM):
   1. This optical fiber backbone cable shall be suitable for installation in building riser systems, in conduit, in cable tray and/or in innerduct.
   2. Optical fiber cable materials shall be all dielectric (no conductive material).
   3. Optical fiber cable shall carry an OFNR (optical fiber non-conductive riser) or OFNP (optical fiber non-conductive plenum) rating. Refer to Section 27 0500 for project requirements.
   4. Optical fiber cable shall be interlocking armored cable.
   5. Outer Sheath: The outer sheath shall be marked with the manufacturer's name, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet.

6. Temperature Range:
   a. Storage: -40°°C to +70°°C (no irreversible change in attenuation).
   b. Operating: -40°°C to +70°°C.
7. Humidity Range: 0% to 100%.
8. Maximum Tensile Strength (å? 12 fibers):
   a. During Installation: 1332 N (300 lb. force) (no irreversible change in attenuation).
   b. Long-Term: 600 N (135 lb. force).
9. Maximum Tensile Strength (ä? 6 fibers):
   a. During Installation: 1000 N (225 lb. force) (no irreversible change in attenuation).
   b. Long-Term: 100 N (67 lb. force).
10. Bending Radius:
    a. During Installation: 20 times cable diameter.
    b. No Load: 10 times cable diameter.

B. Optical fiber cables suitable for installation in multiple environments (e.g., underground duct and building risers) may be used at the Contractor's option. Such optical fiber cables shall meet all specifications noted above for cables designated for each environment through which the optical fiber cable shall pass.

C. Basis of Design (OM3 Multimode):
   1. Hubbell OM3 (HFCD15xxx series).
   2. Additional acceptable manufacturers.
      a. Corning

D. Basis of Design (Singlemode):
   1. Hubbell (HFCD15xxx series)
   2. Additional acceptable manufacturers.
      a. Corning

2.03 OPTICAL FIBER BACKBONE - OUTSIDE PLANT

A. Exterior Conduit (Singlemode):
   1. This optical fiber cable shall be suitable for installation in underground duct and in innerduct.
   2. Optical fiber cable materials shall be all dielectric (no conductive materials).
   3. Optical fiber cable shall be filled with a water-blocking material.
   4. Outer Sheath: Polyethylene (PE). The outer sheath shall be marked with the manufacturer's name, words identifying the cable type (e.g., "Optical Fiber Cable" or "Fiber Optic Cable"), year of manufacture, and sequential length markings. The actual length of the optical fiber cable shall be within -0/+1% of the length markings. The marking shall be in a contrasting color to the cable jacket.
   5. Temperature Range:
      a. Storage: -40°C to +70°C (no irreversible change in attenuation).
      b. Operating: -40°C to +70°C.
   6. Humidity Range: 0% to 100%.
   7. Maximum Tensile Strength:
      a. During Installation: 2700 Newton (600 lb. force) (no irreversible change in attenuation).
      b. Long Term: 890 N (200 lb. force).
   8. Bending Radius:
      a. During Installation: 20 times cable diameter.
      b. No Load: 10 times cable diameter.

9. Basis of Design (Multimode):
    a. Corning (XXX).
    b. Additional acceptable manufacturers:
        1) Hubbell
        2) Mohawk
        3) Berk-Tek
        4) Superior Essex
10. Basis of Design (Singlemode):
    a. Corning (XXX).
    b. Additional acceptable manufacturers:
        1) Hubbell
        2) Mohawk
        3) Berk-Tek
        4) Superior Essex

2.04 OPTICAL FIBER CONNECTORS

A. Optical Fiber Pigtails (Multimode):
    1. Single-fiber fiber optic pigtails shall be constructed from 50/125 µm multimode (MM) optical fiber of the same grade as the multimode fiber optic backbone cable utilizing tight buffer construction.
    2. Fiber optic pigtails shall be factory terminated with a ceramic tipped LC-type connector on one end and shall be a minimum of 5 feet (1.5m) in length or as indicated on the drawings. Channels shall be of equal length.
    3. Connector body shall be of materials similar to that used in the proposed couplings. Refer to Section 27 1500 for connector performance requirements.
    4. Provide in quantity to terminate all backbone fiber optic cable strands on each end.
    5. Basis of Design:
        a. Multimode Optical Fiber Pigtails shall be from the same manufacturer as used for the fiber optic termination equipment.

B. Optical Fiber Pigtails (Singlemode):
    1. Single-fiber fiber optic pigtails shall be constructed from singlemode (SM) optical fiber of the same grade as the singlemode fiber optic backbone cable utilizing tight buffer construction.
    2. Fiber optic pigtails shall be factory terminated with a ceramic tipped LC-type connector on one end and shall be a minimum of 5 feet (1.5m) in length or as indicated on the drawings. Channels shall be of equal length.
    3. Connector body shall be of materials similar to that used int he proposed couplings. Refer to Section 27 1500 for connector performance requirements.
    4. Provide in quantity to terminate all backbone fiber optic cable strands on each end.
    5. Basis of Design:
        a. Singlemode Optical Fiber Pigtails shall be from the same manufacturer as used for the fiber optic termination equipment.

C. Optical Fiber Connectors (SC-type) (Multimode/Singlemode):
    1. SC-type optical fiber connector plugs shall be used to terminate optical fiber patch cords in communication equipment rooms.
    2. SC-type optical fiber connector plugs shall be snap-type with an integrated pull-proof design.
    3. SC-type optical fiber connector plugs shall incorporate domed zirconium ceramic ferrule and shall utilize a PC polish to ensure fiber-to-fiber physical contact for low loss and reflections.

4. SC-type optical fiber connector plugs shall accept 125-micron outside diameter multimode fiber.
5. The attenuation per mated pair shall not exceed 0.7 dB (individual) and 0.5 dB (average). Connectors shall sustain a minimum of 200 mating cycles per TIA/EIA-455-21 without violating specifications.
6. SC-type optical fiber connector plugs shall meet the following performance criteria:

Test Procedure	Maximum Attenuation Change
Cable Retention (FOTP-6)	0.2dB
Durability (FOTP-21)	0.2dB
Impact (FOTP-2)	0.2dB
Thermal Shock (FOTP-3)	0.2dB
Humidity (FOTP-5)	0.2dB

7. Additional Performance Requirements
   a. Length: 2 inches (5.08cm)
   b. Operating Temperature: -40 to 85 degrees C
8. Basis of Design:
   a. Optical fiber connectors shall be from the same manufacturer as fiber cable manufacturer.

D. Optical Fiber Connectors (LC-type) (Multimode/Singlemode):
1. LC-type Optical Fiber Connectors: Shall be used to terminate optical fiber in communication equipment rooms.
2. LC-type optical fiber connector plugs shall be snap-type with an integrated pull-proof design.
3. LC-type optical fiber connector plugs shall incorporate a zirconium ceramic ferrule and shall utilize a factory pre-polish end face to ensure fiber-to-fiber physical contact for low loss and reflections.
4. LC-type optical fiber connector plugs shall accept 1.6mm - 2.0mm and 3.0mm outside diameter fiber.
5. The average insertion loss is 0.3db for multimode and single mode connectors
6. LC-type optical fiber connector plugs shall meet the following performance criteria:

Test Procedure	Maximum Attenuation Change
Cable Retention (FOTP-6)	0.2dB
Durability (FOTP-21)	0.2dB
Impact (FOTP-2)	0.2dB
Thermal Shock (FOTP-3)	0.2dB
Humidity (FOTP-5)	0.2dB

7. Additional Performance Requirements:
   a. Length: 2.23 inches
   b. Operating Temperature: -40 to 85 degrees C
8. Basis of Design:
   a. Optical fiber connectors shall be from the same manufacturer as fiber cable manufacturer.

2.05 OPTICAL FIBER BACKBONE PERFORMANCE

A. OM5 Multimode (MM):
1. Fiber Type: Multimode; doped silica core surrounded by a concentric glass cladding.
2. Index Profile: Graded Index.

3. Transmission Windows: 850-nm and 1300-nm.
4. Core Diameter (nom): 50-èm (microns) ±± 2.5.
5. Cladding Diameter: 125-èm ±± 1.
6. Core-clad Concentricity: ä? 1.0-èm.
7. Cladding Non-circularity: ä? 1.0%.
8. Fiber Coating Diameter:
   a. 245-èm ±± 10 (primary coating).
   b. 900-èm (nominal) secondary coating (tight buffer)
   c. All coatings shall be mechanically strippable without damaging the optical fiber.
9. Attenuation (maximum @ 23 ±± 5°°C; backbone):
   a. @ 850-nm: 3.0 dB/km.
   b. @ 1300-nm: 1.0 dB/km.
   c. @ 1300-nm thru 1380-nm: 1.0dB/km
      1) When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components," the average change in attenuation over the rated temperature range of the optical cable shall not exceed 0.50 dB/km with 80% of the measured fibers not exceeding 0.25 dB/km.
10. Bandwidth (minimum):
    a. @ 850-nm: 4700 MHz*km.
11. No optical fiber shall show a point discontinuity greater than 0.2 dB at the specified wavelengths. Such a discontinuity or any discontinuity showing a reflection at that point shall be cause for rejection of that optical fiber by the Owner.

B. Singlemode (SM):
1. Fiber Type: Singlemode; doped silica core surrounded by a concentric glass cladding.
2. Core Diameter: 8 to 9 µm. All optical fibers shall be of the same nominal core diameter and profile.
3. Cladding Diameter: 125 ±± 1.0 µm.
4. Cladding Non-circularity: ä? 1%.
5. Core to Cladding Offset: ä? 0.8 µm.
6. Fiber Coating Diameter:
   a. 245 ±± 15µm (primary coating).
   b. 900-nm (nominal) secondary coating (tight buffer).
   c. All coatings shall be mechanically strippable without damaging the optical fiber.
7. Cut-off Wavelength (cabled fiber; ìccf) ä? 1260-nm.
8. Mode Field Diameter: 8.3 to 9.8 m at 1300-nm; 10.5 ±± 1.0 µm at 1550-nm.
9. Zero Dispersion Wavelength (ì0): 1301.5 nm less than l0 less than 1321.5 nm.
10. Zero Dispersion Slope (S0): Less than 0.092 ps/nm2*km.
11. Fiber Attenuation (maximum @ 23 ±± 5°°C; Backbone):
    a. @ 1300-nm: 2.0 dB/km
    b. @ 1550-nm: 1.75 dB/km
       1) When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components," the average change in attenuation over the rated temperature range of the optical fiber cable shall not exceed 0.05 dB/km at 1550-nm. The magnitude of the maximum attenuation change of each individual optical fiber shall not be greater than 0.15 dB/km at 1550-nm.
12. Fiber Dispersion (maximum):
    a. @ 1285 to 1330-nm: 3.2-ps/nm*km
    b. @ 1550-nm: 18-ps/nm*km

13. No optical fiber shall show a point discontinuity greater than 0.1 dB at the specified wavelengths. Such a discontinuity or any discontinuity showing a reflection at that point shall be cause for rejection of that optical fiber by the Owner.

PART 3 EXECUTION

3.01 CABLE INSTALLATION REQUIREMENTS

A. Cable slack shall be provided in each backbone fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.

B. A minimum of 5 meters (approximately 15 feet) of slack cable (each cable if applicable) shall be coiled and secured at both ends located in the entrance room, Telecommunications Room or main equipment room, for backbone and intra-building cable.

C. Where exposed, all backbone fiber optic cable shall be installed in protective inner duct. This includes areas where the cable is routed in cable tray and where making a transition between paths (e.g., between conduit and cable tray or into equipment racks). The inner duct should extend into the termination and/or storage enclosure(s) at system endpoints.

END OF SECTION

SECTION 27 1500
HORIZONTAL CABLING REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section describes the products and execution requirements relating to furnishing and installing horizontal communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of copper cabling.

1.02 RELATED WORK

A. Section 27 0500 - Basic Communications Systems Requirements

B. Section 27 1720 - Structured Cabling System Warranty

1.03 QUALITY ASSURANCE

A. Refer to Section 27 0500 for relevant standards and plenum or non-plenum cable requirements.

B. The channel shall be required to meet the performance requirements indicated herein. The manufacturer shall warranty the performance of their system to the required performance (and not just to the Standard, should the required performance exceed the Standard).

C. Specific components of the channel shall be required, at a minimum, to meet the Standard component requirements for that particular component.

D. The installing contractor must be certified by the manufacturer of the structured cabling system.

1.04 SUBMITTALS

A. Under the provisions of Section 27 0500 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
2. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 HORIZONTAL CABLE

A. CAT 6 Enhanced Cable:

1. The horizontal cable requirements must be met as well as the following channel requirements.
2. CAT 6 cable shall terminate on rack-mounted modular patch panels in the Production Studio Server Room 407.11.
3. Performance Tests shall be conducted using swept frequency testing through 250 MHz for the channel. All numbers given are for a 4-connection channel. Discrete frequency testing results at 250 MHz is not acceptable.

4. Performance data shall be characterized as "Guaranteed Headroom" and shall be guaranteed by the manufacturer to perform at guaranteed margins over ANSI/TIA/EIA-568-C.2. Performance data that is not warranted by the manufacturer will not be considered.
5. The structured cabling and connectivity must be provided by the same company. For the purpose of this specification that shall mean that the cabling and connectivity must be marketed, branded, supported, warranted, and distributed by the same company. Specifically, ally or partnerships between cabling manufacturers and connectivity manufacturers do not meet this requirement unless otherwise listed below. Specifically, products made by others through an OEM relationship are acceptable if the products are marketed, branded, supported, warranted, and distributed by the same company.
6. The 4-connector channel performance margins listed in the below criteria shall be guaranteed minimum margins above ANSI/TIA/EIA-568-C.2 with electrical parameters between 1-250 MHz.
    a. Insertion Loss: 14.0%
    b. NEXT: 7.0 dB
    c. PS NEXT: 8.0 dB
    d. ACR-F (ELFEXT): 8.0 dB
    e. PS ACR-F (PS ELFEXT): 8.0 dB
    f. Return Loss: 4.0 dB
7. The jacket color for CAT 6 cable shall be yellow white for voice applications and blue grey for data applications.
8. Basis of Design:
    a. Leviton LANmark-1000 Enhanced Plenum Rated Cable
    b. Additional acceptable manufacturers:
        1) Panduit
        2) Superior Essex

B. CAT 6 Cable:
1. The horizontal cable requirements must be met, as well as the following channel requirements.
2. CAT 6 cable shall terminate on rack-mounted modular patch panels in their respective communication equipment room as indicated on the drawings.
3. Performance tests shall be conducted using swept frequency testing through 250 MHz for the channel. All numbers given are for a 4-connection channel. Discrete frequency testing results at 250 MHz is not acceptable.
4. Performance data shall be characterized as "Guaranteed Headroom" and shall be guaranteed by the manufacturer to perform at guaranteed margins over ANSI/TIA/EIA-568-C.2. Performance data that is not warranted by the manufacturer will not be considered.
5. The structured cabling and connectivity must be provided by the same company. For the purpose of this specification that shall mean that the cabling and connectivity must be marketed, branded, supported, warranted, and distributed by the same company. Specifically, ally or partnerships between cabling manufacturers and connectivity manufacturers do not meet this requirement unless otherwise listed below. Specifically, products made by others through an OEM relationship are acceptable if the products are marketed, branded, supported, warranted, and distributed by the same company.
6. The 4-connector channel performance margins listed in the below criteria shall be guaranteed minimum margins above ANSI/TIA/EIA-568-C.2 with electrical parameters between 1-250 MHz.
    a. Insertion Loss: 5%
    b. NEXT: 3.0 dB

c. PS NEXT: 5.0 dB
d. ACR-F (ELFEXT): 4.0 dB
e. PS ACR-F (PS ELFEXT): 5.0 dB
f. Return Loss: 2 dB

7. Basis of Design:
   a. Leviton Lanmark-6 UTP
   b. Additional acceptable manufacturers:
      1)
      2)
      3)
      4) Panduit
      5)
      6) Superior Essex

C. CAT 6A Cable:
1. The horizontal cable requirements must be met, as well as the following channel requirements.
2. CAT 6A cable shall terminate on rack-mounted modular patch panels in their respective communication equipment room as indicated on the drawings.
3. Cable shall exceed transmission requirements listed in ANSI/TIA/EIA-568-C.2. Performance tests shall be conducted using swept frequency testing through 500 MHz for the channel. All numbers given are for a 4-connection channel.
4. Performance tests shall be conducted using swept frequency testing through 500 MHz for the channel. All numbers given are for a 4-connection channel. Discrete frequency testing results at 500 MHz is not acceptable.
5. Performance data shall be provided by third-party independent testing laboratories only. Testing data shall be submitted on the third-party testing laboratory letterhead. Test data will only be accepted if it displays testing as a channel. Electrical characteristics of the performance of the cable itself will not satisfy this requirement.
6. The structured cabling and connectivity may be provided by the same company. For the purpose of this specification that shall mean that the cabling and connectivity must be marketed, branded, supported, warranted, and distributed by the same company. Specifically, ally or partnerships between cabling manufacturers and connectivity manufacturers do not meet this requirement unless otherwise listed below. Specifically, products made by others through an OEM relationship are acceptable if the products are marketed, branded, supported, warranted, and distributed by the same company.
7. The 4-connector channel performance margins listed in the below criteria shall be guaranteed minimum margins above ANSI/TIA/EIA-568-C.2 with electrical parameters between 1-500 MHz.
   a. Insertion Loss: 3%
   b. NEXT: 2 dB
   c. PS NEXT: 3 dB
   d. PSA NEXT: 3 dB
   e. PSA NEXT (Average):
   f. ACR-F: 2 dB
   g. PS ACR-F: 3 dB
   h. PSA ACR-F: 3 dB
   i. PSA ACR-F (Average): 3 dB
   j. Return Loss: 2dB
8. The jacket color for CAT 6A cable shall be blue for data applications access points.
9. Basis of Design:
   a. Leviton SST Cat 6A U/UTP Cable, CMP

b. Additional acceptable manufacturers:
   1) Panduit
   2) Superior Essex

2.02 CONNECTORS/COUPLERS/ADAPTERS

A. Refer to Section 27 1100 for requirements and 27 13 00 for requirements.

2.03 FACEPLATES/JACKS

A. CAT 6 Jacks:
   1. CAT 6 horizontal cable shall each be terminated at their designated work area location on RJ-45 modular jacks. These modular jack assemblies shall snap into a modular mounting frame. The combined modular jack assembly is referred to as an information outlet.
   2. The same orientation and positioning of modular jacks shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each information outlet type for review by the Architect/Engineer.
   3. Information outlet faceplates shall incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.
   4. Where standalone CAT 6 only modular jacks are identified, the information outlet faceplate shall be configured as to allow for the addition of one (1) additional modular jack (CAT 3, CAT 5E, or CAT 6) to be installed to supplement each such modular jack as defined by this project. The installation of these supplemental modular jacks is NOT part of this project.
   5. Any unused modular jack positions on an information outlet faceplate shall be fitted with a removable blank inserted into the opening.
   6. All modular jacks will be fitted with a dust cover. Modular jacks shall incorporate a dust cover that fits over and/or into the modular jack opening. The dust cover shall be designed to remain with the modular jack assembly when the modular jack is in use. No damage to the modular jack pinning shall result from insertion or removal of these covers. Dust covers that result in deformation of the modular jack pinning, will not be accepted.
   7. The information outlet faceplate shall be constructed of high impact plastic (except where noted otherwise). The information outlet faceplate color shall:
      a. Match the receptacle color used for other utilities in the building, or
      b. When installed in surface raceway (if applicable), match the color of that raceway.
   8. Different faceplate and frame designs for locations, which include optical fiber cabling relative to those that terminate only copper cabling are acceptable. Information outlets that incorporate optical fiber shall be compliant with the above requirements plus:
      a. Be a low-profile assembly.
      b. Incorporate a mechanism for storage of cable and fiber slack needed for termination.
      c. Position the optical fiber couplings to face downward or at a downward angle to prevent contamination.
      d. Incorporate a shroud that protects the optical fiber couplings from impact damage.
   9. All information outlets and the associated modular jacks shall be of the same manufacturer throughout the project.
   10. The CAT 6 modular jacks shall be non-keyed 8-pin modular jacks.
   11. The interface between the modular jack and the horizontal cable shall be a 110-type termination block or insulation displacement type contact. Termination components shall be designed to maintain the horizontal cable's pair twists as closely as possible to the point of mechanical termination.
   12. CAT 6 modular jacks shall be pinned per T568B.

13. CAT 6 termination hardware shall, as a minimum, meet all the mechanical and electrical performance requirements of the following standards:
    a. ANSI/TIA/EIA-568-A-5
    b. ANSI/TIA/EIA-568A
    c. ISO/IEC 11801
    d. IEC 603-7
    e. FCC PART 68 SUBPART F
14. The color for CAT 6 jacks shall be yellow for PoE, grey for data applications, red for IP Cameras. Alternately, a color-coded bezel or icon may be used to identify the CAT 6 modular jack.

B. Cat 6A Jacks:
1. CAT 6A horizontal cable shall each be terminated at its designated work area location on RJ-45 modular jacks. These modular jack assemblies shall snap into a modular mounting frame. The combined modular jack assembly is referred to as an information outlet.
2. The same orientation and positioning of modular jacks shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each information outlet type for review by the Architect/Engineer.
3. Information outlet faceplates shall incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.
4. Where standalone CAT 6A only modular jacks are identified, the information outlet faceplate shall be configured as to allow for the addition of one (1) additional modular jack (CAT 3, CAT 5E, or CAT 6) to be installed to supplement each such modular jack as defined by this project. The installation of these supplemental modular jacks is NOT part of this project.
5. Any unused modular jack positions on an information outlet faceplate shall be fitted with a removable blank inserted into the opening.
6. All modular jacks will be fitted with a dust cover. Modular jacks shall incorporate a dust cover that fits over and/or into the modular jack opening. The dust cover shall be designed to remain with the modular jack assembly when the modular jack is in use. No damage to the modular jack pinning shall result from insertion or removal of these covers. Dust covers that result in deformation of the modular jack pinning, will not be accepted.
7. The information outlet faceplate shall be constructed of high impact plastic (except where noted otherwise). The information outlet faceplate color shall:
8. All information outlets and the associated modular jacks shall be of the same manufacturer throughout the project.
9. The CAT 6A modular jacks shall be non-keyed 8-pin modular jacks.
10. The interface between the modular jack and the horizontal cable shall be an angled insulation displacement type contact and shall provide separation for ANEXT suppression. Termination components shall be designed to maintain the horizontal cable's pair twists as closely as possible to the point of mechanical termination.
11. CAT 6A modular jacks shall be pinned per T568B.
12. CAT 6A termination hardware shall, as a minimum, meet all the mechanical and electrical performance requirements of the following standards:
    a. ANSI/TIA/EIA-568-B.2-10
    b. IEEE 802.af (PoE)
    c. IEEE 802.an 10GBASE-T
    d. ISO/IEC 60603-7
    e. ISO 11801 Class E Compliant
    f. FCC PART 68.5 SUBPART F

13. The color for CAT 6A jacks shall be blue for access points. Alternately, a color-coded bezel or icon may be used to identify the CAT 6A modular jack.

PART 3 EXECUTION

3.01 CABLE INSTALLATION REQUIREMENTS

A. Horizontal Cabling:
   1. The maximum horizontal cable drop length for Data UTP shall not exceed 295 feet in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and must include any slack required for the installation and termination. The Contractor is responsible for installing horizontal cabling in a fashion so as to avoid unnecessarily long runs. Any area that cannot be reached within the above constraints should be identified and reported to the Architect/Engineer prior to installation. Changes to the contract documents shall be approved by the Architect/Engineer.
   2. All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellum grips may be used to spread the strain over a longer length of cable.
   3. Manufacturer's minimum bend radius specifications shall be observed in all instances.
   4. Horizontal cabling installed as open cabling shall be supported at a maximum of 5' between supports. Refer to the specifications for required cable supports.
   5. Horizontal cabling installed as open cable or in cable tray shall be bundled at not less than 10' intervals with hook-and-loop tie wraps. The use of plastic cable ties is strictly prohibited.
   6. The maximum conduit fill for horizontal cabling shall not exceed 40% regardless of conduit length.
   7. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.

B. A coil of 3 feet in each cable shall be placed in the ceiling at the last support (e.g., J-hook, bridle ring, etc.) before the cables enter a fishable wall, conduit, surface raceway or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15-feet of slack shall be left in each horizontal cable under 250 feet in length to allow for change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.
   1. Category 6A cables shall not be mixed with any other category cable in any bundle. Bundles of Category 6A cable shall maintain a 0.5" separation from bundles of cables containing different categories (e.g., Cat 6, Cat 5E).
   2. To reduce or eliminate EMI, the following minimum separation distances from 480V power lines shall be adhered to:
      a. Twelve (12) inches from power lines of less than 5-kVa.
      b. Eighteen (18) inches from high-voltage lighting (including fluorescent).
      c. Thirty-nine (39) inches from power lines of 5-kVa or greater.
      d. Thirty-nine (39) inches from transformers and motors.
   3. Information outlets shown on floor plans with the subscript "W" are intended to be used for wall mounted telephones. Back boxes for wall mounted telephones shall not be located within 12" vertically, or horizontally, from any light switches, power receptacles, nurse call devices, thermostats, or any other architectural element that would otherwise prevent the installation of a wall mounted telephone on the mating lugs.

C. Horizontal Cabling in Modular Furniture:
   1. This Contractor shall be responsible for providing and installing cable completely to the information outlet in the furniture. This Contractor's responsibility does not end at the furniture feed point.
   2. Where furniture panels are installed to include contact with a wall, cabling shall be fed to the furniture panels via conduit.
   3. Where modular furniture is installed without wall contact, the Contractor shall install cabling through floor fittings as shown on the drawings.
   4. Cabling shall be protected in the transition from the floor or wall fittings to the modular furniture via a length of flexible plastic conduit or other approved protective means. Conduit fittings shall be compatible with the Floor and Wall Fittings proposed. There shall be no exposed cable in the transition to the modular furniture. Fill ratio (cable area vs. conduit area) in each feed shall not exceed 40%.
   5. For purposes of bidding, it is to be assumed that the cable pathway shall be limited to the bottom panel of the modular furniture only. Communications cables would be run through these channels to the jack location.
   6. For purposes of bidding, it is to be assumed that it will be the responsibility of the Contractor to punch and reinstall the bottom molding panels on the modular furniture as required to accommodate the communications cabling and information outlets. The panels shall be marked prior to installation by the Owner to identify the desired location of the information outlets.
   7. The information outlet shall be secured to the panel via mounting tabs, pop-rivets, screws or other approved method. Use of adhesive tape is not acceptable. The method of securing the information outlet to the panel shall not result in sharp protrusions (e.g., sheet metal screw tip) into the channel behind the panel.

3.02 CABLE TERMINATION REQUIREMENTS

A. Cable Terminations - Fiber Optic:
   1. ALL fibers shall be terminated using the specified connector type.
   2. All terminated fibers at the telecommunications rooms shall be mated to couplings mounted on panels. Couplings shall be mounted on a panel that, in turn, snaps into the housing assembly. Any unused panel positions shall be fitted with a blank panel inhibiting access to the fiber optic cable from the front of the housing.
   3. All couplings shall be fitted with a dust cap.
   4. Fibers from multiple locations may share a common enclosure, however, they must be segregated on the connector panels and clearly identified. Fibers from multiple destinations may be secured in a common enclosure provided that they are clearly identified as such. Fibers from different locations shall NOT share a common connector panel (e.g., "insert").
   5. Slack in each fiber shall be provided to allow for future re-termination in the event of connector or fiber end-face damage. Adequate slack shall be retained to allow termination at a 30" high workbench positioned adjacent to the termination enclosure(s). A minimum of 1 meter (approximately 39") of slack shall be retained regardless of panel position relative to the potential work area.

END OF SECTION

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SECTION 27 1710
TESTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section describes the testing requirements relating to the structured cabling system and its termination components and related subsystems.

1.02 RELATED WORK

A. Section 27 0500 - Basic Communications Systems Requirements

1.03 QUALITY ASSURANCE

A. Refer to Section 27 0500 for relevant standards.

1.04 SUBMITTALS

A. Under the provisions of Section 27 0500 and Division 1, prior to the start of work, the Contractor shall submit:
   1. Complete information on testing procedure as described herein.
   2. Test plan summary for each cable type to be tested including equipment to be used, setup, test frequencies or wavelengths, results format, etc.

PART 2 PRODUCTS

2.01 TESTING COPPER

A. General Requirements:
   1. Perform acceptance tests as indicated below for each sub-system (e.g., backbone, horizontal, etc.) as it is completed.
   2. Supply all equipment and personnel necessary to conduct the acceptance tests. The method of testing shall be approved by the Architect/Engineer.
   3. Visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. Provide the Architect/Engineer with a written certification that this inspection has been made.
   4. Conduct acceptance testing according to a schedule coordinated with the Owner/Architect/Engineer. Representatives of the Owner may be in attendance to witness the test procedures. Provide a minimum of one (1) week's advance notice to the Architect/Engineer to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.
   5. Tests related to connected equipment of others shall only be done with the permission and presence of the Contractor involved. The Contractor shall ascertain that testing only is required to prove the wiring connections are correct.
   6. Provide test results and describe the conduct of the tests including the date of the tests, the equipment used, and the procedures followed. At the request of the Architect/Engineer, provide copies of the original test results in their native format.

7. All cabling shall be 100% fault-free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the expense of the Contractor. The applicable tests shall then be repeated.
8. Should it be found by the Architect/Engineer that the materials or any portion thereof furnished and installed under this Contract fail to comply with the specifications and drawings with respect or regard to the quality, amount, or value of materials, appliances, or labor used in the work, it shall be rejected and replaced by the Contractor and all work disturbed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.
    a. CAT 6 Cable:
        1) Testing shall be from the modular jack at the information outlet to the modular patch panel in the communication equipment room.
        2) Horizontal cable shall be free of shorts within the pairs, and be verified for continuity, pair validity and polarity, and conductor position on the modular jack (e.g., wire map). Any defective, split, or mis-positioned pairs must be identified and corrected.
        3) CAT 6 horizontal cable shall be tested to 250 MHz as defined by TIA/EIA-568-C.2. Measurements shall be of the "Permanent Link", including patch cords, cabling and modular jacks at the information outlet and modular patch panel. Parameters to be tested must include:
            a) Wire Map
            b) Length
            c) NEXT Loss (Pair-to-Pair)
            d) NEXT (Power Sum)
            e) ELFEXT (Pair-to-Pair)
            f) ELFEXT (Power Sum)
            g) Return Loss
            h) Attenuation
            i) Propagation Delay
            j) Delay Skew
        4) The maximum length of horizontal cable shall not exceed 295 feet, which allows 33 feet for technology equipment and modular patch cords.
        5) To establish testing baselines, cable samples of known length and of the cable type and lot installed shall be tested. The cable may be terminated with an eight-position CAT 6 modular connector (8-pin) to facilitate testing. Nominal Velocity of Propagation (NVP) and nominal attenuation values shall be calculated based on this test and be utilized during the testing of the installed cable plant. This requirement can be waived if NVP and nominal attenuation data is available from the cable manufacturer for the exact cable type under test.
        6) CAT 6 horizontal cable testing shall be performed using a test instrument designed for testing to 250 MHz or higher. Test records shall verify, "PASS" on each cable and display the specified parameters, comparing test values with standards based "templates" integral to the unit. Test records that report a PASS*, FAIL*, or FAIL result for any of the parameters will not be accepted.
        7) In the event results of the tests are not satisfactory, the Contractor shall make adjustments, replacements, and changes as necessary and shall then repeat the test or tests that disclosed faulty or defective material, equipment, or installation methods, and shall make additional tests as the Architect/Engineer deems necessary at no additional expense to the project or user agency.
    b. CAT 6A Cable:
        1) Testing shall be from the modular jack at the information outlet to the modular patch panel in the communication equipment room.

2) Horizontal cable shall be free of shorts within the pairs and be verified for continuity, pair validity and polarity, and conductor position on the modular jack (e.g., wire map). Any defective, split, or mis-positioned pairs must be identified and corrected.
3) CAT 6A horizontal cable shall be tested to 500 MHz as defined by TIA/EIA-568-C.2. Measurements shall be of the "Permanent Link", including patch cords, cabling and modular jacks at the information outlet and modular patch panel. Parameters to be tested must include:
   a) Wire Map
   b) Length
   c) NEXT Loss (Pair-to-Pair)
   d) NEXT (Power Sum)
   e) ELFEXT (Pair-to-Pair)
   f) ELFEXT (Power Sum)
   g) Return Loss
   h) Attenuation
   i) Propagation Delay
   j) Delay Skew
4) The maximum length of horizontal cable shall not exceed 295 feet, which allows 33 feet for technology equipment and modular patch cords.
5) To establish testing baselines, cable samples of known length and of the cable type and lot installed shall be tested. The cable may be terminated with an eight-position CAT 6A modular connector (8-pin) to facilitate testing. Nominal Velocity of Propagation (NVP) and nominal attenuation values shall be calculated based on this test and be used during the testing of the installed cable plant. This requirement can be waived if NVP and nominal attenuation data is available from the cable manufacturer for the exact cable type under test.
6) CAT 6A horizontal cable testing shall be performed using a test instrument designed for testing to 500 MHz or higher. Test records shall verify "PASS" on each cable and display the specified parameters, comparing test values with standards based "templates" integral to the unit. Test records that report a PASS*, FAIL*, or FAIL result for any of the parameters will not be accepted.
7) In the event results of the tests are not satisfactory, the Contractor shall make adjustments, replacements, and changes as necessary and shall then repeat the test or tests that disclosed faulty or defective material, equipment, or installation methods, and shall make additional tests as the Architect/Engineer deems necessary at no additional expense to the project or user agency.

2.02 TESTING FIBER

A. General Requirements:
   1. Perform acceptance tests as indicated below for each optical fiber sub-system (e.g., backbone, horizontal, etc.) as it is completed.
   2. Supply all equipment and personnel necessary to conduct the acceptance tests. The method of testing shall be approved by the Architect/Engineer.
   3. Visually inspect all optical fiber cabling and termination points to ensure that they are complete and conform to the standards defined herein. Provide the Architect/Engineer with a written certification that this inspection has been made.

4. Conduct acceptance testing according to a schedule coordinated with the Owner/Architect/Engineer. Representatives of the Owner may be in attendance to witness the test procedures. Provide a minimum of one (1) week's advance notice to the Architect/Engineer to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.
5. Tests related to connected equipment of others shall only be done with the permission and presence of the Contractor involved. The Contractor shall ascertain that testing only is required to prove that the optical fiber connections are correct.
6. Provide test results and describe the conduct of the tests including the date of the tests, the equipment used and the procedures followed. At the request of the Architect/Engineer, provide copies of the original test results.
7. All optical fiber cabling shall be 100% fault-free unless noted otherwise. If any optical fiber cable is found to be outside the specification defined herein, that optical fiber cable and the associated connector(s) shall be replaced at the expense of the Contractor. The applicable tests shall then be repeated.
8. Should it be found by the Architect/Engineer that the materials or any portion thereof furnished and installed under this Contract fail to comply with the specifications and drawings with respect or regard to the quality, amount, or value of materials, appliances, or labor used in the work, it shall be rejected and replaced by the Contractor and all work disturbed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.
9. The optical fibers utilized in the installed cable shall be traceable to the manufacturer. Upon request by the Owner, provide cable manufacturer's test report for each reel of cable provided. These test reports shall include manufacturer's on-reel attenuation test results at 850-nm and 1300-nm for each optical fiber of each reel prior to shipment from the manufacturer.
    a. On-the-reel bandwidth performance as tested at the factory. Factory data shall be provided upon request.
    b. The testing noted for optical fiber cabling utilizes an Optical Time Domain Reflectometer (OTDR). However, the Contractor may submit to the Architect/Engineer for pre-approval of alternate fiber optic testing equipment.

B. Tests Prior to Installation: The Contractor, at their discretion and at no cost to the Owner, may perform an attenuation test with an OTDR at 850-nm or 1300-nm on each optical fiber of each cable reel prior to installation. Supply this test data to the Architect/Engineer prior to installation.

C. Tests After Installation: Upon completion of cable installation and termination, the optical fiber cabling shall be tested to include:
    1. Optical Attenuation ("Insertion Loss" Method):
        a. Optical Attenuation shall be measured on all terminated optical fibers in one direction of transmission using the "Insertion Loss" method measurement in accordance with the TIA/EIA 526-14, Method B, and be inclusive of the optical connectors and couplings installed at the system endpoints. Access jumpers shall be used at both the transmit and receive ends to ensure that an accurate measurement of connector losses is made. Multimode optical fibers shall be tested at 850 ±± 30 nm. Singlemode optical fibers (if applicable) shall be tested at 1300 ±± 20 nm.
        b. Attenuation of optical fibers shall not exceed the values calculated as follows:
            1) Attenuation (max.) = 2*C+L*F+S dB.
            2) Where C is the maximum allowable Connector Loss (in dB), L is the length of the run (in kilometers), and F is the maximum allowable optical fiber loss (in dB/km). S is the total splice loss (# of splices * maximum attenuation per splice).

2. Verification of Link Integrity (OTDR):
    a. All optical fibers shall be documented in one direction of transmission using an Optical Time Domain Reflectometer (OTDR). Multimode optical fibers shall be tested at 850-nm and 1300-nm (nominal). Singlemode optical fibers (if applicable) shall be tested at 1310-nm and 1550-nm (nominal). The OTDR(s) shall incorporate high-resolution optics optimized for viewing of short cable sections. Access jumpers of adequate length to allow viewing of the entire length of the cable, including the connectors at the launch and receive end, shall be used. Access jumpers used for testing shall match the type and core diameter of the fiber optic strand under test.
    b. Set OTDR's test variables to the manufacturer's published backscatter coefficient and velocity of propagation figure for the specific strand of fiber under test. OTDR's range should be set to approximately 1.5 times the length of the strand under test, pulse width should be optimized for the length of the fiber optic strand under test, and number of averages should be adjusted to approximately 120 seconds per wavelength.
    c. OTDR traces revealing a point discontinuity greater than 0.2 dB in a multimode optical fiber or 0.1 dB in a singlemode optical fiber (if applicable) at any of the tested wavelengths or any discontinuity showing a reflection at that point shall be a valid basis for rejection of that optical fiber by the Owner. The installation of that optical fiber cable shall be reviewed in an effort to remove any external stress that may be causing the fault. If such efforts do not remove the fault, that optical fiber cable and the associated terminations shall be replaced at the expense of the Contractor.

2.03 DOCUMENTATION/AS-BUILTS/RECORDS

A. General:
    1. Upon completion of the installation, submit as-builts per the requirements of Section 27 0500 and Division 1. Documentation shall include the items detailed in the subsections below.
    2. All documentation, including hard copy and electronic forms, shall become the property of the Owner.
    3. The Architect/Engineer may request that a 10% random field retest be conducted on the cable system at no additional cost to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the Contractor, additional testing can be requested to the extent determined necessary by the Architect/Engineer, including a 100% retest. This retest shall be at no additional cost to the Owner.

B. Copper Media Test Data:
    1. Test results shall include a record of test frequencies, cable type, conductor pair and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).
    2. Printouts generated for each cable by the wire test instrument shall be submitted as part of the documentation package. The Contractor shall furnish this information in electronic form (USB thumb drive). The thumb drive shall contain the electronic equivalent of the test results as defined by the bid specification and be in the tester's native format as well as summaries of each test in pdf format. Provide a licensed copy of the software required to view and print the data that is provided in a proprietary format. Furnish one (1) copy of the data and display (if applicable) software.

C. Optical Fiber Media Test Data:
    1. Test results shall include a record of test wavelengths, cable type, fiber and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).

2. OTDR traces of individual optical fiber "signatures" obtained as specified above shall be provided to the Architect/Engineer in electronic form for review. Trace files shall be so named as to identify each individual optical fiber by location in the cable system and optical fiber number or color. Where traces are provided in electronic form, provide along with the above documentation, one (1) licensed copy of software that will allow for the display of OTDR traces provided. The software shall run on a Microsoft Windows-based personal computer.

D. Record Drawings:
1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided.

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 27 1720
STRUCTURED CABLING SYSTEM WARRANTY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section describes support and warranty requirements relating to the structured cabling system and related subsystems.

1.02 RELATED WORK

A. Section 27 0500 - Basic Technology Systems Requirements.

B. Section 27 1100 - Communication Equipment Room (CER).

C. Section 27 1300 - Backbone Cabling Requirements.

D. Section 27 1500 Horizontal Cabling Requirements.

1.03 QUALITY ASSURANCE

A. Refer to Section 27 0500 for relevant standards.

1.04 SUBMITTALS

A. Under the provisions of Section 27 0500 and Division 1, prior to close of the project the Contractor shall submit:

1. A numbered certificate from the manufacturing company registering the installation.

PART 2 PRODUCTS

2.01 WARRANTY

A. A twenty (20) year Product Installation Warranty and System Assurance Warranty shall be provided for the structured cabling system as described in the contract documents.

B. The Product Installation Warranty shall cover the replacement or repair of the defective product(s) and labor for the replacement or repair of such defective product(s).

C. The system assurance warranty shall cover the failure of the wiring system to support the application it was designed to support, as well as additional applications introduced in the future by recognized standards or user forums that use the TIA/EIA 568A component and link/channel specifications for cabling.

D. Upon successful completion of the installation and subsequent inspection, the Owner shall be provided with a numbered certificate from the manufacturing company registering the installation.

PART 3 EXECUTION

3.01 WARRANTY REQUIREMENTS

A. This Contractor shall be responsible for providing, installing and testing a structured cabling system that will meet the manufacturer's warranty requirements.

END OF SECTION

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SECTION 27 4100
PROFESSIONAL AUDIO/VIDEO SYSTEM

PART 1 GENERAL

1.01 RELATED WORK

A. Section 26 0533 - Conduit
B. Section 26 0513 - Wire and Cable
C. Section 27 0500 - Basic Communications Requirements
D. Section 27 0526 - Communications Bonding
E. Section 27 0503 - Through Penetration Firestopping
F. Section 27 1100 - Communication Equipment Rooms
G. Section 27 0528 - Interior Communications Pathway
H. Section 27 1500 - Horizontal Cabling Requirements
I. Section 27 4200 - Electronic Digital Signage Systems

1.02 REFERENCES

A. ADA - Americans with Disabilities Act
B. ADAAG - Americans with Disability Accessibility Guidelines
C. ANSI - American National Standards Institute
D. AVIXA - Audiovisual and Integrated Experience Association (Formerly InfoComm)
E. ANSI/InfoComm A102.01:2017 - Audio Coverage Uniformity
F. ANSI/InfoComm 2M-2010 - Standard Guide for Audiovisual Systems Design and Coordination Processes
G. ANSI/InfoComm F501.01:2015 - Cable Labeling for Audiovisual Systems
H. ANSI/InfoComm 10:2013 - Audiovisual Systems Performance Verification
I. ANSI/AVIXA V202.01:2016 - Display Image Size for 2D Content in Audiovisual Systems
J. ANSI/InfoComm 4:2012 - Audio Visual Systems Energy Management
K. ANSI/InfoComm 3M-2011 - Projected Image System Contrast Ratio
L. IBC - International Building Code
M. IEC - International Electrotechnical Commission
N. NFPA 70 - National Electrical Code (NEC)
O. UL 813 - Commercial Audio Equipment
P. UL 1419 - Professional Video and Audio Equipment
Q. UL 1480 - Speakers for Fire Alarm, Emergency, and Commercial and Professional Use
R. UL 1492 - Audio/Video Products and Accessories
S. CBC - California Building Code (Current Version)

1.03 SYSTEM DESCRIPTION

A. This specification section describes the furnishing, installation, commissioning and programming of audio/video components and systems.

B. Performance Statement: This specification section and the accompanying Contract Documents are performance based, describing the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed, every equipment connection that must be made and every feature and function that must be programmed and configured. Based on the equipment constraints described and the performance required of the system, as presented in these documents, the Vendor and the Contractor are solely responsible for determining all wiring, programming and miscellaneous equipment required for a complete and operational system.

C. This document describes the major components of the system. All additional hardware, subassemblies, supporting equipment and other miscellaneous equipment required for proper system installation and operation shall be provided by the Contractor.

D. This document describes the major programming features and functions of the system. All additional programming, configuration and integration required for proper system installation and operation shall be provided by the Contractor.

E. When a specific manufacturer is not provided in this document for minor pieces of equipment, the Contractor shall provide only those materials considered to be of the same industry commercial and professional quality level as the major equipment manufacturers.

F. General System Description:
   1. The purpose of this section is to define the overall AV system requirements for each space identified on the project drawings. This is to represent the end-user needs, applications, tasks and Functions and features for each space to assist with identifying programing requirements for each space.

G. Room Type Requirements:
   1. General System Requirements:
   2. History Wall:
      a. The History Wall is designed to allow patrons to view a collage of wall mounted displays (6 of them) showing stills and video images. These displays will run at random during normal business hours using a Brightsign player behind each display or similar device as specified.
      b. System Requirements:
         1) Provide a single network drop behind each display.
         2) Provide a Brightsign player behind each display connected to the network.
         3) Provide six (6) 27" wall mounted displays with mounts.
   3. Electrical Requirements:
      a. Provide a single dedicated 120VAC, 20 amp receptacle for each display on the wall at the installation location.
   4. Children’s Entrance Room:
      a. The Children’s Entrance Room is a round room with a path moving through it that allows the passers by to view the display projected on the wall. The projection is made possible from four ceiling mounted projectors positioned so they are edge blended to look like one continuous image. No audio is provided in this space, just the image. It is the intension that the image will be static and run approximately one month at a time with normal turn ON/OFF at the start and end of each day. Servers and components will be housed in the nearest IDF or COMM Closet that can accommodate the equipment.

b. It is recommended that the projector manufacturer should installation services and serve as the integrator for this room, or recommend one very familiar with the product. Edge blending and maintenance for this room is part of the integrator responsibility.
c. System Requirements:
    1) Provide four hi-lumen Barco projectors with ultra short throw lenses. Projectors are to be ceiling mounted in a semicircular pattern projecting on a curved wall. All projectors are to be Edge Blended.
    2) Provide hi-reflective coating on wall that will be projected on. Refer to projector manufacturer specifications for details on coating value.
    3) Provide routing of video sources to the appropriate IDF or Comm Closet.
    4) Provide appropriate content switches and equipment necessary for day to day functioning.
    5) Provide exact mounting as specified. Coordinate with electrical and infrastructure for power and proper air flow.
d. Electrical Requirements:
    1) Provide a single dedicated 120VAC, 30 amp receptacle for each projector in the ceiling at the installation location.

5. Community Room**:**
    a. The Community room is a large room for the public to meet and be briefed. It will feature a 2x2 video wall with deep back boxes behind each of the displays that will house the equipment for the room. Six (6) ceiling mounted speakers provide audio along with ADA listening capabilities. A wall plate is provided for HDMI input into the system along with BYOD capability. A wall mounted touch panel provides control for the room. Wireless microphones provide audio pickup in the room.
    b. System Requirements:
        1) Provide the capability for the display of temporary video sources connected through an auxiliary input panel in the wall box.
        2) Provide routing of video sources and accompanying audio via a matrix switcher.
        3) Provide 2X2 flat panel display mounted on the front wall of the room as the primary display device with RP Visual backboxes.
        4) Provide ceiling loudspeakers and associated electronics to reproduce the mono or summed-stereo to mono audio signal.
        5) Equipment rack mounted behind the displays on the RP Visual mounts for the entire room system. Provide a control system with touch screen control panel mounted to the wall.
        6) The control system to provide control for:
            a) System on/off
            b) Audio and/or video source and destination selection
            c) Audio level
            d) Source on/off
    c. Provide portable ALS system compliant with 2013 CBC 11B-219 and 11B-706, signage compliant with 2013 CBC 11B-216.10.Architectural and Infrastructure Requirements:
        1) Provide appropriate backing for mounting the display to the wall. Coordinate with electrical backboxes.
    d. Electrical Requirements:
        1) At Display:
            a) Provide one (1) 120VAC, 20A quad receptacle behind each display. Refer to drawings for elevation.
            b) Provide flat panel display recessed back box with integrated surge suppression and hardwired 120VAC, 20A connection.

2) Information Technology (IT) Requirements (Recommendations):
   a) Provide WAN coverage.
   b) Provide network drop behind display.
   c) Provide network drop at keypad location.

6. Teen Gaming Room**:**
   a. The Teen Gaming room is primarily designed for teens to relax and play video games in a supervised environment. The room can also be used as a makeshift classroom with PC inuts at the Librarians desk. The system features four 65" displays that are wall mounted. They each have BYOD capability for gaming and can be controlled using a matrix switch and touch panel located at the librarians desk.
   b. Systems Description:
      1) Provide four (4) 65" wall mounted in-room displays.
      2) Provide the capability for the displays of temporary video sources connected through an auxiliary inputs at the librarians desk or through wireless BYOD device.
      3) Provide a control system with touch screen control panel.
      4) The control system to provide control for:
         a) System on/off
         b) Audio and/or video source and destination selection
         c) Audio level
         d) Source on/off
   c. Architectural and Infrastructure Requirements:
      1) Provide appropriate backing for mounting the display to the wall. Coordinate with electrical backboxes.
   d. Electrical Requirements:
      1) At Display:
         a) Provide one (1) 120VAC, 20A quad receptacle behind each display. Refer to drawings for elevation.
         b) Provide flat panel display recessed back box with integrated surge suppression and hardwired 120VAC, 20A connection.
      2) At Librarians Table:
         a) Provide one (1) 120VAC, 20A duplex receptacle 6" above table height and below flat panel display.
      3) Information Technology (IT) Requirements (Recommendations):
         a) Provide WAN coverage.
         b) Provide network drop behind display.
         c) Provide network drop at keypad location.
7. Classrooms
   a. The classrooms are flex spaces used for multiple purposes. The all feature an 85" display that is wall mounted with a keypad control interface that is wall mounted next to it along with an HDMI input plate. Four ceiling mounted speakers provide audio for the room. A BYOD allows input flexability.
   b. System Requirements:
      1) Provide capability for the display of temporary video sources connected through a wall plate mounted.
      2) Provide a ceiling-mounted dual technology occupancy sensor to enable the room control system.
      3) Provide a 4K LED flat panel display with built-in speakers mounted on the front wall of the room as the primary display device.
      4) Provide USB camera with built-in microphone and separate mount to enable videoconferencing.

5) Provide a control system with keypad control panel.
6) SPECIFIER: Edit for specific control system as required.
7) The control system to provide control for:
    a) System on/off
    b) Display input selection
    c) Audio level
    d) Channel control

c. Architectural and Infrastructure Requirements:
    1) Provide appropriate backing for mounting the display to the wall. Coordinate with electrical backboxes.

d. Electrical Requirements:
    1) At Display:
        a) Provide one (1) 120VAC, 20A quad receptacle behind display. Refer to drawings for elevation.
        b) Provide flat panel display recessed back box with integrated surge suppression and hardwired 120VAC, 20A connection.
    2) At Table:
        a) Provide one (1) 120VAC, 20A duplex receptacle.
    3) Acoustical Requirements (Recommendations):
    4) Information Technology (IT) Requirements (Recommendations):
        a) Provide WAN coverage.
        b) Provide network drop behind display.
        c) Provide network drop at keypad location.

8. Small Conference Rooms
    a. The small conference rooms are flex spaces used for multiple purposes. The wall features a 65" display that is wall mounted with a keypad control interface that is wall mounted next to it along with a USB input plate. A video soundbar allows conferencing through an owner’s computer with a keypad for control. A BYOD allows input flexability.
    b. System Requirements:
        1) Provide capability for the display of temporary video sources connected through a wall plate mounted.
        2) Provide a ceiling-mounted dual technology occupancy sensor to enable the room control system.
        3) Provide a 4K LED flat panel display with built-in speakers mounted on the front wall of the room as the primary display device.
        4) Provide USB camera with built-in microphone and separate mount to enable videoconferencing.
        5) Provide a control system with keypad control panel.
        6) SPECIFIER: Edit for specific control system as required.
        7) The control system to provide control for:
            a) System on/off
            b) Display input selection
            c) Audio level
            d) Channel control
    c. Architectural and Infrastructure Requirements:
        1) Provide appropriate backing for mounting the display to the wall. Coordinate with electrical backboxes.

d. Electrical Requirements:
    1) At Display:
        a) Provide one (1) 120VAC, 20A quad receptacle behind display. Refer to drawings for elevation.
        b) Provide flat panel display recessed back box with integrated surge suppression and hardwired 120VAC, 20A connection.
    2) At Table:
        a) Provide one (1) 120VAC, 20A duplex receptacle.
    3) Acoustical Requirements (Recommendations):
    4) Information Technology (IT) Requirements (Recommendations):
        a) Provide WAN coverage.
        b) Provide network drop behind display.

9. Provide network drop at keypad location.
10. Classrooms
    a. The classroom are flex spaces used for multiple purposes. The all feature an 85" display that is wall mounted with a keypad control interface that is wall mounted next to it along with an HDMI input plate. Four ceiling mounted speakers provide audio for the room. A BYOD allows input flexability.
    b. System Requirements:
        1) Provide capability for the display of temporary video sources connected through a wall plate mounted.
        2) Provide a ceiling-mounted dual technology occupancy sensor to enable the room control system.
        3) Provide a 4K LED flat panel display with built-in speakers mounted on the front wall of the room as the primary display device.
        4) Provide USB camera with built-in microphone and separate mount to enable videoconferencing.
        5) Provide a control system with keypad control panel.
        6) SPECIFIER: Edit for specific control system as required.
        7) The control system to provide control for:
            a) System on/off
            b) Display input selection
            c) Audio level
            d) Channel control
    c. Architectural and Infrastructure Requirements:
        1) Provide appropriate backing for mounting the display to the wall. Coordinate with electrical backboxes.
    d. Electrical Requirements:
        1) At Display:
            a) Provide one (1) 120VAC, 20A quad receptacle behind display. Refer to drawings for elevation.
            b) Provide flat panel display recessed back box with integrated surge suppression and hardwired 120VAC, 20A connection.
        2) At Table:
            a) Provide one (1) 120VAC, 20A duplex receptacle.
        3) Acoustical Requirements (Recommendations):
        4) Information Technology (IT) Requirements (Recommendations):
            a) Provide WAN coverage.
            b) Provide network drop behind display.
11. Provide network drop at keypad location.

12. Large Study Room
    a. The Conference rooms provide support to staff for day to day operation. They feature a wall mounted 75" display panel and keypad for control.
    b. System Requirements:
        1) Provide the capability for the display of temporary video sources connected through an auxiliary input panel in the table box.
        2) Provide one (1) 75" display.
        3) Provide an automatic PTZ video camera for video input.
        4) Provide routing of video sources and accompanying audio via a matrix switcher.
        5) Provide a control system with touch screen control panel located at the instructor's station.
        6) The control system to provide control for:
            a) System on/off
            b) Audio and/or video source and destination selection
            c) Audio level
            d) Source on/off
    c. Architectural and Infrastructure Requirements:
        1) Provide appropriate backing for mounting the display to the wall. Coordinate with electrical backboxes.
    d. Electrical Requirements:
    e. Information Technology (IT) Requirements (Recommendations)
        1) Provide WAN coverage.
        2) Provide network drop at each projector.
        3) Provide network drop at touch panel location.

1.04 LICENSING REQUIREMENTS

A. All user licenses required for system operation shall be included in the Contractor's bid. User licenses shall include, but not be limited to, server and workstation software and any other licensing that is required by the manufacturer for operation of any system component.
    1. Licenses shall be provided on a one-to-one basis. One license shall be provided for each server, workstation, and device requiring a license. In the event the manufacturer requires the purchase of a block of licenses, the minimum standard licensing package to support all devices.

1.05 In addition to the licensing requirements listed above, provide licensing and configuration of remote central asset management, scheduling, and control software on up to InsertINTELLECTUAL PROPERTY OWNERSHIP

A. All supporting documentation, programming, uncompiled source code, graphic files, DSP code and diagrams, written and electronic files, including all latest versions of the documentation and software necessary to edit and adapt the system(s), shall be provided to the Owner for all spaces and all systems. The integrator and/or programmer shall also maintain a current copy to be provided at the Owner's request.
    1. The Owner shall have the right to modify the intellectual property directly, or to have the intellectual property modified by any party of the Owner's choosing.

1.06 PROJECT RECORD DOCUMENTS

A. Submit documents under the provisions of Section 27 0500.

B. Provide all applicable certifications.

C. Provide statement that system checkout test, as outlined in the shop drawing submittal, is complete and satisfactory.

D. Provide schedules documenting all terminal block wiring, including cable numbers.

E. Warranty: Submit written warranty and complete all Owner registration forms.

F. Complete all operation and maintenance manuals as described below.

G. The Contractor shall include all factory-provided test results for equipment installed on the project.

H. The Contractor shall include all test results from system demonstration and performance testing specified in this document.

I. Record Drawings shall minimally include:
   1. All revisions to, or deviations from the original drawings, as well as final dimensions, cable routes, connector panel drawings, cable numbering charts, and control system programming documentation. A complete as-installed equipment list, listed by room, and with manufacturers' names, model numbers, serial numbers, and quantities of each item.
   2. A complete and correct system schematic, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers and layouts, and other designations and programming code.
   3. Complete equipment rack layouts showing locations of all rack-mounted equipment items.
   4. Additional information, diagrams or explanations as designated under respective equipment or systems specification section.

J. Within each equipment room, the appropriate floor plan for which that equipment room serves shall be laminated and mounted for use by the Owner. Functional drawings shall be posted at each AV closet or included at every AV rack within a room.

K. Upon completion and final acceptance of the project, the Contractor shall provide the Owner a copy of the programming code for any and all AV systems and devices programmed by the Contractor.
   1. For any subsequent modifications to the programming code, an updated copy of the code shall be provided to the Owner.

1.07 UNIT PRICES

A. Contractor shall provide a unit price for the following pieces of equipment:
   1. One (1) lamp for each projector type on the project.
   2. One (1) projector filter for each projector type on the project.

B. Unit costs shall indicate material, installation and programming costs separately.

1.08 EXTRA MATERIALS

A. Furnish extra materials as described below.

B. Extra stock shall match products installed and shall be packaged with protective covering for storage. Provide identification labels describing contents. Deliver extra materials to Owner.
   1. Projector bulbs for each type of projector, when installed.
      a. If projector is equipped with one (1) bulb, provide a total of two (2) extra bulbs.
      b. If projector is equipped with more than one (1) bulb, provide a total of two (2)extra bulbs for each bulb within the projector.
   2. Filters: Provide a total of two (2) filters for each device that uses filters. If the device is equipped with more than (1) filter, provide a total of two (2) filters for each filter.

PART 2 PRODUCTS

Capacity of Seating in Assemble Areas	Minimum Required Number of Receivers	Minimum Number of Receivers to be Hearing-aid (T-coil) Compatible
50 or less	2	2
51 to 200	2, plus 1 per 25 seats over 50 seats	2
201 to 500	2, plus 1 per 25 seats over 50 seats	1 per 4 receivers
501 to 1,000	20, plus 1 per 33 seats over 500 seats	1 per 4 receivers
1,101 to 2,000	35, plus 1 per 50 seats over 1,000 seats	1 per 4 receivers
Over 2,000	55, plus 1 per 100 seats over 2,000 seats	1 per 4 receivers

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.

C. Verify that required utilities are available, in proper location, and ready for use.

D. Beginning of installation means installer accepts existing conditions.

3.02 PRE-INSTALLATION

A. A pre-installation meeting shall be held after the project has been awarded but before any submittals or work has been conducted. The purpose of this meeting is to review the drawings and specifications to assist with the construction and installation process that will occur during construction. The meeting will include the Engineer, Architect, Owner's Representative, and all relevant installing contractors for this system. The meeting will be chaired by the project manager for the AV contract and will include the following topics:

B. The Contractor shall be responsible for submitting all requested submittals and holding the pre-installation meeting prior to any purchasing, installation, programming, and construction coordination. Any delays or changes to the project as a result of meeting this requirement will be at the Contractor's expense.

3.03 INSTALLATION

A. Comply with the manufacturer's instructions and recommendations for installation of all products.

B. Provide all system wiring between all components as directed by the manufacturer or required for proper system operation.

C. Mount all touch screen and keypad devices where shown on plans in accordance with Americans with Disabilities Act (ADA) requirements for both side reach and front reach.

D. Cabling Requirements:
   1. Non-plenum rated cabling may be used instead of plenum when installed with-in conduit in plenum rated areas.

2. All cabling shall be routed according to function. Cabling shall be grouped and bundled by groups, such as: microphone and line level audio, control, video and speaker. In no case shall cabling from different functional groups be intermixed. No cabling shall be routed parallel to 120 VAC or higher power circuits unless separated by a minimum of 6" and the 120 VAC or higher power is installed in conduit.
3. When cabling is installed in conduit, a separate conduit shall be provided for each cabling functional type.
4. Cable bundles shall be loosely bundled to allow the visual following of individual cables within the bundle and to permit the easy removal and addition of cables, as necessary.
5. Horizontal cabling installed as open cable or in cable tray shall be bundled at not less than 10' intervals with hook-and-loop tie wraps. The use of plastic cable zip ties is strictly prohibited in any situation.
6. Cabling shall not be spliced under any circumstances.
7. Each cable shall be appropriately identified (as defined on the record documents) at each end's termination point using pressure sensitive label strips.
8. Twisted Pair Cabling for All Applications:
   a. The Contractor shall ensure that the twists in each cable pair are preserved to within 0.5 inch of the termination. The cable jacket shall be removed only to the extent required to make the termination.
   b. The Contractor shall ensure that the cable shields are continuous throughout, terminated, and grounded according to the manufacturer's recommendations.

E. Grounding Requirements:
1. Provide a minimum of #6 AWG conductor from the nearest electrical service ground bus or nearest telecommunications room ground bus bar to the A/V equipment racks and cabinets regardless of location. Size cable as required by the NEC.
2. Cables containing shields shall not have the shields grounded at conduits, boxes, racks, etc. Ground the shield only at the equipment end.
3. Audio cable shields for line-level signals shall be connected to the metal equipment chassis at both ends of the cable.
4. Audio cables connected to transformers shall have the cable shield connected to the transformer shield and transformer case ground.
5. The Contractor shall not connect cable shields together from differing cables.
6. XLR cable shields shall be connected to chassis ground.
7. Signal-grounded balanced shields are not acceptable and shall not be installed. All balanced shields shall be chassis grounded.

F. Rack and Cabinet Requirements:
1. Ground equipment racks/cabinets as noted within this specification section and Section 27 0526 - Communications Grounding.
2. Provide one (1) RU of space between adjacent pieces of equipment with top and/or bottom vents, above the topmost piece of equipment, and below the bottommost piece of equipment. Provide a vented cover panel covering each rack space.
3. Terminate all speaker cabling on individual barrier strips for positive "+", negative "-", and shield. The shield barrier strip shall be grounded.
4. Provide a power conditioning surge arrestor in the rack for distribution of AC power from the wall receptacles indicated on the plans. The quantity of plugs shall be adequate so that no equipment in the rack shall require plugging into an AC source outside the rack.
5. Power sequencing shall be provided in the racks where shown on the drawings. All amplifiers located in the racks shall be sequenced "last on – first off". Power sequencers shall provide power conditioning and surge protection.

G. Control System Installation Requirements:
   1. The Contractor shall perform calculations for the required wire AWG size based on distance for system power for touch panels, keypads and other devices being powered. A minimum of a 15% overhead is required.

3.04 VIDEO SYSTEM TESTING AND CALIBRATION

A. All video equipment shall receive proper testing and configuration.

B. Color Space Optimization:
   1. The Contractor shall set the color space of each source and display device to a uniform color space to optimize the switching speed and compatibility of a digital video system. Each device shall be set to an RGB or YCbCr color space depending on the systems primary function and compatibility of the devices.
   2. If the primary function of the space is video and other digital media, the color space of each device shall be set to a YCbCr color space. If the primary function of the space is computer-based graphics and presentations, the color space of each device shall be set to an RGB color space.
   3. Chroma subsampling shall be set to a consistent 4:4:4 or 4:2:2 across all devices. Set to 4:4:4 when all equipment is capable.
   4. If all devices are not capable of displaying a certain color space, all devices shall be set to a common shared color space.

C. Extended Display Identification Data (EDID) Management:
   1. The Contractor shall set the EDID management tables in capable equipment so all sources output the highest common EDID table of the displays (sinks).
   2. For systems with capable matrix switches, the matrix shall dynamically adjust its EDID tables so any source will output the highest common EDID table of the displays (sinks) being outputted to.
   3. If any source or Owner-furnished equipment (OFE) is not outputting properly, the Contractor shall provide and install an EDID Emulator and set it to the highest common EDID table of the displays (sinks) being outputted to.

D. Projectors, monitors and receivers shall be tested and adjusted for proper signal sync, convergence, brightness, contrast, and color level. The Contractor shall adjust all other parameters necessary to achieve a proper video image.

E. All video source selections shall be tested and verified.

F. All projectors and displays shall have a minimum burn-in time of 96 hours prior to any adjustments are made and the completion of the project

G. All projectors and displays shall have their hue/tint and color/saturation calibrated with a video signal test generator and blue lens filter after a minimum warmup time of 20 minutes. Provide all calibrated settings results for each projector and display in the final documentation.

H. All projectors and displays shall have their brightness, contrast and sharpness calibrated with a video signal test generator after a minimum warmup time of 20 minutes. Provide all calibrated settings results for each projector and display in the final documentation.

I. All dynamic contrast functions shall be turned off.

J. The Contractor shall utilize a portable oscilloscope to set video output gain and peaking levels on all line drivers and receivers for analog signals.
   1. The Contractor shall submit screen shots of the fixed signal.
   2. Calibration by eye is not acceptable.

K. Full video calibration for all projectors and displays shall be provided with the following minimum requirements:
   1. The Contractor shall utilize non-contact professional video calibration tools such as Sencore OTC1000-CM ColorPro Optical Tri-stimulus Colorimeter or Klein K-10 Tri-stimulus CIE Colorimeter, Sencore or Extron Video Generator and the latest version of ColorPro by CalMan software or pre-approved equal.
   2. The projector or display shall have a minimum burn-in time of 96 hours prior to calibration.
   3. The projector or display shall have a minimum warmup time of 20 minutes before calibration begins. All efforts shall be taken to allow the display to warm up for a minimum of 60 minutes to allow the luminance to fully stabilize.
   4. The space shall be as dark as possible. The colorimeter's ambient light sensor filter shall be recalibrated every 30 minutes when outside ambient light is present to account for the changes in daylight levels.
   5. All inputs utilized on the projector or display shall be calibrated using the appropriate video signal, aspect ratio and resolution. Submit results for each input as a separate report.
   6. The projector or display shall be calibrated to the Rec. 709 HDTV color standard. White balance shall be calibrated as close as possible to the D65 point for both high IRE and low IRE levels.
   7. The projector or display shall have its 3D Color Management calibrated.
   8. The projector or display shall have its brightness and contrast adjusted both before and after the gamma is calibrated.
   9. Gamma shall be calibrated to an average of 2.2. Gamma shall be verified after the calibration is completed and readjusted, as necessary.
   10. The projector or display shall have its hue/tint and color/saturation calibrated with a blue lens filter.
   11. For calibrating 3D projectors and displays, the matching 3D glasses shall be secured to the front of the Colorimeter "looking" through the glasses for the 3D mode calibration only.
   12. Record the full on/full off contrast ratio both before and after calibration. Provide these results in the final documentation.
   13. The Contractor shall submit the final calibration results to the Architect/Engineer for approval and include the approved results in final documentation submitted to the Owner.
   14. Calibration by eye is not acceptable.
   15. Any setting that cannot be calibrated because the projector or display lacks the functions shall be noted in the final documentation.
   16. For video wall applications, or where multiple projectors or displays that will share content are being used within a single space, all displays after calibration shall be adjusted to match the lowest performing projector or display so all projectors or displays are uniform. If a projector or display differs greatly from the other displays, that projector or display shall be replaced at no cost to the Owner and recalibrated.

3.05 AUDIO SYSTEM TESTING AND CALIBRATION:

A. This Contractor shall field adjust any surface-mounted or flown loudspeaker orientation to achieve the necessary coverage pattern to the intended listening plane. Loudspeakers always face listeners and minimize coverage on walls. The contractor shall be familiar with the named and specified nominal coverage angle of all speakers above its crossover point or for speech range, (500-4,000 Hz).

B. All speakers shall be tested for polarity prior to high work and a table of test results shall be included for A/E inspection. All loudspeakers shall be connected with uniform polarity, where a positive pressure pulse at the input corresponds to a positive driver excursion, and all drivers are uniform always moving in the same direction. Main speakers shall not be lifted or hoisted into high access areas without polarity testing.

C. The Contractor shall make incremental adjustments on the equipment output and input tolerances to achieve matching signal levels while preserving +10 dB minimum headroom and also unity gain. Insert all broadband or high pass filters first for system protection after review of manufacturers specifications for power and bandpass.

D. The Contractor shall utilize a Real Time Audio (RTA) spectrum analyzer with AES2 Broadband pink noise at a minimum of 1/3 octave, capable of providing detailed plots and reports.
   1. The Contractor shall have and own a calibrated Type 1 or Type 1.5 microphone for all measurements, that is recently calibrated within the last year.
   2. Calibration by ear, tablets and portable phones with integrated microphones are never acceptable. All software analysis tools require a calibrated interface and calibrated microphone. No Android devices are used for metering or calibration. IOS devices with calibrated software and interfaces may be used.

E. Provide high quality media with full bandpass program material for critical listening. MP3 or streaming audio is not acceptable. Testing shall illustrate WAV file quality playback for impact and clarity.

F. The Contractor shall provide graphic plots of the reference ambient noise for each space at the time of the calibration and submit with the calibration results. Test signal shall be 10dB minimum above ambient noise levels during testing.

G. The Contractor shall use a listener sitting height of four (4) feet ± 1" for rooms where the primary function will be sitting. The Contractor shall use a listener standing height of five feet three inches (5.25') ± 1" for rooms where the primary function will be standing

3.06 AUDIO SYSTEM PERFORMANCE REQUIREMENTS

A. The Contractor shall test and provide documents verifying all the following performance criteria. The Architect/Engineer shall be informed when the testing will take place and have the option to witness the testing and ask for additional testing for any reason.

B. The Contractor shall develop an Audio Coverage Uniformity Measurement Location (ACUML) plan for each required space based on the project floor plans, and submit to the Architect/Engineer for review and approval prior to testing. The plan shall represent the majority of the listening area and perimeter seating in the direct field of main speakers.

C. The tests shall be performed at the multiple locations defined on the ACUML plan representing the majority of the listening area(s). The Contractor shall indicate on the floor plan drawings where each test was performed, with the corresponding graphic plot, and submit with the final documentation for review and approval by the Architect/Engineer.

D. The test shall be taken with AES2 Broadband pink noise at a minimum of 15 dB above the reference ambient noise level, taking caution to not overdrive and clip any component of the system beyond 0.5% Total Harmonic Distortion (THD), with a maximum system THD of 1.0%.

E. The audio system(s) shall meet the following minimum requirements:
   1. Achieve a total average SPL of 95 dBA in the majority of seating area with additional headroom. Use dBC for levels above 95 dBA.
   2. The system's total SPL frequency response shall be within ± 4 dB from 500 Hz to 8000 Hz. All efforts shall be made to equalize the system's frequency response possible throughout the system's entire 100 Hz to 16kHz spectrum.
   3. All vocal microphones shall have high and low pass filters set to minimize rumble, pop and hiss. The high pass filter cutoff frequency shall be set between 125 and 160 Hz, with a 12 dB per octave slope, minimum. The low pass filter cutoff frequency shall be set at 12,000 Hz, with a 6 dB per octave slope. Adjust frequency and slope as required to maximize performance for both male and female voices.

4. The subwoofer/speaker low/high crossover points shall be a Butterworth (BW) filter set at 80 Hz with a 24 dB per octave slope. This crossover point shall be adjusted as needed to achieve a smooth frequency response. The subwoofer high-pass filter shall be set to manufacturer's recommended half-power point or 40 Hz, whichever is higher.
5. Achieve a minimum RaSTI value of 0.63.

3.07 DSP-BASED AUDIO PROCESSOR PROGRAMMING

A. Full system programming shall be provided for the system. Programming shall be performed by a factory trained and certified programmer or an employee of the equipment manufacturer.

B. DSP pathfile with initial settings shall be provided by the Contractor for review by the Architect/Engineer before installation.

C. The IP-based audio (IEEE AVB, Dante, etc.) and components shall be on a dedicated Virtual LAN (VLAN) for the A/V systems. These components shall be on a dedicated subnetwork of the VLAN. The Contractor shall coordinate these requirements with the Owner prior to installation.

D. A parametric EQ shall be provided after each crossover point or as approved in the DSP pathfile during shop submittal review. These shall be utilized to set the speaker output as defined in the Audio System Calibration section within this specification. These equalizers should not be made available to the user to adjust.

E. Levelers, compressor/limiters, duckers, gates and delays shall be preset during testing and commissioning and are not available for user adjustment following commissioning.
   1. Adjust delays for time of flight plus 8 to 10 ms, typical.

F. Provide each microphone input with high-pass filter, 5-band parametric EQ, auto-leveler and volume module. Provide line level inputs with high-pass filter, 3-band parametric EQ, compressor/limiter, and volume module.

G. Acoustic Echo Cancelation (AEC) shall be provided for each conference microphone input.

H. A broadband pink noise generator shall be provided with a selectable on/off control button within the DSP pathfile. The noise shall be routable through all processing EQs and speaker outputs during testing.

I. Provide volume meters with labeling for each input and each output.

J. Provide with user control software to be installed on Owner-provided and installed computer.

K. The Contractor shall utilize the latest version of the programming software.

L. The Contractor shall ensure that all components are updated to the latest firmware at the completion of the project.

3.08 DSP-BASED AUDIO PROCESSOR CONTROL SOFTWARE PROGRAMMING

A. Full system software programming shall be provided for the system. Programming shall be performed by a factory-trained and certified programmer or an employee of the equipment manufacturer.

B. The Contractor shall schedule a series of meetings with the Owner and Architect/Engineer to define and determine the exact page layout requirements prior to the final configuration of the audio system. An Owner sign-off of the final layouts shall be required.

C. The Contractor shall use the latest version of the software.

D. At a minimum, there shall be password-protected pages for zone combining, input/output volume control with meters, speaker output volume control with meters, signal routing, signal processing (EQ's, feedback suppression, etc.), and supervision/maintenance for all spaces and combined zones.

E. A 15% programming dollar allowance shall be included for Owner and Architect/Engineer comments on additional system functionality as construction progresses. This shall be shown as a separate line item in the bid (include hours).

3.09 MULTIMEDIA CONTROL SYSTEM INTEGRATION AND PROGRAMMING

A. Programming and Integration for Control Systems:
   1. Full system programming shall be provided for the system. Programming shall be performed by a factory trained and certified programmer or an employee of the equipment manufacturer.
   2. The Contractor shall schedule a series of meetings with the Owner and Architect/Engineer to define and determine the exact integration requirements of the control system prior to the installation of the control system and components. An Owner sign-off of the final configuration shall be required.
   3. This section only defines the minimum requirements. The programmer shall provide complete programming for a fully functional system.
   4. The Contractor shall utilize the latest version of the programming software.
   5. The Contractor shall ensure that all components are updated to the latest firmware at the completion of the project.
   6. The IP-based control system and controlled components shall be on a dedicated Virtual LAN (VLAN) for the A/V systems. These components shall be on a dedicated subnetwork of the VLAN. The Contractor shall coordinate these requirements with the Owner prior to installation.
   7. Integration and programming of the following pieces of equipment shall be provided, with the following minimum features and functions:
      a. All equipment shall include on/off control, except for equipment that must remain active for system functionality.
      b. Integration of HDCP (High-bandwidth Digital Content Protection) and DPCP (Display Port Content Protection) protected content and sources:
         1) No protected sources or content shall be allowed to be selected to route through non-protected devices and displays. A warning shall be displayed stating this information to the user.
      c. Matrix Switcher Integration:
         1) The Contractor shall provide bi-directional RS-232 or Ethernet control system connections and programming with the following minimum functions:
            a) On/off control of the matrix switcher.
            b) Allow for independent video routing of individual video inputs to any audio number of audio outputs.
            c) Allow for audio follow video switcher mode.
            d) Allow for independent audio routing of individual audio inputs to any audio number of audio outputs.
            e) Provide source detection of video inputs.
            f) HDCP (High-bandwidth Digital Content Protection) and DPCP (Display Port Content Protection) Protection:
            g) For HDCP/DPCP - compliant sources; switcher shall only allow for routing of signals to HDCP compliant devices.
            h) For HDCP/DPCP - complaint switchers; room combining/uncombining features shall allow for complete audio and /or video devices to be connected to the system using a simplified interface.

d. DSP Audio Processor Integration:
    1) The Contractor shall provide bi-directional RS-232 or Ethernet control system connections and programming with the following minimum functions:
        a) On/off control of all microphones.
        b) Volume and mute control of all microphones and input sources.
        c) Volume and mute control of all outputs.
        d) Independent volume and mute control of all assisted listening outputs.
        e) On/off and reset control of feedback eliminators and suppressors.
        f) Advanced routing of audio signals.
        g) Audio conferencing dialer keypad with speed dials.
        h) Audio conferencing CallerID display on touchpanel and/or workstation.
        i) Acoustic Echo Cancelation (AEC) control.
e. Audio Conference Integration:
    1) Refer to DSP Audio Processor Integration for requirements.
f. Projector Integration:
    1) The projectors shall be integrated into the A/V control system via bi-directional RS-232 or Ethernet control. Provide with the following minimum functions:
        a) On/off control.
        b) Lamp status feedback.
        c) Filter status feedback.
        d) Source switching control.
        e) Audio volume control with mute.
        f) Video mute.
        g) Auto image.
g. Display Integration:
    1) The displays shall be integrated into the A/V control system via bi-directional RS-232 or Ethernet control. Provide with the following minimum functions:
        a) On/off control.
        b) Display status feedback.
        c) Source switching control.
        d) Audio volume control with mute.
        e) Video mute.
        f) Tuner channel control with direct channel access.
        g) Station presets with station icons.
h. Motorized Projection Screen Integration:
    1) Screens shall be integrated into the A/V control system via OR bi-directional RS-232 or Ethernet control.
        a) Up/down and stop control shall be provided.
i. Projector/Flat Panel Display Lift Integration:
    1) The Contractor shall provide bi-directional RS-232 or Ethernet control system connections and programming with the following minimum functions:
        a) Up/down and stop control shall be provided.
        b) Service position control shall be provided (if capable).
j. Video Conference/Telepresence Integration:
    1) The Contractor shall provide bi-directional RS-232 or Ethernet control system connections and programming with the following minimum functions:
        a) Refer to DSP Audio Processor Integration for audio requirements.
        b) Video conferencing dialer keypad with speed dials.
        c) PTZ near end camera control.
        d) PTZ far end camera control with lockout control at the far end.

e) Multi-window control with multiple presets the contractor shall coordinate with the Owner and users on designed layouts. All system inputs shall be selectable for each window.

k. Pan/Tilt/Zoom (PTZ) Camera Integration:
1) The Contractor shall provide bi-directional RS-232 or Ethernet control system connections and programming with the following minimum functions:
a) Provide full pan, tilt and zoom control.
b) Provide presets for fixed camera positions, contractor shall coordinate with the Owner for desired preset positions.

l. Document Camera/Visualizer Integration:
1) The Contractor shall provide bi-directional RS-232 or Ethernet control system connections and programming with the following minimum functions:
a) The Contractor shall provide, at a minimum, power on and off functions as well as zoom and focus functions.
b) Bulb life and equipment status shall be monitored (if available).

m. Multi-window Processor Integration:
1) The Contractor shall provide bi-directional RS-232 or Ethernet control system connections and programming with the following minimum functions:
a) All system inputs shall be selectable for each window of the processor.
b) Multiple pre-configured window presets shall be provided.
c) The Contractor shall coordinate with the Owner and users on desired layouts.

n. Divisible Room Integration and Programming:
1) The following represents the minimum integration and programming requirements for divisible rooms.
a) The touch panel shall show a grid or map of the rooms and spaces that are combinable.
b) The user shall be able to highlight a group of rooms or spaces in any combination and hit combine.
c) Once combined, all functions shall operate as a single space including, but not limited to, master audio volume control and lighting.
d) All input sources shall be selectable to be output to any combination of displays.
e) Once rooms are combined all speaker volume levels shall normalize and all volume controls shall adjust the system as a whole.
f) Once rooms are combined all lighting levels shall normalize and all lighting controls shall adjust the system as a whole.

B. Programming and Configuration for Touch Panels:
1. This section only defines the minimum requirements. The programmer shall provide complete touch panel layouts and programming for a fully functional system.
2. The Contractor shall schedule a series of meetings with the Owner and Architect/Engineer to define and determine the exact touch panel layout requirements prior to the purchase and installation of the touch panels. An Owner sign-off of the final layouts shall be required.
a. Some tabs, pages, buttons and functions may be required to have a password at the Owner's discretion. This shall be coordinated during the meetings.
3. Contractor logos are not allowed on the touch panels. The Contractor shall coordinate with the Owner on desired logos to be displayed.

4. All programming for interface and control of all devices shown on the drawings shall be provided. Programming shall be provided for the following minimum functionality:
    a. The main screen shall include graphical buttons for the primary room functions.
        1) Upon selection of the graphical button, all the required functions shall be displayed on the screen. All required equipment shall turn on.
    b. Master System On/Off Control:
        1) When the master system off button is selected, all capable components within the system shall be turned off or placed on standby, except for equipment that is required to remain on for the system to function like the control system processor.
    c. The main screen shall include graphical buttons for the selection of individual source selections.
        1) Upon selection of the graphical button for a source selection, all functional controls for the pieces of equipment, as well as all status indicators, shall be provided in graphical format on the screen.
        2) Rooms with multiple independent outputs and displays shall have a source routing matrix to allow any input to be routed to any output.
    d. The main screen shall include a button for advanced equipment status and monitoring.
        1) Upon selection of the graphical button, the page shall display the on/off status of all monitored equipment, projector lamp hours, projector filter status, and all other features listed within this section that require monitoring
    e. The main screen shall include a button for microphone volume control and muting.
        1) Upon selection of the graphical button, it shall display the individual volume level of each wired and wireless microphone, with a mute for each.
        2) Rooms with multiple independent audio outputs and zones shall have a source routing matrix to allow any input to be routed to any output or zone.
    f. At all times, on all screens, a button shall be provided to return to the main screen, except for modal pop-ups.
    g. A master volume control and mute shall be provided at all times on all screens, except for modal pop-ups.
    h. A master video mute shall be provided at all times on all screens, except for modal pop-ups and audio-only functions.
    i. A modal countdown timer shall be displayed showing the warmup and cooldown time of the projector. All functions shall be locked out while the projector is in cooldown mode.
    j. All unused hard buttons shall not be labeled. A blank touch panel bezel shall be provided if no hard buttons are used.
5. Room scheduling touch panels shall provide the following minimum functions:
    a. The touch panel shall display the room name, room number, date, and time at all times in a clearly visible font.
    b. Display Microsoft Outlook calendar day view with the ability to look up other available rooms and book a room directly from the touch panel.
    c. The border of the touch panel and/or touch panel buttons shall be green when the room is available and red when the room is in use.
    d. A door chime icon shall be provided to sound a tone through the room's interior touch panel.
        1) The interior touch panel shall have an Enter or Do Not Enter button that displays the answer on the exterior to the room touch panel or scheduling panel.
    e. The interior touch panel shall have a Do Not Disturb (DND) button that disables or replaces the exterior scheduling touch panel's chime button.

f. All unused hard buttons shall not be labeled. A blank touch panel bezel shall be provided if no hard buttons are used.

C. Touch Panel Layout Principles, Considerations and Guidelines:
1. Icons and Buttons:
a. Icons shall not be used solely as a button but can be embedded in a button.
b. Icons shall appear to be flat and unpressable.
c. Status bars or text windows for time, date, room number, and similar information shall appear to be slightly depressed into the screen and appear to be unpressable.
d. Buttons shall appear to be pressable by appearing to come off the screen with beveled edges, lighting gradients, and shadows. When pressed, the button shall appear to be depressed into the screen.
1) Buttons that are momentary shall change color when pressed, appear to depress, then pop back up and revert to the original button color and state.
2) Buttons that are not momentary shall change color when pressed, appear to depress, remain depressed, then pop back up, and revert to the original button color and state when pressed again.
e. Buttons and icons shall appear to be lit from the top left corner of the screen.
f. Buttons shall be grouped together according to general function.
g. Button size shall be based on the ratio of Phi (1:1.618) and be sized appropriately based on the screen area and dpi (pixel pitch).
h. Maintain a minimum of 5 to 10 pixels between buttons on small to medium touch panels, and a minimum of 10 to 15 pixels between buttons on medium to large touch panels.
i. Telephone dialer keypads shall be based on the ITU-T E.161/ANSI TI-703 standard telephone layout and include the a-z letters below each appropriate number.
j. TV and radio tuner keypads shall be based on the ITU-T E.161/ANSI TI-703 standard telephone layout, except for the asterisk (*) being replaced by a dot (.) and the pound (#) being replaced with Enter.
k. IP-address keypads shall be based on the standard computer keyboard 10-key numeric keypad typically found on the right side of the keyboard.
l. Buttons such as Power, Play, Stop, Record, Rewind, Previous, Forward, Eject, Return, Next, Up, Down, Left, Right, Plus, Minus, etc. shall use standard industry symbols. Record shall always be a solid red circle.
2. Text and Fonts:
a. The Contractor shall use a standard sans-serif bold Arial or Calibri font style unless the Owner dictates otherwise.
b. Words shall have the first letter capitalized and the rest of the word lower case. No words shall be all capitals or all lower case. Follow standard grammatically correct sentence structure where the first word is capitalized and the rest of the sentence is lower case, followed by the appropriate punctuation mark with accurate syntax and correct verbs.
c. All font size in a single group or cluster shall maintain the same font size. Headers to a group or cluster shall have a slightly enlarged font size. and footers shall have a slightly smaller font size in comparison to the group font size to maintain a visual hierarchy.
3. Color Considerations:
a. Colors shall be selected so that, when converted to monochrome, all text, buttons, icons, groups, clusters, borders, etc. are clearly visible to accommodate all color blind or color-impaired individuals and ADA requirements.
b. Background colors shall be cool low saturation colors such as grey, blue, or green and their analogous colors, and be a gradient from top down or top left to bottom right.

c. Base colors shall be analogous to the background color but be of a higher saturation to stand out more clearly.
d. Button colors shall be analogous to the background color, stand out clearly from the base colors, and be of a higher saturation cool color, gray, or a low saturation black.
e. Icon, symbols, and text color shall be a neutral white or black, or a low saturation grey, and shall clearly stand out from the background or button it is placed on.
f. Buttons for modal acknowledgement, exit or return, or other modal action shall be a warm color such as red or yellow and their analogous colors.
g. Buttons, icons, symbols or text for emergency or urgent notifications shall be bright red.

4. Pages and Background:
   a. Groups and clusters shall have clearly defined borders, with spacing between adjacent groups.
   b. Modal pop-up windows or pages shall be required when a command requires user input before it is executed or when a button has multiple nested elements to control, such as microphone volumes, zone control, lighting and environment control, advanced system controls, etc.
      1) The modal pop-up pages shall dim and grey out the background and buttons, overlay the main page, and have a clear back or exit button to bring the user back into the active page the user was on before the modal pop-up.
      2) A model pop-up timer page shall appear when a projector is being turned on or off for the appropriate warmup or cooldown time. No additional commands shall be allowed during this time.
      3) Model pop-ups shall not replace or completely overlay the background.
   c. Images or pictures shall never be used as backgrounds to any page other than a master start page, if appropriate.
5. Medium to Large Format Touch Panel Layout Guideline Template:
   a. IMAGEClient Logo - Static Window
   b. A/V Source Selection - Static Window
   c. Display Power, Screen Controls, Light Controls, Shade Controls, and other Environmental Controls - Static Window
   d. Controls for Selected Source and Status or Home Page - Dynamic Window
   e. Master Volume and Mute, Video Mute, and Microphone Volume - Static Window
   f. Home Button - Static Window
   g. Date, Time, and Room Number - Static Window
   h. Master System Off - Static Window
6. Small Format Touch Panel Layout Guideline Template:
   a. A/V Source Selection and Source Control and Status After Selection - Dynamic Window
   b. Home Button - Static Window
   c. Date, Time, and Room Number - Static Window
   d. Master System Off - Static Window
7. Small Format Room Scheduling Touch Layout Guideline Template
   a. Room Schedule and Scheduling Control - Dynamic Window
   b. Chime Button - Static Window
   c. Date, Time, and Room Number - Static Window

D. Programming and Configuration for Keypads:
   1. This section only defines the minimum requirements. The programmer shall provide complete keypad layouts and programming for a fully functional system.

2. Full system programming and configuration shall be provided for the system. Programming and configuration shall be performed by a factory-trained and certified programmer or an employee of the equipment manufacturer.
3. This section only defines the minimum requirements. The programmer shall provide complete programming and configuration for a fully functional system.
4. The Contractor shall utilize the latest version of the programming and configuration software.
5. The Contractor shall ensure that all components are updated to the latest firmware at the completion of the project.
6. All programming and configuration for interface and control of all devices shown on the drawings shall be provided. Programming and configuration shall be provided for the following minimum functionality:
    a. A master system on and off button.
        1) All capable components within the system shall be turned off or placed on standby when the system is selected to be off.
    b. A master volume control up/down buttons or knob and a mute
    c. Source select or source toggle button(s).
    d. DVD control including, but not limited to, play, pause, stop, fast forward, rewind and chapter forward and reverse.
    e. Screen up and down control.
    f. TV channel up and down control.
    g. All unused hard buttons shall not be labeled.

3.10 CENTRALIZED CONTROL SYSTEM ASSET MANAGEMENT SOFTWARE PROGRAMMING

A. A Centralized Control Asset Management System shall be provided to integrate all IP-based control systems for remote control, monitoring, troubleshooting and statistics.

B. The workstation(s) and/or server(s) shall be Owner provided and Owner installed. The Contractor shall provide, install, and program all software specified and required. The Contractor shall coordinate with the Owner on the Owner's preferred operating system, antivirus, and all other required software to be installed on the workstation(s) and/or server(s). Refer to manufacturer recommendations for computer workstation and server requirements and ensure the Owner is aware of and complies to these recommendations.

C. The Contractor shall coordinate with the Owner on the location of the preferred file server for the central database files to which the workstations will connect.

D. The Centralized Control Asset Management System shall be on the same dedicated Virtual LAN and subnetwork as the control systems. The Contractor shall coordinate these requirements with the Owner prior to installation.

E. The Contractor shall provide, install and configure the software on up to three (3) workstations of the Owner's choosing.

F. Integration to Microsoft Exchange Version Insert shall be provided, installed, configured, and programmed.
    1. The Contractor shall provide and install add-in software for Microsoft Outlook for direct user access to server scheduling.
    2. The Contractor shall train and assist the Owner in creating basic email templates for various notifications.

G. Integration to Microsoft Active Directory/LDAP shall be provided, installed, configured, and programmed.
    1. The Contractor shall train and assist the Owner in creating user access levels.

H. The system shall be based on latest version of server/cloud-based software.

I. A series of meetings shall be scheduled by the Contractor with the Owner, Architect/Engineer, and control system manufacturer to determine all required functions, reports and statistics to be utilized. An Owner sign-off of the final layouts and configuration shall be required. At a minimum, provide the following:
   1. Hardware polling for system diagnostics.
   2. Processor "on line" status.
   3. Rooms system on/off status.
   4. Display presence.
   5. Display on/off status.
   6. On/off switching capabilities with log of devices used.
   7. Which devices are in use.
   8. Event/error codes.
   9. Lamp status.
   10. Equipment fault or out of tolerance status
   11. Filter status.
   12. Room scheduling with on/off control of system.
   13. Scheduling of digital signage displays including video walls on/off control and status (if digital signage system in not capable of scheduling and controlling the displays).
   14. Status of lights in room (if applicable).
   15. Motion detection in room (if applicable).
   16. Log of audio and video conference numbers and IP addresses.
   17. Room temperature and humidity (if applicable).
   18. Reporting features would be included for the following:
      a. Lamp life.
      b. Room system usage statistics.
      c. Device usage statistics.
   19. Room scheduling touch panel integration shall be provided with the following minimum features:
      a. Room name, room number, date, and time data.
      b. Microsoft Outlook calendar integration with the ability to look up other available rooms and book a room directly from the touch panel.
      c. Room in use or available status.
   20. Crestron Green Light software add-in package for RoomView Server Edition shall be included and integrated.
   21. Room scheduling touch panel integration shall be provided with the following minimum features:
      a. Room name, room number, date and time data.
      b. Microsoft Outlook calendar integration with the ability to look up other available rooms and book a room directly from the touch panel.
      c. Room in use or available status.

J. The system shall be based on manufacturer's latest version of enterprise software.

3.11 SYSTEM COMMISSIONING

A. The Contractor shall notify the Architect/Engineer and Owner prior to conducting final system commissioning.

B. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements. Refer to Section 01 0900 - General Commissioning.

C. System verification testing is part of the commissioning process. Verification testing shall be performed by the Contractor and witnessed and documented by the Commissioning Agent. Refer to Section 01 0900 - General Commissioning for system verification tests and commissioning requirements.

D. Contractor shall demonstrate system performance of all equipment and adjust settings as directed by the Architect/Engineer and/or Owner.
   1. All system settings, software options and other parameters shall be simulated and tested by the Contractor

3.12 FIELD SERVICES

A. The installer shall conduct a planning meeting with the Owner. The purpose of this meeting shall be to determine all equipment settings that are considered preferences (where proper system operation does not depend on the setting).

B. The installer shall include labor for all planning and all programming activities required to implement the Owner's preferences for equipment settings.

C. It shall be the responsibility of the Contractor/installer to provide a complete, functional system as described by the design documents. These responsibilities include:
   1. Complete hardware setup, installation and wiring and software configuration.
   2. Complete programming of software in accordance with the Owner's desires determined by the planning meeting.
   3. Complete system diagnostic verification.
   4. Complete system commissioning.

3.13 SYSTEM ACCEPTANCE

A. The Contractor shall submit for review a formal acceptance and system checkout procedure. The system checkout procedures shall include all system components and software. The Contractor shall perform the tests and settings and document all results.

3.14 SYSTEM DOCUMENTATION

A. Complete documentation shall be provided for the system. The documentation shall describe:
   1. All operational parameters of the system.
   2. Complete documentation of programming and features.
   3. Complete operating instructions for all hardware and software.

B. The following sections shall be provided in the system documentation:
   1. User Manual: A step-by-step guide and instructions detailing all system user functions.
   2. Technical Manual: A comprehensive document providing all system operations, troubleshooting flowcharts, functional system layout, wiring diagrams, block diagrams and schematic diagrams.
   3. Maintenance Manual: A comprehensive document on all aspects of physical maintenance of the systems, including cleaning of the displays, bulb changes, filter cleaning, filter changing and UPS maintenance.

3.15 SYSTEM TRAINING

A. All labor and materials required for on-site system training shall be provided. Training shall be conducted at the project site using the project equipment.
   1. Provide two week's advanced notice of training to the Owner and Architect/Engineer.
   2. The Architect/Engineer shall be presented with the option to attend the training.

3. Provide a training outline agenda describing the subject matter and the recommended audience for each topic.

B. At a minimum, the following training shall be conducted:
   1. User Manual: A course detailing the system functions and operations that a daily user will encounter.
   2. Technical User: Provide configuration training on all aspects of the system(s), including equipment and software.
   3. Maintenance User: Provide training on all aspects of physical maintenance of the systems, including cleaning of the displays, bulb changes, filter cleaning and filter changing.

C. Minimum on-site training times shall be:
   1. User Manual: One (1) Insert day.
   2. Technical user: One (1) day.
   3. Maintenance user: Four (4) hours.
   4. The Contractor shall include in his/her bid one (1) additional day of training each quarter for the 12-month period of the project warranty. The Contractor shall return to the site for additional follow-up training during this period.

END OF SECTION

SECTION 27 5113
PAGING SYSTEMS

PART 1 GENERAL

1.01 RELATED WORK

A. Section 26 0533 - Conduit and Boxes
B. Section 26 0535 - Surface Raceways
C. Section 26 0513 - Wire and Cable
D. Section 27 0500 - Basic Communications Systems Requirements
E. Section 27 0503 - Through Penetration Firestopping
F. Section 27 0526 - Communications Bonding
G. Section 27 0528 - Interior Communication Pathways
H. Section 27 1500 - Horizontal Cabling Requirements
I. Section 27 0553 - Identification and Administration

1.02 REFERENCES

A. ADA - Americans with Disabilities Act
B. ADAAG - Americans with Disabilities Accessibility Guidelines
C. NFPA 70 (NEC) – National Electrical Code
D. UL 813 - Standards for Commercial Audio Systems
E. UL 1480 - Speakers for Fire Alarm, Emergency, and Commercial and Professional Use
F. Code of Federal Regulations Title 29 Subtitle B Chapter XVII Part 1910 Subpart L Section 1910.165 - Employee Alarm Systems
G. 2022 FGI Guidelines 2.1-8.5.1.1 (7) - Acoustics Considerations
H. Illinois Administrative Code Title 77 Chapter I Subchapter b Part 250 Section 250.2500 - Electrical Requirements
I. ISO R 266-1997
J. ANSI S1.6-1984

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under the provisions of Section 27 0500.
B. Store and protect products under the provisions of Section 27 0500.

1.04 SYSTEM DESCRIPTION

A. This specification section describes the furnishing, installation, commissioning and programming of a complete, turnkey multi-zone paging system.

B. Performance Statement: This specification section and the accompanying design documents are performance based, describing the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed or every equipment connection that must be made. Based on the equipment constraints described and the performance required of the system as presented in these documents, the vendor and the Contractor are solely responsible for determining all wiring, programming, and miscellaneous equipment required for a complete and operational system.

C. This Contractor shall furnish and install a paging system as hereinafter specified and further detailed on the drawings. System shall be completely wired and ready for use including, but not limited to, outlet boxes, conduit, wire, equipment, speakers, controls, and equipment cabinets.

D. Basic System Requirements: The system shall be capable of providing the following minimum features in addition to those specified elsewhere in this specification and on the drawings:
   1. Multi-zone paging system, capable of expanding the quantity of zones by the addition of modular components. Expansion of the quantity of zones by the replacement of equipment is not acceptable without a documented trade-in policy by the manufacturer.
   2. Live and pre-recorded emergency voice messages shall have priority over all non-emergency messages and other program material.
   3. Live all-call voice messages via microphone.
   4. Live and pre-recorded all-call voice message via message initiation station.
   5. Live and pre-recorded all-call voice messages via page port of Owner's telephone system.
   6. Live and pre-recorded voice announcements to a specific zone or group of zones via page port of Owner's telephone system. Zone or group shall be user-selectable via touch-tone dialing at the initiation of a message.
   7. Scheduled tone signaling via line-level audio from tone generator, triggered via contact closure from synchronized clock system.
   8. Night ring signaling, triggered via
   9. Two-way talkback communication with selected zone.
   10. Digital feedback elimination for live voice messages.
   11. Field-configurable priority override hierarchy for signal source inputs.
   12. Individual volume control for each signal source input.
   13. Supervision of speaker cabling for electrical faults, including shorts, open circuits, and ground faults. Faults shall be indicated at a continually-attended location.
   14. Uninterruptible power supply to support continued system operation in the event of a loss of utility power.

1.05 PROJECT RECORD DOCUMENTS

A. Submit documents under the provisions of Section 27 0500.

B. Provide floor plans identifying actual locations of all installed overhead paging system equipment and devices.

C. Provide final system block diagram showing any deviations from shop drawing submittal. Block diagram shall include cable number documenting the numbers installed on both ends of the cable in the field.

D. Provide documentation of all test results and statement that system checkout test, as outlined in shop drawing submittal, is complete and satisfactory.

E. Warranty: Submit written warranty and complete all Owner registration forms.

F. Complete all operation and maintenance manuals as described herein.

1.06 WARRANTY

A. Unless otherwise noted, provide warranty for a minimum of one (1) year after Substantial Completion, as defined by the Contract. Certain system components may require additional manufacturer's warranty as described herein.

B. The warranty shall:
   1. Cover the replacement or repair of the defective product(s) and labor for the replacement or repair of such defective product(s).
   2. Include emergency service and repair on-site, with response times of 24 hours from time of notification. The system shall be repaired and restored to operation within 24 hours of technician's arrival on site.

C. Refer to the individual product sections for further warranty requirements of individual system components.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with all manufacturer's instructions and recommendations for installation of all equipment, devices, and materials.

B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.

C. Wiring:
   1. Refer to Division 26 for conduit requirements and additional wiring requirements. Wiring not installed in conduit shall be plenum rated.
   2. All cabling shall be run in conduit "free-air" in non-continuous cable supports or cable tray above accessible ceilings, and in conduit or in a secured metal raceway in exposed areas. Supports shall be spaced at a maximum 4-foot interval. If cable "sag" at mid-span exceeds 6 inches, another support shall be used.
   3. All overhead paging system audio cabling, including but not limited to speaker, line-level audio, and microphone-level audio cabling, shall be installed in its own cable pathway and shall not share any raceway or cable pathway with telephone or computer network cabling or cabling of any other system.
      a. Cable shall not be laid directly on the ceiling grid or attached in any manner to the ceiling grid wires. Cables shall not be attached to or supported by existing cabling, plumbing or steam piping, ductwork, ceiling supports, electrical or communications conduit, or structural elements.
   4. Manufacturer's minimum bend radius specifications for cables shall be observed in all instances.
   5. All cable shall be installed at right angles and be kept clear of work by other trades. To reduce or eliminate EMI, the following minimum separation distances from £ 480V power lines shall be adhered to:
      a. 12 inches from power lines of 5-kVa
      b. 18 inches from high voltage lighting (including fluorescent)
      c. 39 inches from power lines of 5-kVa or greater
      d. 39 inches from transformers and motors
   6. It shall be noted that all cables shall be installed in continuous lengths from endpoint to endpoint. No splices shall be allowed unless noted otherwise.

7. All cable shall be free of tension at both ends.
8. Both ends of all cables shall be clearly labeled with an alphanumeric identifier. On speaker cables, the label shall indicate the speaker cable circuit zone or run and the telecommunications room in which the zone or run initiates; on line-level cables, the label shall indicate the signal and signal source. Record all speaker cable identifiers on record drawings.
9. No acid core or other corrosive flux solder shall be used in this system.
10. Speaker cable conductor sizes listed are minimum requirements. Actual wire size required shall be determined by the Contractor to maintain a maximum of 10% voltage drop or 0.5 dB insertion loss on any speaker zone. Actual speaker cabling installed shall meet or exceed minimum conductor sizes listed. Basis of design paging speaker cable listed herein is provided to list the minimum criteria and performance requirements for paging speaker cable.
11. The polarity of all cabling shall remain consistent throughout the project, on all equipment.
12. Do not run unbalanced audio signals over cables longer than 10 feet. Contractor shall provide a shielded transformer-based converter at signal source to convert the unbalanced signal to a balanced signal.
13. The Contractor shall provide an isolation transformer for any balanced or unbalanced audio line that exhibits hum, EMI / RFI, power line noise, or ground loops.
14. Provide all system wiring between all components as shown on project documents, as directed by the manufacturer, and/or required for proper system operation and to provide specified system functionality.

D. Equipment:
1. All necessary devices, sub-components, accessories, and incidental materials required to provide a complete, turn-key paging system that provides specified performance and all required system features and functions listed herein and as further detailed on the drawings shall be provided and installed as part of a complete system.
2. All speakers shall be connected in proper polarity.
3. Install all head end equipment and devices in a manner that allows ample air flow for cooling.
4. Install and tighten all connectors in accordance with manufacturer's instructions, using the appropriate purpose-designed tools recommended by the manufacturer for that purpose. Use caution to avoid stripping or damaging connectors, terminals, or equipment by over-tightening termination fasteners.
5. The conductor color code used in terminating system cabling at system equipment and devices shall remain consistent from device to device for each unique device type throughout the project.

E. Grounding Requirements:
1. Furnish and install a minimum #6 AWG bonding conductor from each overhead paging system head end component to the nearest wall-mounted telecommunications grounding busbar. Actual bonding conductor size determined by its installed length. Refer to Section 27 0526 for grounding and bonding conductor sizing criteria.
2. Audio cable shields for line level signals shall be connected to the metal equipment chassis at both ends of the cable. Audio cables connected to transformers shall have the cable shield connected to the transformer shield and transformer case ground.
3. Speaker cables containing shields shall not have the shields grounded at conduits, boxes, racks, etc. Ground speaker cable shields at signal origin telecommunications room end only.

3.02 SYSTEM SETUP, PROGRAMMING, AND ADJUSTMENT

A. The Contractor shall provide all system programming, startup, balancing, tuning, and adjustment required as part of this project. This shall include all calibration and adjustments of equipment controls, troubleshooting, and final adjustments that may be required.

B. Complete all necessary programming to provide the indicated functionality.

C. Program priority override hierarchy as follows:
   1. Emergency voice message input
   2. Emergency tones
   3. Voice paging microphone
   4. Voice Page port input
   5. Voice message input
   6. Schedule tones
   7. Night ring
   8. Background music

D. Paging system shall be adjusted to provide 85 measured at one (1) meter from each speaker when voice pages are made. Sound shall be clear, even, and undistorted and free of any hum, noise, or sonic anomalies. Where speakers are controlled via local volume controls, adjustments shall be made with the volume control set at 70

E. Paging system shall be adjusted to achieve a minimum Speech Transmission Index (STI) of 0.50 or a Common Intelligibility Scale (CIS) rating of 0.7 at representative points within all areas of coverage.

F. Paging system zone output equalization shall be adjusted to achieve +/- 3 dB over entire published effective frequency range of installed speakers, measured on axis at a distance of 1 meter from 10% of each speaker type installed +/- 4 dB over the 2,000 Hz octave band throughout all corridors, open treatment areas, and public spaces. All efforts shall be made to adjust the audible system output's average frequency response in all areas covered by each speaker zone to be as equal as possible when measured at ISO R 266-1997 / ANSI S1.6-1984 1/3 octave preferred frequencies from 20 Hz to 20 KHz.

3.03 TESTING

A. The Contractor shall conduct all system testing as part of the requirements of this project. This shall include all calibration and adjustments of equipment controls, troubleshooting, and final adjustments or corrective action that may be required to provide a complete system that provides the specified performance and all required system features and functions listed herein and as further detailed on the drawings.

B. At a minimum, the installer shall perform the following inspections and tests of the installed overhead paging system:
   1. Verify that all features and functionality are operating properly.
   2. Verify that the system receives signal from all sources and routes those signals as specified.
   3. Verify that priority override hierarchy functions properly and according to the hierarchy specified.
   4. Verify that system output meets specified sound level at each speaker.
   5. Verify that system output meets specified minimum STI and/or CIS rating at representative points within all areas of coverage.
   6. Verify that system output meets specified equalization requirements in all coverage areas.
   7. Verify that all controls are properly labeled and interconnecting wires and terminals are identified.

C. Document all test results and submit as part of final system documentation package.

3.04 TRAINING

A. All labor and materials required for on-site system training shall be provided. Training shall be conducted at the project site using the project equipment.

B. Provide two week's advanced notice of training to the user.

C. Provide a training outline agenda describing the subject matter and the recommended audience for each topic.

D. At a minimum, the following training shall be conducted:
   1. Users:
      a. Provide training on the system functions and operations that a daily user will encounter, including navigation of the user interface to accomplish common operations.
   2. Maintenance Staff:
      a. Provide training on the system functions and operations that a daily user will encounter, including navigation of the user interface to accomplish all common operations.
      b. Provide training on all system components and the basic configuration of the system.
      c. Identify and describe preventive and remedial maintenance procedures to be performed by the Owner.
      d. Review troubleshooting flow charts and describe troubleshooting procedures for common issues.

E. Minimum on-site training times shall be:
   1. Users: Two (2) hours.
   2. Maintenance Staff: Two (2) hours.

END OF SECTION

SECTION 27 5129
AREA OF REFUGE SIGNAL SYSTEM

PART 1 GENERAL

1.01 **SUMMARY**

A. Section Includes: Furnish, install, and wire all equipment associated with the installation of a Digital Area of Refuge/Area of Rescue Assistance Signal System. This work shall include a main control panel, optional remote control panels, an internal modem, optional proprietary field switches for systems over 8 zones, remote call stations, power supply(s), outlet boxes, cables and wiring as shown on the drawings and as specified herein.

1.02 **SUBMITTALS**

A. General: Data sheets on all equipment being provided as well as recommended cable types. Internal control cabinet drawings showing internal block diagram connections shall be provided. Wiring diagrams showing typical field wiring connections as well as single line floor plan indicating equipment locations as well as cable routings and quantities.
   1. Product Data: Submit product data, including manufacturer's (Specifications Data) product sheet, for specified products.
   2. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage and accessories. Include cabling diagrams, wiring diagrams, station installation details, and equipment cabinet details.

B. Quality Assurance Submittals: Submit the following:
   1. Test Reports: Certified test reports showing compliance with specified performance characteristics.
      a. Manufacturer's Instructions: Manufacturer's installation instructions.
         1) Manufacturer's Field Reports: Manufacturer's field reports specified herein.

C. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division I Closeout Submittals (Maintenance Data and Operation Data) Section.
      a. Warranty: Warranty documents specified herein.

D. Project Closeout
   1. A one-year maintenance contract offering continued factory authorized service of this system shall be provided as part of this contract.
      a. The contractor shall furnish manufacturer's manuals of the completed system including individual specifications sheets, schematics, inter-panel and intra-panel wiring diagrams.
         1) All information necessary for the proper maintenance and operation of the system must be included.
         2) Provide four copies.
      b. As built drawings that include changes to wiring, wiring designations, junction box labeling, and other pertinent information shall be supplied upon completion of the project.
         1) Provide a minimum of two (2) hours of in-service training with the system.

(a) These sessions shall be broken into segments that will facilitate the training of the system users in operating station equipment.
(b) Operating manuals and user's guides shall be provided at the time of training.

1.03 **WARRANTY**

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
   1. Warranty Period: 2 years commencing on the Date of Substantial Completion.
   2. All materials and installation shall be guaranteed to be free of defects in material and workmanship for one year after final acceptance of installation and tests.

1.04 **INSTALLATION STANDARDS**

A. The system shall be installed in accordance with the CBC requirements.
   1. ADA (Americans with Disabilities Act) requirements.
B. The completed system shall be in compliance with state and local electrical codes.
C. All wiring shall test free from grounds and shorts.
D. Install according to the manufacturers wiring diagrams.
   1. The 4800 Digital Emergency Communications System requires installation by factory trained authorized dealers/distributors, in accordance with ANSIINFP A 70 National Electrical Code and NFPA 72 Fire Alarm Code.
   2. Properly trained personnel, familiar with Telecommunications Industry Associations 568 EIA standard, are required for proper installation. Failure to terminate the wiring correctly will cause damage to the system and void the warranty.
E. The 4800 Digital Emergency Communication System shall be installed in a controlled, indoor dry environment, with temperatures maintained between 55°F and 95°F.

1.05 **SYSTEM OPERATIONS**

A. Furnish, install, and place into operation a Digital Rescue Assistance System as indicated on the drawings and as specified herein.
   1. A common control panel shall be provided at the main building entrance or other location as authorized by local authority or the fire department where shown on the drawings to indicate light and tone signals from multiple remote call stations and allow voice communication. Optionally, up to four secondary panels can also be installed throughout the building to allow alternate locations to respond to a call for assistance.
B. When the system is operational, a LED signals power on.
   1. When the remote call station switch is activated, a one shot tone is made at the call station and a LED is lit that is steady. The call is displayed digitally on the control panel(s) with a tone along with a display of the call and its location on a 40-character LCD four line display.
   2. When the alarm signal is answered by the control panel, the remote call station is signaled by the LED flashing that voice communication is initiated.
      a. Voice communication with the remote call station can then be initiated from the control panel via a handset.
         1) External modem connection to a public telephone system shall be provided after a programmable time delay.

b. The system shall poll (supervise) all the call stations, control panels and field switches on a continuous basis at least every 200 seconds to identify line faults and defective equipment. Faults will be alerted and displayed at the control panel(s).

PART 2 PRODUCTS

2.01 **RESCUE ASSISTANCE-AUDIONISUAL EQUIPMENT**

A. Basis of Design Manufacturer: Cornell Communications, Inc. or equal product approved via substitution.
   1. Contact: 7915 N 81 St., Milwaukee, WI 53223-3830; Telephone: 800- 558-8957; (414) 351-4660; Fax: (414) 351-4657
   2. System: Cornell 4800 Rescue Assistance-Digital System and Components.

B. Equipment
   1. This system shall consist of multiple remote call stations, which will communicate with one to five control panels and have access to a public telephone system for external alarm notification and two-way voice communication. Expansion Switches will also be utilized when the number of call stations exceeds eight.
      a. The digital communication system is based on Ethernet CobraNet technology.
      b. It consists of four primary components, a Control Panel, Call Station(s), Expansion Switch(es) and Power Supplies. In any given system there will be at least one Control Panel and between one and 255 Call Stations. The system will support a maximum of five Control Panels. For larger systems, Expansion Switches may be used. The Expansion Switch is based on the Control Panel hardware design. The Control Panel and Expansion Switch are eight port proprietary switches. The Control Panel and/or Expansion Switches power the Remote Call Stations. The system interconnects using standard CAT-6 cable. The Ethernet restriction of 100m of cable between a Control Panel and/or Expansion Switch and endpoint applies.
      c. System also requires (I) Pair #16 AWG, stranded, non-shielded cable, from the PS to the Control Panels/Switches for power and (I) Pair #22 AWG, stranded, non-shielded cable, circulating from the PS to all of the Power Detect (J9) connections on the Control Panel.

C. Control Panel(s)
   1. When the system is operational, a LED signals power on. When the system is operating in battery power mode a different LED will be on.
      a. The main control panel shall be a CORNELL Model A-4800M or remote control panel shall be a CORNELL Model A-4800R, with capacity for 255 zones utilizing Ethernet CobraNet technology. The panel can be surface mounted at the Main Fire Department Entrance to the building or other location as authorized by the local authority or fire department. Optional secondary control panels shall also be installed at the following locations (specificed by the facility)

D. Verify locations with the Local Fire Marshal and the Architect.
   1. A LCD display shall display the first three zones in alarm status. Up to 255 zones can be seen via a scroll button.
      a. Each zone alarm will be identified by a building identifier, the floor location, and the description of the area.
      b. In the case of an electrical fault: a system fault LED light on the control panel shall illuminate, the fault location will be shown on the LCD display and the alarm shall emit a repeating sound.

c. An audible alarm shall be mounted on the annunciator panel, which will emit a minimum sound level of 90 db at 30 em when a remote zone station calls.
   1) Depressing the select zone switch will answer a call and open the intercom line to the first zone displayed. You can talk to the zone via the handset, which operates in full duplex mode.
   2) Depressing the select switch again will end the call, change the call status to answered, move the next call to the first line of the display, which allows you to repeat step 4 above answering the next call.
   3) If you desire to review all calls: press the scroll button to step through the list of calls.
d. The control panel shall have operating directions as well as both alarm and voice mute buttons.
e. The power supply shall be a 24VDC emergency battery backup, CORNELL model B-5243B or B-5248A. Additional power supplies may be required for larger systems.
   1) The internal modem will place a call to a designated location via a dedicated public telephone line to notify them of the alarm after a user programmed delay to allow for local response.
f. The system will be configured via a USB flash drive and laptop computer.
g. Raw call data can be optionally logged via the RS-232 terminal interface to a device such as a laptop or desktop computer.

E. Remote Call Stations
   1. The remote call station shall be CORNELL Model 4800V, with a momentary switch, microphone, and loudspeaker utilizing Ethernet/CobraNet technology.
   2. The station shall have hands free voice communication with the control panel.
   3. The station shall have silk-screened operating instructions.
      a. The Cornell Model 4800V shall be Vandal Resistant. The standard two gang mounting plate can be flush or surface mounted and incorporates heavy-duty switches and speakers along with stainless steel plates.

F. Field Switches
   1. The field switch shall be CORNELL Model ES-4808 with 8 ports utilizing Ethernet/CobraNet proprietary technology.

2.02 **SOURCE QUALITY**

A. Source Quality: Obtain rescue assistance equipment and system from a single manufacturer.

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.

3.02 **EXAMINATION**

A. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

3.03 **INSTALLATION**

A. Cabling Requirements
   1. Wiring from the control panel to secondary control panels, field switches and the call stations shall be industry standard CAT -6 cable.
      a. Power requires (I) Pair #16 A WG, stranded, non-shielded cable, from the PS to the Control Panels/Switches for power and (I) Pair #22 AWG, stranded, non-shielded cable, circulating from the PS to all of the Power Detect (J9) connections on the Control Panel.
      b. Verify cable types with the Rescue Assistance System Manufacturer.

B. Rescue Assistance Signal System – Audio Visual Installation
   1. Complete system shall be installed in strict accordance with manufacturer's recommendations.
      a. Wiring shall be installed in raceways throughout the building.
      b. Conduit, if required, shall be 112" minimum. Depending upon local building codes, plenum rated or fire rated cable may be required.

3.04 **FIELD QUALITY REQUIREMENTS**

A. Site Tests (Post Installation Testing): Checkout final connections to the system shall be made by a factory technician authorized by the manufacturer of the products installed.
   1. Factory authorized technicians shall demonstrate operation of the complete system and each major component to the staff.
   2. System field wiring diagrams shall be provided to the subcontractor by the manufacturer prior to installation.

B. Inspection: Perform a complete functional test of the system upon completion of the installation and instruct the staff in the operation and maintenance of the system.

3.05 **CLEANING**

A. Cleaning: Repair or replace damaged installed products. Remove construction debris from project site and legally dispose of debris.

END OF SECTION

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SECTION 28 0500
BASIC ELECTRONIC SAFETY AND SECURITY SYSTEM REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Basic Safety and Security System Requirements (herein referred to Security) specifically applicable to Division 28 sections, in addition to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.02 REFERENCES

A. CCR California Code of Regulation

B. CBC California Building Code

C. CFC California Fire Code

D. CEC California Electric Code

E. CMC California Mechanical Code

F. CPC California Plumbing Code

G. California Title 24 - Building Energy Efficiency Standards

H. SCAQMD South Coast Air Quality Management District

1.03 SCOPE OF WORK

A. This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the security systems as shown on the drawings and specified herein.

B. Each Contractor shall provide all new materials as indicated in the schedules on the drawings, and/or in these specifications, and all items required to make the portion of the security systems a finished and working system.

C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.

D. Description of systems include but are not limited to the following:

1. Electronic access control system
2. Electronic intrusion detection system
3. Video surveillance
4. Fire detection and alarm.
5. Low voltage security wiring (less than +120VAC) as specified and required for proper system control and communications.
6. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the "Suggested Matrix of Scope Responsibility".
7. Firestopping of penetrations of fire-rated construction as described in Section 28 0503.

1.04 OWNER FURNISHED PRODUCTS

A. ACCESS CONTROL HEADEND SERVER.

1.05 DIVISION OF WORK BETWEEN ELECTRICAL AND SECURITY CONTRACTORS

A. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.

B. Definitions:
   1. "Electrical Contractor" as referred to herein refers to the Contractors listed in Division 26 of this Specification.
   2. "Electrical Contractor" shall also refer to the Contractor listed in Division 28 of this specification when the "Suggested Matrix of Scope Responsibility" indicates the work shall be provided by the EC. Refer to the Contract Documents for the "Suggested Matrix of Scope Responsibility".
   3. "Security Contractor" as referred to herein refers to the Contractors listed in Division 28 of this Specification.
   4. Low Voltage Security Wiring: The wiring (less than 120VAC) associated with the Security Systems, used for analog and/or digital signals between equipment.

C. General:
   1. The purpose of these Specifications is to outline typical Electrical and Security Contractor's work responsibilities as related to security systems including back boxes, conduit, power wiring and low voltage security wiring. The prime contractor is responsible for all divisions of work.
   2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the Security Drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the Security Drawings but required for the successful operation of the systems shall be the responsibility of the Security Contractor and included in the Contractor's bid.
   3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Security systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Security Contractor has convened to determine the exact location and requirements of the installation.
   4. This Contractor shall establish Electrical and Security utility elevations prior to fabrication and installation. The Security Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
      a. Lighting Fixtures
      b. Gravity Flow Piping, including Steam and Condensate
      c. Sheet Metal
      d. Electrical Busduct
      e. Sprinkler Piping and other Piping
      f. Conduit and Wireway
      g. Open Cabling

D. Electrical Contractor's Responsibility:
   1. Assumes all responsibility for all required conduit and power connections when shown on the "Suggested Matrix of Scope Responsibility" to be provided by the Electrical Contractor.
   2. Assumes all responsibility for providing and installing cable tray.

3. Responsible for Security Systems grounding and bonding.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Security Contractor's Responsibility:
1. Assumes all responsibility for the low voltage security wiring of all systems, including cable support where open cable is specified.
2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility."
3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).
4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of security equipment which is required to be bonded to the telecommunications bonding system.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other contractors to determine a viable layout.

1.06 COORDINATION DRAWINGS

A. Definitions:
1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
d. Maintenance clearances and code-required dedicated space shall be included.
e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify Architect/Engineer of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to Owner.
a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.
3. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:
   1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
   2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
      a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
   3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of applicable drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:
   1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
      a. Scale of drawings:
         1) General plans: 1/4 Inch = 1 '-0" (minimum).
         2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
         3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
         4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).
         5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
   2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
   3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
   4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the Architect/Engineer for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:
   1. Coordination drawing files shall be made available to the Architect/Engineer and Owner's Representative. The Architect/Engineer will only review identified conflicts and give an opinion, but will not perform as a coordinator.
   2. A plotted set of coordination drawings shall be available at the project site.
   3. Coordination drawings are not shop drawings and shall not be submitted as such.
   4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
   5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
   6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The Architect/Engineer reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the Architect/Engineer.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
    a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
    b. Potential layout changes shall be made to avoid additional access panels.
    c. Additional access panels shall not be allowed without written approval from the Architect/Engineer at the coordination drawing stage.
    d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the Architect/Engineer and the Owner's Representative.
    e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain signoff of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.07 QUALITY ASSURANCE

A. Qualifications:
1. Only products of reputable manufacturers as determined by the Architect/Engineer will be acceptable.
2. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the installation, termination, testing, and placing into operation electronic security devices shall be individually trained by the manufacturer.
3. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.
4. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of electronic security devices and have personnel adequately trained in the use of such tools and equipment.
5. A resume of qualification shall be submitted with the Contractor's bid indicating the following:
    a. A list of recently completed projects of similar type and size with contact names and telephone numbers for each.
6. Conform to all requirements of the City of Inglewood Codes, Laws, Ordinances and other regulations having jurisdiction.
7. In the event there are no local codes having jurisdiction over this job, the current issue of the National Electrical Code shall be followed.
8. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, Architect/Engineer shall determine the method or equipment used.

9. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
10. Verify the installation environment prior to purchasing or installing any cable. Cable installed in a plenum environment shall be appropriately rated. Bring all discrepancies between the contract documents and installation conditions to the attention of the Architect/Engineer prior to purchase or installation.
11. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

B. Permits, Fees, Taxes, Inspections:
1. Procure all applicable permits and licenses.
2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.
3. Pay all applicable charges for such permits or licenses that may be required.
4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized independent agency/consultant.
7. All equipment, and materials shall be as approved or listed by the following: (Unless approval or listing is not applicable to an item by all acceptable manufacturers.)
   a. Factory Mutual
   b. Underwriters' Laboratories, Inc.

C. Examination of Drawings:
1. The drawings for the Security Systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and the exact routing of cabling to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.
3. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
4. If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.
5. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.
6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.

D. Electronic Media/Files:
1. Construction drawings for this project have been prepared utilizing AutoCAD MEP.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
4. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
5. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
6. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
7. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

E. Field Measurements:
1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

1.08 WEB-BASED PROJECT SOFTWARE

A. The General Contractor shall provide a web-based project software site for the purpose of hosting and managing project communication and documentation until completion of the warranty phase.

B. The web-based project software shall include, at a minimum, the following features: construction schedule, submittals, RFIs, ASIs, construction change directives, change orders, drawing management, specification management, payment applications, contract modifications, meeting minutes, construction progress photos.

C. Provide web-based project software user licenses for use by the Architect/Engineer. Access will be provided from the start of the project through the completion of the warranty phase.

D. At project completion, provide digital archive of entire project in format that is readable by common desktop software applications in format acceptable to Architect/Engineer. Provide data in locked format to prevent further changes.

1.09 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.
1. Submittals list:

Referenced Specification Section	Submittal Item	Coordination Drawings
28 05 03	Through-Penetration Firestopping	
28 13 00	Electronic Access Control	
28 23 00	Video Surveillance	
28 26 05	Rescue Assistance Communication System	

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:
   1. Transmittal: Each transmittal shall include the following:
      a. Date
      b. Project title and number
      c. Contractor's name and address
      d. Division of work (e.g., plumbing, heating, ventilating, etc.)
      e. Description of items submitted and relevant specification number
      f. Notations of deviations from the contract documents
      g. Other pertinent data
   2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
      a. Date
      b. Project title and number
      c. Architect/Engineer
      d. Contractor and subcontractors' names and addresses
      e. Supplier and manufacturer's names and addresses
      f. Division of work (e.g., plumbing, heating, ventilating, etc.)
      g. Description of item submitted (using project nomenclature) and relevant specification number
      h. Notations of deviations from the contract documents
      i. Other pertinent data
      j. Provide space for Contractor's review stamps
   3. Composition:
      a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
      b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
      c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
   4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
   5. Contractor's Approval Stamp:
      a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
      b. Unstamped submittals will be rejected.
      c. The Contractor's review shall include, but not be limited to, verification of the following:
         1) Only approved manufacturers are used.
         2) Addenda items have been incorporated.
         3) Catalog numbers and options match those specified.
         4) Performance data matches that specified.
         5) Electrical characteristics and loads match those specified.

6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
7) Dimensions and service clearances are suitable for the intended location.
8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.

6. Submittal Identification and Markings:
   a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
   b. The Contractor shall clearly indicate the size, finish, material, etc.
   c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
   d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
    a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal.
16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

C. Electronic Submittal Procedures:
   1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
   2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
    a. Submittal file name: 28 XX XX.description.YYYYMMDD
    b. Transmittal file name: 28 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

D. Paper Copy Submittal Procedures:
1. Paper copies are acceptable where electronic copies are not provided.
2. The Contractor shall submit ten (10) paper copies of each shop drawing.
3. Each set shall be bound in a three-ring binder or presentation binder. Copies that are loose or in pocket folders are not acceptable.

1.10 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:
1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:
1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
2. Break down all costs into:
    a. Material: Delivered cost of product with taxes paid.
    b. Labor: Labor cost, excluding overhead and profit.
3. Itemize the cost for each of the following:
    a. Overhead and profit.
    b. Bonds.
    c. Insurance.
    d. General Requirements: Itemize all requirements.
4. For each line item having an installed cost of more than $5,000, break down costs to list major products or operations under each item. At a minimum, provide material and labor cost line items for the following:
    a. Security systems:
        1) Surveillance
        2) Access control

D. Update Schedule of Values when:
1. Indicated by Architect/Engineer.
2. Change of subcontractor or supplier occurs.
3. Change of product or equipment occurs.

1.11 CHANGE ORDERS

A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.

B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.

C. Change order work shall not proceed until authorized.

1.12 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a representative of the manufacturer has inspected the installation and certified that the equipment is properly installed and that the equipment is ready for operation:
   1. Firestopping, including mechanical firestop systems.

1.13 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.

B. Store materials on the site to prevent damage.

C. Keep fixtures, equipment and materials clean, dry and free from harmful conditions.

1.14 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.15 WARRANTY

A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 28 may require additional warranty requirements for specific equipment or systems.

B. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.

C. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.16 INSURANCE

A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.17 MATERIAL SUBSTITUTION

A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The Architect/Engineer shall make the final determination of whether a product is equivalent.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor bears full responsibility for the unnamed manufacturers' equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.

D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

PART 2 PRODUCTS

2.01 Refer to individual sections.

PART 3 EXECUTION

3.01 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 26 0533. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.

B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.

C. The Contractor shall be responsible for identifying and reporting to the Architect/Engineer any existing conditions including but not limited to damage to walls, flooring, ceiling and furnishings prior to start of work. All damage to interior spaces caused by this Contractor shall be repaired at this Contractor's expense to pre-existing conditions, including final colors and finishes.

D. All cables and devices installed in damp or wet locations, including any underground or underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

3.03 FIELD QUALITY CONTROL

A. General:
   1. Refer to specific Division 28 sections for further requirements.
   2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.
   3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.
   4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

B. Protection of cable from foreign materials:
   1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
   2. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local

Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

3.04 PROJECT CLOSEOUT

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:
   1. The Architect/Engineer will not perform a final jobsite observation until the project is ready. This is not dictated by schedule, but rather by completeness of the project.
   2. Refer to the end of this section for a "STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION."
   3. The Contractor shall sign this form and return it to the Architect/Engineer so that the final observation can commence.

C. Before final payment will be authorized, this Contractor must have completed the following:
   1. Submitted operation and maintenance manuals to the Architect/Engineer for review.
   2. Submitted bound copies of approved shop drawings.
   3. Record documents including edited drawings and specifications accurately reflecting field conditions, inclusive of all project revisions, change orders, and modifications.
   4. Submitted a report stating the instructions given to the Owner's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representative as having received the instructions.
   5. Submitted testing reports for all systems requiring final testing as described herein.
   6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.
   7. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site; submit receipt to Architect/Engineer prior to final payment being approved.

3.05 OPERATION AND MAINTENANCE MANUALS

A. General:
   1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
   2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:
   1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
   2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
   3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
    a. O&M file name: O&M.div28.contractor.YYYYMMDD
    b. Transmittal file name: O&Mtransmittal.div28.contractor.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Paper Copy Submittal Procedures:
1. Once the electronic version of the manuals has been approved by the Architect/Engineer, paper copies of the O&M manual shall be provided to the Owner. The content of the paper copies shall be identical to the corrected electronic copy.
2. Binder Requirements: The Contractor shall submit O&M manuals in heavy duty, locking three ring binders. Incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. "Peel and stick" labels are not acceptable. Sheet lifters shall be supplied at the front of each notebook. The three-ring binders shall be 1/2" thicker than initial material to allow for future inserts. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other form of binding is acceptable.
3. Binder Labels: Label the front and spine of each binder with "Operation and Maintenance Instructions", title of project, and subject matter.
4. Index Tabs: Divide information by specification section, major equipment, or systems using index tabs. All tab titling shall be clearly printed under reinforced plastic tabs. All equipment shall be labeled to match the identification in the construction documents.

D. Operation and Maintenance Instructions shall include:
1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copy of final approved test and balance reports.
5. Copies of all factory inspections and/or equipment startup reports.
6. Copies of warranties.
7. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
8. Dimensional drawings of equipment.
9. Capacities and utility consumption of equipment.
10. Detailed parts lists with lists of suppliers.
11. Operating procedures for each system.

12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
13. Repair procedures for major components.
14. List of lubricants in all equipment and recommended frequency of lubrication.
15. Instruction books, cards, and manuals furnished with the equipment.

3.06 INSTRUCTING THE OWNER'S REPRESENTATIVE

A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.

B. Provide verbal and written instructions to the Owner's representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. Refer to the individual specification sections for minimum hours of instruction time for each system.

D. Operating Instructions:
   1. The Contractor is responsible for all instructions to the Owner and/or Owner's operating staff on the security systems.
   2. If the Contractor does not have Engineers and/or Technicians on staff that can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.07 SYSTEM STARTING AND ADJUSTING

A. The security systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.

B. All operating conditions and control sequences shall be simulated and tested during the start-up period.

C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to ensure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.08 RECORD DOCUMENTS

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.

C. This Contractor shall maintain at the job site, a separate and complete set of Security Drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Technology Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.

D. Record actual routing of all conduits sized 2" or larger.

E. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.

F. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

3.09 ADJUST AND CLEAN

A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.

B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.

C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

3.10 SPECIAL REQUIREMENTS

1. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards: CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.
2. South Coast Air Quality Management District Rule 1168 - Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.
3. South Coast Air Quality Management District Rule SCAQMD 1113 - Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION

To assist the contractor in a timely close-out of the project, it is crucial that the final jobsite observation is not conducted prior to the project being ready. The contractor is required to review the completion status of the project at the time the observation is scheduled. This review, and the subsequent submittal of this form to the Architect/Engineer, shall indicate the contractor's agreement that the area of the project being requested for final observation is ready as defined below. The following list represents the degree of completeness required prior to requesting a final observation:

1. All cabling pathways (cable tray, ladder rack, conduit sleeves, etc.) are installed and all cabling has been pulled through them.
2. All mechanical firestop products are installed and all other penetrations have been sealed.
3. All CCTV cameras, mounts, cabling and all headend equipment are installed, programmed and operational.
4. All access control system equipment, including card readers, conduits, cabling, electronic locks, controllers and all headend equipment, is installed, programmed and operational.

Prime Contractor: _____ By: _____

Requested Observation Date _____ Today's Date: _____

Contractor shall sign this readiness statement and transmit to Architect/Engineer at least 10 days prior to the requested date of observation.

It is understood that if the Architect/Engineer finds that the project is not complete as defined above and that the final jobsite observation cannot be completed on the requested date, the Architect/Engineer will return to the site at a later date. All additional visits to the site for the purposes of completing the final observation will be billed T&M to the Contractor at our standard hourly rates, including travel expenses or the contractor's retainage may be deducted for the same amount.

END OF SECTION

SECTION 28 0503
THROUGH PENETRATION FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Through-Penetration Firestopping.

1.02 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.03 REFERENCES

A. UL 263 - Fire Tests of Building Construction and Materials

B. UL 723 - Surface Burning Characteristics of Building Materials

C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops

D. UL 2079 Tests for Fire Resistance of Building Joint Systems

E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)

F. Intertek / Warnock Hersey - Directory of Listed Products

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops

I. CBC California Building Code

J. 1997 Uniform Building Code

1.04 SUBMITTALS

A. Submit under provisions of Section 28 0500.

B. Submit Firestopping Installers Certification for all installers on the project.

C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer's installation instructions, and UL or Intertek / Warnock Hersey Assembly number.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
4. F ratings for each firestop system.

E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

F. Submit VOC rating of firestopping material in g/L (less water) with documentation that it meets the limits set forth in SCAQMD Rule 1168.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

B. Install material prior to expiration of product shelf life.

1.06 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
   1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
   2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:
   1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
   2. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 5.0 CFM/sq.ft. at both ambient temperature and 400°°F.

C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

F. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:
   1. LEED - Low Emitting Materials - Adhesives and Sealants.
   2. CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.
   3. South Coast Air Quality Management District Rule 1168 - Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.
   4. South Coast Air Quality Management District Rule SCAQMD 1113 - Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

1.07 MEETINGS

A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Construction Manager, General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.
   1. Review foreseeable methods related to firestopping work.
   2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.08 WARRANTY

A. Provide one year warranty on parts and labor.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.
   1. 3M; Fire Protection Products Division
   2. Hilti, Inc.
   3. RectorSeal Corporation, Metacaulk
   4. Tremco; Sealant/Weatherproofing Division
   5. Johns-Manville
   6. Specified Technologies Inc. (S.T.I.)
   7. Spec Seal Firestop Products
   8. AD Firebarrier Protection Systems
   9. Wiremold/Legrand: FlameStopper
   10. Dow Corning Corp.
   11. Fire Trak Corp.
   12. International Protective Coating Corp.
   13. HoldRite

2.02 THROUGH PENETRATION FIRESTOP SYSTEMS

A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.

B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.

C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.

D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.

E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.

F. Provide firestopping systems allowing continuous insulation for all insulated pipes.

G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated:
   a. F Rating = Floor/Wall Rating
   b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated:
   a. F Rating = Wall Rating
   b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated:
   a. F Rating = Wall/Floor Rating
   b. L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999

Penetrating Item	UL System No.
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999
*Alternate method of firestopping is patching opening to match original rated construction.	

H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.

I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.

C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.

D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.02 INSTALLATION

A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.

B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.03 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.04 IDENTIFICATION

A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:
   1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
   2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.05 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The Contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the Contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The Contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the Contractor's expense.

END OF SECTION

SECTION 28 1300
ELECTRONIC ACCESS CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Server
B. Client Workstations
C. Field Control Hardware
D. Application Software
E. Access Control Graphical User Interface
F. Credentials and Badging
G. Portal Devices
H. Visitor Management
I. Interfaces and Integrations

1.02 RELATED WORK

A. Section 08 7100 - Door Hardware
B. Section 26 0513 - Wire and Cable
C. Section 26 0533 - Conduits and Boxes
D. Section 26 0535 - Surface Raceways
E. Section 27 0526 - Communications Bonding
F. Section 27 0528 - Interior Communication Pathways
G. Section 27 0543 - Exterior Communication Pathways
H. Section 27 0553 - Identification and Administration
I. Section 27 1500 - Horizontal Cabling Requirements
J. Section 28 0500 - Basic Electronic Safety and Security System Requirements.
K. Section 28 0503 - Through Penetration Fire stopping.
L. Section 28 1600 - Intrusion Detection System
M. Section 28 2300 - Video Surveillance
N. Section 28 3100 - Fire Detection and Alarm Systems.

1.03 QUALITY ASSURANCE

A. Manufacturer: The manufacturer shall have a minimum of ten (10) years documented experience in the development and manufacture of access control software and hardware. The software developer shall be, at a minimum, a Microsoft Silver Certified Integrator and Partner for those systems that reside in a Microsoft environment.

B. Contractor:
   1. Shall be a factory-authorized installation, service and support company specializing in the selected manufacturer's product, with demonstrated prior experience of a minimum of three (3) years installing, programming and supporting the selected manufacturer's system.
   2. Shall have been in business for a minimum of three (3) years and shall have installed a minimum of three (3) similar or larger sized systems. Contractor shall have a minimum of two (2) service technicians who are certified in the proposed manufacturer's system.
   3. Shall have as a regular, full time employee a minimum of one employee with the following certification(s) or education Should more than one certification be required, one employee may maintain multiple certifications.
      a. A certification of PSP from ASIS

C. Material:
   1. All material which is Contractor furnished shall be new, unused and free from defects.
   2. Where more than one of any specified item of equipment or material is used, all such items shall be the same product from the same manufacturer.

1.04 REFERENCES

A. International Building Code

B. NFPA 70 - National Electrical Code.

C. The BOCA National Building Code

D. UL 294 - Standard for Access Control Systems.

E. UL 365 - Standard for Police Station Connected Burglar Alarm Units and Systems.

F. UL 464 - Standard for Audible Signal Appliances.

G. UL 603 - Standard for Power Supplies for Use with Burglar Alarm Systems.

H. UL 609 - Standard for Local Burglar Alarm Units and Systems

I. UL 634 - Standard for Connectors and Switches for Use with Burglar Alarm Systems.

J. UL 827 - Standard for Central Station Alarm Services.

K. UL 1076 - Standard for Proprietary Burglar Alarm Units and Systems.

L. UL 1449 - Standard for Surge Protective Devices.

M. UL 1635 - Standard for Digital Alarm Communicator Systems.

N. UL 1638 - Standard for Visual Signaling Appliances – Private Mode Emergency and General Utility Signaling.

O. UL 1778 - Uninterruptible Power Systems.

1.05 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 28 0500.

B. Product Data Submittal: Provide manufacturer's technical product specification sheet for each individual component type. Submitted data shall show the following:
   1. Compliance with each requirement of these documents. The submittal shall acknowledge each requirement of this section, item-by-item.
   2. All component options and accessories specific to this project.
   3. Electrical power consumption rating and voltage including UPS sizing.
   4. Heat generation for all power consuming devices.
   5. Wiring requirements.

6. Server processor(s), workstation configurations, total and available disk space, and memory size.
7. All network bandwidth, latency and reliability requirements.
8. Backup/archive system size and configuration.
9. Submit two of each type of credential to be used (access card, key fob, etc.).

C. System Drawings: Project-specific system CAD drawings shall be provided as follows:
1. Provide a system block diagram noting system components and interconnection between components. The interconnection of components shall clearly indicate all wiring required in the system. When multiple pieces of equipment are required in the exact same configuration (e.g., multiple identical controllers), the diagram may show one device and refer to the others as "typical" of the device shown. The diagram shall list room numbers where each controller will be located. This block diagram shall be provided in Adobe PDF.
2. Provide a schedule of all controllers and the doors/points each controller controls. This schedule shall be provided in Adobe PDF.
3. Provide schedules describing each system input location by an architecturally familiar reference, e.g., Door 312A. The architectural door schedule shall be used as the basis. These schedules shall be provided in Adobe PDF

D. Submit sample format of site specific programming guides to be used for system planning/programming conference with Owner. These guides shall be provided in Adobe PDF.

E. So that required Owner personnel are present at the planning/programming conference required in Part 3 of this section, submit meeting agenda for the conference a minimum of two weeks prior to the conference.

F. Submit detailed description of Owner training to be conducted at project end, including specific training times. Refer to Part 3 of this section for details.

G. IP Addresses: Contractor shall provide to Owner, in a documented transmittal and in Microsoft Excel format, the names and locations of devices which require an IP address. An authorized representative of the Owner shall furnish the addresses for the associated devices in Microsoft Excel format in a documented transmittal. Should Owner change the IP address structure after approval of the list, Owner may be responsible for additional fees involved with reprogramming.

H. Quality Assurance:
1. Provide materials documenting experience requirements of the manufacturer and Installing Contractor. Provide documentation of the training and other applicable certifications of the Contractor.
2. Provide system checkout test procedure to be performed at acceptance. Test procedures shall include all external alarm events.

1.06 SYSTEM DESCRIPTION

A. This section describes the furnishing, installation, programming and commissioning of a complete, turnkey access control system. The terms "access control system" and "security management system", or SMS, may be used interchangeably herein.

B. The company, manufacturer, and product names used in this section are for identification purposes only. All trademarks and registered trademarks are the property of their respective owners.

C. Performance Statement: This section and the accompanying access control-specific design documents are performance based, describing the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the equipment constraints described and the performance required of the system, as presented in these documents, the vendor and the Contractor are solely responsible for determining all wiring,

programming, and miscellaneous equipment required. The Contractor shall be responsible for determining quantities of materials required for a complete and operational system. Floor plan drawings and schedules have been developed to aid the Contractor in determining device quantities and installation locations, but, where discrepancies between floor plans and schedules arise, the greater number shall govern.

D. Basic System Description:
   1. The access control system shall provide the following functionality:
      a. Electronic control access to designated areas.
      b. Validation of cardholder credentials by use of personnel database, card formats, PINs. The system shall compare the time, location, and unique credentials of an attempted entry with information stored in the database.
      c. Access to designated areas will be validated only when a user's credential has a valid number for its facility and the number is valid for the current time and for the reader where it is used.
      d. The system software shall access the hardware that validates the person and monitors the security of a building by use of intelligent system controllers, reader interfaces, locks, readers, inputs and outputs. When access has been validated, a signal to the portal locking device shall be activated to enable alarm free access at that location.
      e. The system shall be configured by use of application software.
      f. The system shall monitor activities using operator monitoring software which includes graphical maps which display alarms, status and activity.
      g. The system shall differentiate and restrict administrative and operational access through use of password authentication.
      h. The system shall report on various aspects of the system by use of reports, both default and customizable. Reports shall be able to be printed.
      i. The system shall have the capability to report alarms both audibly and visually.
      j. The system shall control hardware from the monitoring station by use of manual actions and events.
      k. The system shall provide record and data management by use of journals. There shall be a full audit trail.
      l. The system shall allow for data to be imported from other products by use of database migration tools. These products may include Human Resources databases for name and/or time and attendance information, information from previous access control systems consisting of badge numbers from credentials that will be re-used, Microsoft Excel spreadsheets, or other systems as defined herein.
      m. The system shall allow access using a web interface or a mobile application for use on the iOS and Android operating systems.

E. Integrations, Software Development Kit (SDK) and Application Programming Interface (API):
   1. The manufacturers of the systems that are integrated shall make an SDK available to other manufacturers.
   2. Prior to the release of this section, the manufacturers of the systems that are to be integrated shall have made available to each other all APIs to perform the specific integrated functions required in this section.
   3. The integrations shall be completed and tested, and shall have been implemented on at least one system of similar size prior to the release of this section. The integrations shall not be accomplished for the first time for this project unless written pre-approval has been granted by Owner to Contractor prior to bid deadline.

4. During the warranty period, should a new API or version of software be released by the SMS manufacturer or any of the manufacturers of systems or devices that are integrated, that API or version of software shall be installed in the appropriate system or device defined in this section at no charge to Owner. Should any loss of functionality in the integration be exposed through this installation, as compared to the accepted system, Contractor shall correct the functionality at no charge to Owner.
5. Any and all development costs for specified functionality or inter-system integrations shall be included in the Contractor's bid. No additional costs or fees for the integrations shall be charged to Owner from the time of notice to proceed through system acceptance.

1.07 OWNER FURNISHED MATERIAL

A. Telephone service
B. Data circuit / internet service
C. Active telephone service equipment, such as key system, PBX or VOIP switch equipment
D. Active computer network equipment:
   1. Routers
   2. Switches
   3. Hubs
   4. Wireless access points
   5. Uninterruptible power supplies for Owner furnished products
E. Active computer equipment:
   1. SMS server - refer to Part 2 for details
   2. SMS workstation(s) - refer to Part 2 for details
   3. SMS badging station(s) - refer to Part 2 for details
   4. Uninterruptible power supplies for Owner furnished products
F. Credentials:
   1. Badges
   2. Key fobs
   3. Adhesive tags
   4. Active transmitters

1.08 LICENSING REQUIREMENTS

A. All user licenses required for system operation shall be included in the Contractor's bid. User licenses shall include server and workstation software, network controllers, card readers, printers, badging stations, and any other licensing that is required by the manufacturer for operation of any system component.
   1. Licenses shall be provided on a one-to-one basis. One license shall be provided for each device requiring a license. In the event the manufacturer requires the purchase of a block of licenses, license blocks provided shall be no greater than what is required for the number of devices in this project. Contractor shall document the number of remaining licenses in the project record documents and Operations and Maintenance data.
   2. In addition to the licensing requirements listed above, provide licensing and configuration of system administration/operation software for 1workstations. The workstation licenses shall be concurrent use seats, and the client software shall be able to be loaded on an unlimited number of workstations at no extra cost to the Owner. Contractor shall install client software on the same number of machines as licenses provided. As part of the training, Contractor shall demonstrate to Owner how to install client software on additional workstations.

3. All Contractor-furnished software shall contain a perpetual, permanent license in which no other fees beyond the single payment for the work of this section are required in order to use the proposed software indefinitely. Owner understands that, after the initial warranty period has expired, maintenance and technical support fees may be required annually, quarterly, or monthly in order to receive software updates and technical support. However, it remains the option of Owner to purchase or decline this service. If Owner chooses to discontinue or never purchase this service, the software shall continue to be legally licensed for use. All software shall be the latest version released, and all Contractor-furnished servers and workstations shall be current on all patches and updates for all software on the machines at the time of acceptance of the associated systems.
4. The SMS shall require only a single license key present on the server for the SMS to operate. The key shall be a physical device or a software key. License keys shall not be required at the client workstations.

1.09 PROJECT RECORD DOCUMENTS

A. Submit documents under the provisions of Section 28 0500.

B. Provide final system block diagram showing any deviations from shop drawing submittal.

C. Provide statement that system checkout test, as outlined in the shop drawing submittal, is complete and satisfactory.

D. Provide schedules documenting:
   1. Controller installation locations including specific door numbers being controlled.
   2. All terminal block wiring, including cable numbers.

E. Warranty: Submit written warranty and complete all Owner registration forms.

F. Complete all operation and maintenance data manuals as described below.

1.10 OPERATION AND MAINTENANCE DATA

A. Submit documents under the provisions of Section 28 0500.

B. Manuals: Final copies of the manuals shall be delivered within 7days after completing the installation test. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of the contractor responsible for the installation and maintenance of the system, and the factory representatives for each item of equipment for each system. The manuals shall have a table of contents and labeled sections. The final copies delivered after completion of the installation test shall include all modifications made during installation, checkout, and acceptance testing. Manuals shall be submitted in electronic format only, Adobe PDF. The manuals shall consist of the following:
   1. Hardware Manual: The manual shall describe all equipment furnished including:
      a. General description and specifications.
      b. Installation and check out procedures.
      c. System and equipment layout and electrical schematics to the control board and field device level. For multiple devices wired identically, only one wiring diagram is required per door configuration, to be labeled "TYPICAL".
      d. Alignment and calibration procedures.
      e. Manufacturers repair parts list indicating sources of supply.
   2. Software Manual: The software manual shall describe the functions of all software and shall include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
      a. Definition of terms and functions.
      b. System use and application software.
      c. Initializations, startup, and shutdown procedures.

d. Reports generation.
e. Details on forms customization and field parameters.

3. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system including:
   a. Computers and peripherals.
   b. Log in/Log out procedures.
   c. Use of system, command, and applications software.
   d. Recovery and restart procedures.
   e. Graphic alarm presentation.
   f. Use of report generator and generation of reports.
   g. Data entry.
   h. Operator commands.
   i. Alarm messages.
   j. System permissions functions and requirements.
4. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, cleaning, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

1.11 WARRANTY

A. Unless otherwise noted, provide warranty for one (1) year after date of Substantial Completion for all materials and labor.

B. Onsite Work During Warranty Period: This work shall be included in the Contractor's bid and performed during regular working hours, Monday through Friday.
   1. Inspections: The Contractor shall perform two minor inspections at six-month intervals (or more often if required by the manufacturer), and two major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
   2. Minor Inspections: These inspections shall include:
      a. Visual checks and operational tests of all equipment, field hardware, and electrical and mechanical controls.
      b. Mechanical adjustments if required on any mechanical or electromechanical devices.
   3. Major Inspections: These inspections shall include all work described under paragraph Minor Inspections and the following work:
      a. Clean all equipment, including exterior surfaces and accessible and serviceable interior surfaces.
      b. Perform diagnostics on all equipment.
      c. Check, test, and calibrate (if required) all sensors.
      d. Run all system software diagnostics and correct all diagnosed problems.

C. Operation: Upon the completion of any scheduled adjustments or repairs, Contractor shall verify operation of the SMS.

D. Service: The Owner will initiate service calls when the SMS is not functioning properly. If requested by the Owner, the Contractor shall respond or remain at the site after normal business hours, and the Owner shall reimburse the Contractor for the incremental cost difference between premium labor rates and standard labor rates. This reimbursement applies to premium labor rates that do not exceed time-and-one-half rates after normal business hours and double-time rates for Sundays and holidays. The Owner shall be furnished with telephone number(s) where service personnel can be reached 24/7/365. Qualified service personnel shall be at the site within 4hours after receiving a request for service.

E. Records, Logs and Work Requests: Contractor shall keep records and logs of each task completed under and outside of warranty. These logs shall be maintained in Microsoft Word or Excel. The log shall include the model and serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, description of work performed, the amount and nature of the material used, and the time and date of commencement and completion of the work. Complete logs shall be kept and shall be available for review on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the SMS. The Contractor shall deliver a record of the work performed within three (3) business days after work is completed. Defective items that have been replaced shall be given to the Owner. Should the replacement item be a temporary replacement until the removed item is repaired, Contractor shall retain possession of the defective item for repair and subsequent re-installation.

F. System Modifications: Modifications by the Contractor are allowed after system acceptance. Contractor shall make recommendations for system modification in writing to the Owner. No system modifications shall be made without prior, written approval of the Owner. Any modifications made to the system shall be incorporated into the Operations and Maintenance Manuals, and other documentation affected. The Owner shall be provided with electronic restorable versions of all configurations prior to the modifications being made.

G. Software: At no charge, the Contractor shall provide to Owner all updates released by the manufacturer during the period of the warranty and verify operation of the system upon installation. These updates include system software updates, patches, bug fixes and revisions, as well as firmware updates. These updates shall be accomplished in a timely manner, fully coordinated with SMS administrators and operators, shall include training for the new changes/features, and shall be incorporated into the Operations and Maintenance Manuals and software documentation.

H. Refer to the individual product sections for further warranty requirements of individual system components.

1.12 ANNUAL SERVICE CONTRACT

A. Provide annual cost for extended service and maintenance agreement after the first year for the access control system according to the following terms:
   1. The term of the warranty shall begin on the system acceptance date and shall continue for one (1) year. The extended service and maintenance warranty shall begin following this first year if accepted by the Owner. The term shall be automatically renewed for successive one-year periods unless canceled in writing by the Owner with Contractor confirmed receipt, up to the date of expiration. The service and maintenance agreement shall include the following basic services to the Owner, including all necessary parts, labor and service equipment:
      a. Repair or replace any security equipment item that fails to perform as initially installed, as specified, or as determined per the manufacturer's performance criteria.
      b. Perform preventive maintenance on the security equipment during the 6th month and 12th month of the service contract. This preventive maintenance shall include cleaning, realignment, inspection, and testing of security devices. The Owner shall receive a written report of these inspections that identifies the security system's status and, if required, a list of all necessary repairs or replacements.

c. Provide maintenance on the SMS system software. At no charge, the Contractor shall provide to Owner all updates released by the manufacturer during the period of the service contract and verify operation of the system upon installation. These updates include system software updates, patches, bug fixes and revisions, as well as firmware updates. These updates shall be accomplished in a timely manner, fully coordinated with SMS administrators and operators, shall include training for the new changes/features, and shall be incorporated into the Operations and Maintenance Manuals and software documentation. Contractor shall not be responsible for maintenance of Owner data.

2. The Contractor shall be compensated for any repairs or maintenance provided as a result of Owner abuse, misuse, intentional damage, accidental damage, or power fluctuations exceeding specified equipment tolerances.
3. Service: The Owner will initiate service calls when the SMS is not functioning properly. If requested by the Owner, the Contractor shall respond or remain at the site after normal business hours, and the Owner shall reimburse the Contractor for the incremental cost difference between premium labor rates and standard labor rates. This reimbursement applies to premium labor rates that do not exceed time-and-one-half rates after normal business hours and double-time rates for Sundays and holidays. The Owner shall be furnished with telephone number(s) where service personnel can be reached 24/7/365. Qualified service personnel shall be at the site within 4 hours after receiving a request for service.

B. Provide complete terms and conditions of warranty and service.

C. The Owner will enter into a contract directly with the vendor. This specification section is not a contract between the Owner and the vendor to perform these services.

PART 2 PRODUCTS

2.01 ELECTRONIC ACCESS CONTROL SYSTEM MANUFACTURERS

A. Identiv Hirsch Velocity

B. Approval of Alternate Manufacturers:
1. Refer to the project drawings for manufacturer and model numbers for the Basis of Design products.

2.02 FIELD CONTROL HARDWARE

A. Interior Control Panels:
1. Control boards, power distribution and terminals shall be enclosed in a NEMA 1 rated enclosure that is key lockable. Contractor shall not furnish padlock. All enclosures that are part of this project shall be keyed alike. Contractor shall furnish and install a mechanically fastened tamper switch on the interior of the enclosure.
2. Control boards are allowed to be in an enclosure separate from the power supplies/power distribution. Should they be in separate enclosures, the interface wiring shall be in rigid metallic conduit, RMC, with Myers hubs at both ends of the conduit.
3. Control panels shall be rack mountable in an enclosure specifically for rack mounting. Control boards and power supplies shall be located in the enclosure. The enclosure shall have screw or compression terminals on the rear panel for connection of field devices.

4. Intra-enclosure wiring shall be dressed using tie wraps and/or covered plastic wire way. Hook-up wires for identical purposes shall have the same color insulation. For example, if one input pair utilizes green and white insulated conductors, all similar inputs shall use green and white insulated conductors. The same color scheme shall be followed for all access control panels that are part of this project.
5. Cabling from field devices such as readers, door position switches, request-to-exit devices and locking devices shall not be directly terminated to the control boards and power supplies. The field devices shall be terminated to terminals located on the left side, right side or both sides of the enclosure back panel. Intra-enclosure wiring shall be routed from the terminals to the control boards and power distribution. Quantity and functional sequence of the terminals shall be identical portal to portal.
6. All devices inside the enclosure, less cabling and batteries, shall be mechanically fastened to a removable solid or perforated metal back panel with either:
    a. Metal or plastic standoffs
    b. DIN rail
7. Hook and loop fasteners, double sided tape or adhesives are not allowed to attach devices to the back panel. Mounting devices to the interior of the door shall only be allowed when the following two (2) conditions are met:
    a. The access control hardware manufacturer offers prefabricated enclosures with devices mounted to the interior of the door.
    b. Only the same devices that the access control manufacturer mounts to the interior of the door are allowed to be mounted in a different enclosure, and those devices shall be mounted in an identical manner.
8. 120V 20A input power shall be hard wired to a circuit breaker disconnect and to one duplex receptacle on the interior of the enclosure. Should devices in the enclosures require plug-in transformers/power supplies, the receptacle shall be utilized. One (1) power strip with integrated circuit breaker shall be located in the bottom of the enclosure as needed.
9. Power to the locking devices shall be provided by a power distribution board with no fewer than four (4) outputs. Each lock shall be individually protected. The power distribution board shall:
    a. Provide protection with fuses or positive temperature coefficient (PTC) devices.
    b. Provide control so that each output is individually selectable as latching or non-latching with fire alarm activation.
    c. Provide control so that each output shall have Fail Safe and Fail Secure terminals.
    d. Provide a fire alarm input with associated trigger LED.
    e. Provide an individual LED per output to indicate when an input has been triggered and the associated output has been activated.
    f. Accept a dry, closed contact input to activate the individual lock outputs.
    g. Provide a dry, Form C relay that energizes on activation of the fire alarm input. This output may then be used as a fire alarm input to other power distribution boards in the same or a different enclosure, or may provide input to another device such as a multi-pole relay.
10. A minimum of four (4) 12V 7 AH rechargeable, sealed, lead acid batteries shall be located in the bottom of the enclosure. Two of the batteries shall be connected in series for 24V devices, and two batteries shall be connected in parallel for 12V devices. Connections to the batteries shall be made with appropriate terminals crimped on the connecting conductors. Batteries shall be clearly labeled in a permanent manner with the date of installation.

11. Power to control boards, readers and auxiliary devices such as request-to-exit motion detectors shall be provided by a power distribution board with no fewer than four (4) outputs. All devices powered by the same voltage at an individual portal shall be protected by the same fuse or PTC unless current requirements dictate otherwise. Individual fuses or PTCs may protect more than one control board.
12. All access control panels, when populated with control boards and power supplies, shall have the following capacities:
    a. Control of a minimum of two (2) portals.
    b. Spare capacity of a minimum of one (1) access control portal, two (2) auxiliary inputs and two (2) auxiliary outputs greater than the requirements of the project at the time of system specification.
    c. Five (5) spare fuses of each type used, to be in their original packaging, to be located in each power supply enclosure.
    d. 50% spare current capacity on all power supplies located in unconditioned spaces and 40% spare capacity for those in conditioned spaces. Lower spare capacities are allowable based on prior approval of Contractor-provided power calculations.
13. Locations where enclosures may be mounted are shown on the plans. Final location, with approval of Owner's representative, shall be selected by Contractor based on distribution of controlled portals and devices.
14. At time of Substantial Completion, Contractor shall furnish a schematic diagram of intra-enclosure wiring and a complete bill of materials for the enclosures and the devices located within. This documentation shall include a schedule of fuses and the device(s) that each fuse protects. This documentation shall be placed by Contractor in a Contractor-furnished print pocket located on the inside of the enclosure door.

B. Exterior Control Panels:
1. Control panels, power distribution and terminals shall be located in a NEMA 4X stainless steel enclosure that is pad-lockable. Contractor shall not furnish padlock. Enclosures shall have a tamper switch mechanically attached to the interior of the enclosure.
2. Control boards and power supplies shall be in the same enclosure.
3. Intra-enclosure wiring shall be dressed using tie wraps and/or covered plastic wire way. Hook-up wires for identical purposes shall have the same color insulation. For example, if one input pair utilizes green and white insulated conductors, all similar inputs shall use green and white insulated conductors. The same color scheme shall be followed for all access control panels which are part of this project.
4. All devices inside of the enclosure shall be mechanically attached to a removable solid or perforated metal back panel. Hook and loop fasteners, double sided tape or adhesives are not allowed in order to attach devices to the back panel. Mounting devices to the interior of the door is not allowed.
5. 120V 20A input power shall be hardwired to a circuit breaker disconnect and to one (1) duplex receptacle located within the enclosure. Should devices require plug-in transformers/power supplies, the receptacle shall be utilized. One (1) power strip with integrated circuit breaker shall be located in the bottom of the enclosure as needed.
6. Power to devices and gate activation relays shall be provided by a power supply and power distribution board with no fewer than four (4) outputs. The power distribution board shall provide protection with fuses or positive temperature coefficient (PTC) devices.
7. Activation of gate operator inputs shall be via an ice cube, plug-in, DPDT, DIN rail-mounted relay, located on the inside of the access control enclosure. The relay shall have a manual check button and an indicator LED.
8. Devices inside of enclosure shall be rated for the temperatures to which they will be exposed. Contractor shall furnish and install a heater and ventilation rated for use in the enclosure to meet the temperature ratings of the devices in the enclosure.

9. All access control panels, when populated with power supplies and control boards, shall have the following capacities:
    a. Control of a minimum of two (2) access control portals.
    b. Spare capacity of a minimum of one (1) access control portal, one (1) auxiliary input and one (1) auxiliary output greater than the requirements of the project at time of system acceptance.
    c. Five (5) spare fuses of each type used, to be in their original packaging, to be located in the enclosure.
    d. 50% spare current capacity on all power supplies located in unconditioned spaces and 40% spare capacity for those in conditioned spaces. Lower spare capacities are allowable based on prior approval of Contractor provided power calculations.
10. All strands of fiber that are routed to the enclosure shall be terminated with landed patch panel style connectors. Refer to Section 27 1500 for fiber connector type.
11. All cables that enter the enclosure shall be in rigid metal conduit, RMC, or liquid tight flexible conduit, with Myers hubs at both ends of the conduit. Conduits shall enter the enclosure only from the bottom.
12. At time of Substantial Completion, Contractor shall furnish a schematic diagram of intra-enclosure wiring and a complete bill of materials for the enclosure and the devices located within. This documentation shall be placed by Contractor in a Contractor-furnished print pocket located on the inside of the enclosure door.

C. Intelligent System Controllers (ISC):
1. The controller shall communicate with the host via an on board 10/100/1000 Base T Ethernet port.
2. The controllers shall be a distributed architecture with full peer-to-peer networking capability. Parent/Child controller configurations are not acceptable. All controllers in the system shall be capable of operating in a standalone mode if communication is lost with the server or main controller. In no case shall a controller depend on communication with an upstream controller for proper standalone operation.
3. The communications bus shall be supervised for wiring integrity. If a communication failure is detected, the system shall report the loss. All controllers unable to receive communication shall operate as standalone devices including grant/deny decisions, complete with event buffers. All events shall be uploaded to the server upon restoration of communications.
4. The controllers shall utilize flash memory or similar technology, allowing program updates to be downloaded from the server. Program storage shall be in ROM.
5. The controllers shall have the capacity for 15,000 cardholders and 45,000 transactions. All access decisions involving these cardholders shall be made at the lowest controller level without communication to the server.
6. Handle all non-host related access control monitoring and decision making.
7. LED indicators for power, fault and communications.
8. Provide for local and global input/output linking:
    a. The SMS shall support a global linkage feature whereby any input/output/event shall be linked to any other input/output/event in the SMS. Input/output linkages shall be able to span across intelligent system controllers.
    b. System administrators shall be able to create global input/output function lists, each consisting of a sequence of actions to be performed, such as changing card reader modes, activating outputs, and opening or closing anti-pass back areas. Each function list may include up to six actions.
9. Reporting of transactions and status information to the server.

10. Interface with standard reader technologies without special interface hardware, additional logic panels or other integrators. Supported technologies shall include:
    a. 13.56 MHz Contactless Smart with or without biometrics or keypad
    b. 13.56 MHz Multi-technology Smart
    c. Proximity, with or without keypad
    d. Magnetic stripe, with or without keypad
    e. Wiegand
    f. Bar code
    g. Keypad
    h. Biometric, with Wiegand output

D. Reader Interface Module (RIM):
1. Reader interface modules are not shown on the plans. Refer to the installation section of this specification for allowable equipment mounting locations. It is the responsibility of the Contractor to determine the number and configuration of reader interface modules required based on the inherent characteristics of each product line and the requirements and restrictions described in this document.
2. RIM shall interface with and accept data from TTL, Wiegand and RS-485 type readers and door hardware.
3. RIM shall provide a minimum of three (3) inputs per portal for portal position, request to exit and auxiliary input.
4. RIM shall provide a minimum of two (2) outputs per portal for locking device and auxiliary output. Each output shall be Form C and shall be rated at 3A at 28VDC.
5. RIM shall communicate to controller by RS-485.

E. Input Control Module (ICM):
1. The input control module shall provide supervised and non-supervised alarm input zones and monitor/report line fault conditions, alarm conditions, power faults and tampers.
2. Input control modules are not shown on the plans. Refer to the installation section of this specification for allowable equipment mounting locations. It is the responsibility of the Contractor to determine the number and configuration of input control modules required, based on the inherent characteristics of each product line and the requirements and restrictions described in this document.
3. UL 294 and 1076 listed.
4. Each input configurable for normally open or normally closed.
5. Each input configurable for timing.
6. Each input configurable for end of line resistance.
7. Status LEDs for communication to the host, heartbeat and input status.
8. Communications line supervision.
9. AES 128 bit encryption.
10. 2-wire RS485 communications.
11. No fewer than eight (8) inputs per board/control module.
12. Alarm Masking: The ability to mask the alarm input on a time zone basis.
13. Activate Output: The ability for any input to activate any output.
14. Configuration of Debounce Time: The ability to control the amount of time that an input state change must remain consistent in order for it to be considered a real change of state.
15. Elevator control support for number of floors shown on the drawings.
16. Global Linkage: The ability to link outputs with inputs that are attached to any ICM/output control module (OCM).
17. Checkpoint: The ability to configure an input as a designated stop on one or more guard tours.

18. Entry/Exit Delay: The ability to set up entry/exit delays for inputs that are attached to any ICM. This shall include:
    a. Non-Latched Entry: When an input activates, the alarm will not be reported until the entry delay expires. If the input is still active when the entry delay expires, the alarm will be reported. If the input is not active when the entry delay expires, then the alarm will not report.
    b. Latched Entry: When an input activates, the alarm will not be reported until the entry delay expires. If the input is still active when the entry delay expires and the alarm has not been masked, the alarm will be reported. If the input has been masked when the entry delay expires, then the alarm will not report.
    c. Exit Delay: When an input activates, the alarm will not be reported (operates as if masked) until the exit delay expires. If the input is still active when the exit delay expires, the alarm will be reported. If the input is not active when the exit delay expires, the alarm will not be reported.

F. Output Control Module (OCM) and Functionality:
1. Output control modules are not shown on the plans. Refer to the installation section of this specification for allowable equipment mounting locations. It is the responsibility of the Contractor to determine the number and configuration of output control modules required, based on the inherent characteristics of each product line and the requirements and restrictions described in this document.
2. The output control module(s) shall provide Form C relay contacts for load switching, rated at 3A at 28VDC.
3. Each relay shall support "On" "Off" and "Pulse."
4. Outputs can be pulsed from 0.1 seconds to 24 hours.
5. Status LEDs for communication to the host, heartbeat and relay status.
6. 2-wire RS485 communications.
7. No fewer than eight (8) outputs per board/control module.
8. Communications line supervision.

2.03 APPLICATION SOFTWARE

A. General Performance:
1. The application software, in conjunction with the associated hardware, shall have the following features, functionality and capabilities. The functions that are to be implemented shall be determined in the planning conference between Contractor and Owner referenced in Part 3 of this section.
2. All Users:
    a. All users shall be capable of being authenticated against Active Directory using LDAP before being granted system access. Should the Owner not use Active Directory, the system shall provide a built-in login and credential management tool to permit rules-based access rights on a per-user basis.
    b. The access rights shall be selectable on a per-user basis. In addition, user groups shall be capable of being assigned whereby each user group has a common set of access rights. Users shall be capable of being assigned to these user groups by the system administrator.
3. Operators:
    a. Operator Groups: A minimum of 32 operator groups, allowing specific system module privileges to be accessed with each module being granted specific views, edit and execute privileges.
    b. Operator Levels: System access shall require a valid login using an electronic credential. , governing a specific operator's level of access to each menu item.

c. The SMS shall allow a system operator to login over another system operator who is already logged into the same client workstation without the need to reboot the system. This process shall log the first system operator off alarm monitoring and log the new system operator on, changing any permission necessary for that system operator.

4. Logs, Status, Maintenance, Diagnostics:
   a. Historical Log: The system shall allow event history to be written to the hard disk in an archive format. At a minimum, the system shall support 500,000 transactions. Warning messages shall be generated at a user defined level of capacity. The system shall have the ability to offload the archive files to removable media automatically or manually.
   b. System Status: The system shall query the status of any or all of the system's access control points, inputs and outputs.
   c. System Maintenance/Diagnostics: The system shall provide for remote diagnostic capabilities. In addition, online diagnostics and communications maintenance shall be able to be activated from the operator interface.
5. Administrator:
   a. The SMS shall provide system administrators with the ability to segment their access control SMS field hardware devices into various zones or areas where alarm monitoring client workstations will monitor. These zones shall be assigned an alphanumeric name using up to a minimum of 64 characters.
   b. The SMS shall allow other devices such as card readers, input and output modules and intelligent system controllers to be automatically part of the monitoring zone when an intelligent system controller is selected, and it shall allow the system administrator to define which devices such as card readers, etc. belong to that monitor zone.
   c. Updating of monitor zones shall take place in real time and without requiring operators to re-login.
6. General:
   a. Elevator control support for the number of floors and cabs shown on the drawings.
   b. The SMS shall use an open architecture where all data must reside on a single database and must be accessible in real time to every SMS workstation or web-based client connected to the network. The system database shall be used to create and maintain the cardholder database. A screen designer module shall allow the creation and editing of custom database tables and data entry screens.
   c. The SMS shall be able to connect to and interface bi-directionally with external data sources using all of the following methods:
      1) ASCII with support for XML-formatted text exchange of data activated both manually and automatically.
      2) ASCII with support for XML-formatted text exchange of data using a direct table interface activated both manually and automatically.
      3) Real time exchange of data via Active Directory/LDAP utilizing an API supported by the SMS manufacturer. The live exchange of data shall permit exposure of SMS events and transactions to other data sources in real time and allow for receipt of data into the SMS, permitting this data to be acted upon and trigger linked events in the SMS in real time.
   d. Security: Access privileges within the application software shall be permitted by use of a password protection system. The cardholder database shall have the following password security levels.
      1) A minimum of six (6) unique operator access levels
      2) Ability to view only the database fields

3) Ability to restrict operator viewing to any of the individual database screens within a record
4) Ability to restrict operator viewing to any of the database partitions

e. Cardholder Configurations: Each cardholder shall be capable of having up to five (5) access levels actively assigned to their account.
f. The system shall have cardholder identifications for "Visitor" and "Escort", with an associated optional validity period assignable with an activation and deactivation date.
g. The cardholder database screen shall have the following data associated with each cardholder:
1) Last edit by operator with edited date and time
2) Last date/time card was used
3) Last reader giving valid access
4) Last reader denying access
5) Anti-pass back status
h. The system shall provide advanced query capability with the following search criteria: equal to, not equal to, greater than, greater than or equal to, less than, less than or equal to, like, is empty, is not empty, is between, and, or, not.
i. Access Control Configuration: The configuration application shall be password protected, restricting what each individual may edit or display inside the configuration application.
j. Text descriptions of access points such as doors.

7. Time Zones:
a. The SMS shall be capable of creating and storing up to 255 time zones. Each time zone shall have a minimum of six (6) intervals. Each interval shall be assignable to any day of the week.
b. Each time zone shall be assignable to an alphanumeric name. Time zones shall be applied to access levels, card reader modes, alarm inputs, alarm outputs, and alarm masking and logging functions. Time zones shall be allowed to belong to any or all access levels so that the time zone only has to be defined once.

8. Access Levels:
a. The SMS shall be capable of defining a minimum of multiple access levels per cardholder.

9. Temporary Access Levels:
a. The SMS shall be capable of assigning temporary access levels inclusive of the assignable access levels.

10. Access Groups:
a. The SMS shall be capable of assigning access groups.
b. Each access group shall be assignable to an alphanumeric name.

11. Precision Access Levels:
a. The SMS shall be capable of assigning precision access levels in addition to the access levels, with the ability to assign unlimited card reader and time zone combinations. Precision access levels provide capability of assigning a unique access level on a per card basis.
b. Each precision access level shall be assignable to an alphanumeric name.

12. Holidays:
a. The SMS shall provide holiday assignments using an embedded calendar. Access rights, card reader modes, and alarm masking schedules must be able to be altered when the current date is designated as a holiday.
b. Dates for Daylight Saving Time changes shall be definable and shall take effect automatically.

c. The SMS shall support holiday ranges that allow a single holiday to span across multiple calendar days.

13. Field Hardware Communications:
    a. The SMS shall support communications with the intelligent system controllers (ISCs) by the following protocols:
        1) RS-232
        2) RS-485
        3) TCP/IP
        4) Open Supervised Device Protocol (OSDP)
    b. Upon loss of communications between the SMS server and the ISC, an alarm shall be created with a time stamp. Upon re-established communication, the SMS and the ISC shall automatically re-synchronize from the point of communication loss without operator intervention.
14. Dual Path Field Hardware Communication:
    a. The SMS shall support dual path communications between the SMS server and the ISCs. This shall allow for a redundant communication path in the event the primary path fails. The secondary path shall support all primary path protocols.
    b. In the event of a communication failure of the primary path, the ISC shall initiate a switchover to the secondary path. During this fail switchover period, the ISC shall periodically check to see if the primary path has been re-established and will automatically switch back upon a successful connection. Alarms shall be generated upon loss or restoration of communications.
15. Area Control:
    a. Area control shall be a security method of preventing a person from passing their credential to another person for dual entry into a single location using one card. The SMS shall support the following area control features.
    b. Global Hard Anti-Pass Back:
        1) The Global Hard Anti-Pass Back feature shall require that a credential always be used to enter and exit an area. The controlled areas shall have both entry and exit card readers at all portals. Entry and exit readers shall be able to span across multiple ISCs. Areas shall be logically defined under the SMS, and area control shall not be required at all areas. Global Hard Anti-Pass Back shall work in the following manner:
            a) A cardholder must present his/her credential at the entry card reader of the area that the person wishes to enter. Once access has been granted into the area, the cardholder cannot present the credential to another entry card reader within the same area without first presenting his/her credential to the respective exit card reader of that area. Should a cardholder attempt to use any other card reader in the same area besides the occupied area's exit card reader once access has been granted to that area, the cardholder shall be denied access and an alarm shall be reported to the alarm monitoring client workstation. Nested control areas (areas inside areas) shall be definable with a minimum of 64 entry and exit card readers. It shall be possible to have an area within an area and/or multiple areas that are independent of each other in which Global Hard Anti-Pass Back rules shall apply.

c. Global Soft Anti-Pass Back:
   1) The Global Soft Anti-Pass Back feature shall require that a credential be used to enter and exit an area. The controlled areas shall have both entry and exit card readers at all portals. Entry and exit readers shall be able to span across multiple ISCs. Areas shall be logically defined under the SMS, and area control shall not be required at all areas. Global Soft Anti-Pass Back shall work in the following manner:
      a) A cardholder must present his/her credential at the entry card reader of the area that the person wishes to enter. Once access has been granted into the area, the cardholder cannot present the credential to another entry card reader within the same area without first presenting his/her credential to the respective exit card reader of that area. Should a cardholder attempt to use any other card reader in the same area besides the occupied area's exit card reader once access has been granted to that area, the cardholder shall be allowed access (if that cardholder has the appropriate access level to access the new area), and an alarm shall be reported to the alarm monitoring client workstation. It shall be possible to have an area within an area and/or multiple areas that are independent of each other.
d. The following summary criteria shall apply under Global Hard or Soft Anti-Pass Back:
   1) Initially all card holders are reset to Area 0.
   2) Any cardholder shall enter a controlled area any time after Time 0 by presenting a credential to a SMS entry card reader.
   3) A cardholder shall not exit the controlled area unless he/she has entered the area presenting a credential to the SMS entry card reader.
   4) A cardholder shall not enter the controlled area a second time unless the cardholder has exited that area previously.
   5) A cardholder shall be able to enter through any entry card reader and exit through any exit card reader of a single controlled area.
   6) These options shall include a "forgiveness" feature that will allow the system administrator to reactively reset the anti-pass back of all cardholders to Area 0, either through a manual override or a time zone command.
   7) The SMS shall provide an anti-pass back exempt option for privileged or VIP cardholders. Cardholders with this option will not have anti-pass back rules applied to them.
   8) The SMS shall also have a "forgiveness" feature that will allow the system administrator to proactively assign an automatic reset to an individual cardholder. This shall allow the system administrator to reset the anti-pass back of an individual cardholder to Area 0 automatically for a defined number of times.
e. Timed Anti-Pass Back:
   1) Timed Anti-Pass Back shall allow the system administrator to decide how long after a cardholder has presented their credential that they will have to wait before the same credential will be accepted again at the same card reader. This helps prevent multiple swipes by an individual to allow access to others through turnstile doors.
f. Two-Person Control:
   1) Two-Person Rule shall be provided to restrict access to certain areas unless there are two (2) cardholders present. This restricts individuals from being alone in restricted or highly secure areas. When an area is configured for Two-Person Rule, the following criteria shall prevail:

a) The card reader shall grant access only if two valid cardholders (with authorized access levels) swipe their credentials one after the other. In the event a second authorized card is not presented within 10 seconds of the first authorized credential, the card reader shall reset and the first card will have to be swiped again.
b) Once two people occupy an area, individual access shall be granted.
c) Individual exit shall be permitted until an area is occupied by only two cardholders, at which point the Two-Person Rule applies for exit.

g. Mustering:
1) The SMS shall support Mustering functionality. The Mustering function shall provide an automatic capability for registering cardholders that are on site during an incident. Designated exit and entry card readers shall be used to enter and leave hazardous locations and safe locations. When an incident occurs, a muster report shall be generated that consists of a listing of all personnel that are within the hazardous locations, as well as all personnel that have registered in a safe location.

h. Alarm Masking Groups:
1) The SMS shall support a group alarm masking feature whereby system administrators shall be able to create groups of alarm inputs that enable them to mask or unmask multiple input control module inputs and card reader inputs simultaneously.
2) The following events shall have the ability to be part of an alarm masking group:
a) Input Control Module Events
b) Alarm Input Active
c) Card Reader Events
d) Auxiliary Input Active
e) Denied Count Exceeded
f) Door Contact Tamper
g) Door Forced Open
h) Door Held Open
i) Card Reader Input Tamper
3) Alarm Masking Groups shall be able to be masked as a group or as individual points.
4) Alarm Masking Groups must support the ability to be masked multiple times. Alarm Masking Groups shall be able to be masked and/or unmasked via alarm monitoring commands by guards, via card reader keypad function keys, or via global linkage commands.
5) The SMS shall support "2-man control" for masking Alarm Masking Groups.
6) The SMS shall support an Alarm Masking Group status change (masked to unmasked or unmasked to masked) action to be linked to a function list that is capable of performing many system actions, such as activating a relay output. The SMS shall support a minimum of 64 Alarm Masking Groups per intelligent system controller. with a minimum of 200 alarm inputs per Alarm Masking Group.

i. Cardholder Escort Control:
1) The SMS shall support comprehensive escort functionality based upon access levels. Access levels shall include options for "Escort Required", "Designated Escort", "Not an Escort" and "Does not require an Escort." Contractor shall integrate escort level and designation into badge design in cooperation with Owner.
2) The escort feature shall be capable of one-to-one and one-to-many Escort to Escorted functionality.

j. Cardholder Use Limits:
   1) The SMS shall support a Cardholder Use Limit feature that shall allow system administrators to specify the maximum number of times that a cardholder may use their credential at card readers in the SMS.
k. Extended Individual Strike Times:
   1) The SMS shall support Extended Individual Strike Times that allows a card reader's strike to be active for an extended period of time beyond the pre-determined standard strike time on a per cardholder basis. The extended strike time shall be user definable up to 255 seconds. Extended strike times shall be set on a card reader by card reader basis.
l. Extended Individual Door Held Open Times:
   1) The SMS shall support Extended Individual Door Held Open Times that allow a card reader's door to be held open for an extended period of time beyond the pre-determined standard held open time on a per cardholder basis. The extended held open time shall be user definable up to eight (8) hours. Extended held open times shall be set on a card reader by card reader basis.
m. Extended, On Demand, Door Held Open Times:
   1) The SMS shall support Extended, On Demand, Door Held Times via a command keypad located in the field. The Extended Held Open command configuration shall consist of a command key sequence that shall be from three to six keys used to enter the number of minutes to extend the door held open time (up to 999 minutes) and a pre-alarm time (from 0 to 30 minutes).
   2) Only those cardholders having command authority at a given card reader configured for 'Allow User Commands' shall have the ability to execute the Extended Held Open command at that card reader. The Extended Held Open command shall be available after a valid cardholder has received an access grant at the card reader. The cardholder shall have a period of 15 seconds after the access grant to enter the extended held open command sequence.
n. Elevator Control:
   1) The SMS shall support Elevator Control using standard access control field hardware.
   2) For card readers placed within elevator cabs, Elevator Control shall permit the restriction of cardholder access to certain floors while also allowing general access to other floors.
   3) For card readers placed in elevator lobbies, Elevator Control shall permit the restriction of cardholder access from calling the elevator using the elevator call buttons until an allowed credential is presented at the card reader.
   4) The feature shall allow, at the elevator, the use of any card reader and all card reader modes used on any other card reader in the SMS. Each elevator card reader shall control access for the number of floors shown on the plans.
   5) The SMS shall be able to track which floor was selected by an individual cardholder for auditing and reporting purposes.
o. Graphical System Overview Tree:
   1) A Graphical System Overview Tree shall display a graphical representation of all field hardware System administrators shall be able to modify a device that is depicted on the Graphical System Overview Tree or see its properties by double clicking on the icon, and the SMS shall bring them to the appropriate form.
p. Pre-Alarm:
   1) The SMS shall support a Pre-Alarm feature at the card reader. The pre-alarm will sound a tone at the card reader prior to the door held open alarm. The pre-alarm setting shall be configurable for up the maximum allowable door hold open time.

q. Alarm/Event Logging:
   1) All alarms and events in the SMS shall, by default, always be recorded in the database. The SMS shall give system administrators the ability to select, on a time-zone basis, the times that they require the SMS to log specific events to the database.
   2) System administrators shall have the option for particular alarm/events to be set to log or not to log on any individual reader and/or input.

r. Scheduling Utility:
   1) The SMS shall provide an integral Scheduling Utility. The Scheduling Utility shall allow system administrators to schedule actions to occur on a one-time or a recurring basis. Recurring schedules shall be configured to begin immediately, last indefinitely, or have optional start and end dates.
   2) The Scheduling Utility shall be available from both the system administration and alarm monitoring modules.
      a) The types of actions that shall be schedulable include, but are not limited to:
      b) Action Group
      c) Event Archiving/Purging
      d) Arm/Disarm Area
      e) Start of Guard Tour
      f) Execution of Scripts
      g) Activate, Deactivate, Pulse Device Output and Device Output Groups
      h) Global Anti-Pass back Reset
      i) Download Firmware to equipment.
      j) Download Database to ISCs
      k) Execute Function List
      l) Mask/Unmask Inputs, Input Groups, Alarm Mask Groups, Door Forced Open or Held Open
      m) Open Door, Open Door Group
      n) Change Reader Mode
      o) Automatic Reports
      p) Reset Use Limit
      q) Move Bulk Credentials from an Area
      r) Deactivate Credentials
      s) Logout Visitors
      t) Schedule PTZ Presets
   3) The Scheduling Utility shall maintain a history log in the database for actions that it executes.

16. Multiple Card Formats:
    a. Each ISC shall support a minimum of eight (8) access control card formats and, if applicable, eight (8) asset formats.
17. Card Reader Cipher Mode:
    a. The SMS shall support a Card Reader Cipher Mode that shall allow authorized cardholders to enter their credential ID by typing it into a card reader keypad, thus emulating the presentation of the credential to the card reader.
18. Denied Access Attempts Counter:
    a. The SMS shall support a Denied Access Attempts Count on a per card reader basis. The "Denied Attempts Count" value shall be configurable from 0 to 255. The following access denial types shall cause the current denied count to be incremented:
       1) Unknown PIN entry at a card reader configured as 'PIN or Card' mode.
       2) Invalid cipher entry at a card reader in Cipher Mode.

3) Invalid PIN entered for a given card at a card reader configured as 'Card and PIN' mode.
4) Non-matching biometric presented for a given card at a card reader in Biometric Verify mode.

19. Card Reader Time Zone Overrides:
    a. The SMS shall allow for the pre-defined default card reader settings to be overridden or temporarily changed on a time-zone basis. At the beginning of the selected time zone, the selected card reader's operational mode shall be modified from its default mode to any one of the following modes: Locked, Unlocked, Facility Code, Card Only, Card or PIN, Card and PIN, Card and Biometric, Card or PIN and Biometric, and/or Card and PIN and Biometric. The aforementioned options shall be available depending on the type of card reader used.
    b. Each card reader shall have the ability to have multiple time zone setting overrides assigned to them as required by the system administrator.
20. Alarm/Event Routing:
    a. The SMS shall be capable of allowing system administrators to route alarms and events to various alarm monitoring client workstations on the network. The SMS shall allow any alarm or event to be routed to one or multiple client workstations on the network regardless of where the alarm is generated in the field. Alarms shall be routed to client workstations on a device-by-device level.
    b. The SMS shall be capable of automatic re-routing of an alarm from workstation X to workstation Y if the alarm is not responded to within a user definable time period.
    c. The SMS shall implement network synchronization such that in the event that an alarm is routed to multiple client workstations, once the first client workstation acknowledges the alarm, the alarm shall be cleared from all other client workstations. As such, alarms that are routed to an Alarm Monitoring client workstation that does not have a System Operator logged in shall be queued so that all unacknowledged alarms will report to that client workstation once a System Operator has logged into the SMS. Alarms/Events shall be routed based on default settings or time zone control.
21. Alarm Attributes:
    a. The system administrator shall have the ability to configure how the SMS handles the annunciation of alarms on an individual basis. Each alarm and/or event shall have the option(s) to:
        1) Display at one or more alarm monitoring client workstation.
        2) Allow higher priority alarms to be displayed on the alarm monitoring client workstation ahead of lower priority alarms.
        3) Require the field device that generated the alarm to be restored to its normal state before the alarm is cleared.
        4) Print the alarm to the local event printer.
        5) Have a customized voice message annunciate at the client workstation.
        6) Have the alarm breakthrough to the alarm monitoring window should the system operator be working in another application
        7) Allow system operators to change the journal entry once the alarm has been acknowledged.
        8) Ensure that the alarm will not be able to be deleted from the alarm monitoring window upon acknowledgment.
        9) Display text and audio instructions outlining the procedures to follow when responding to the alarm.
        10) Automatically call-up associated maps.
        11) Automatically call up the associated cardholder record.

12) Automatically call up the associated cardholder photo using the video verification function.
13) Require a password to view the alarm.
14) Require a password to acknowledge the alarm.
15) Require acknowledgment to clear.
16) Allow mandatory journal entry upon acknowledgment.
17) Use pre-defined journal entries for alarms.
18) Select the option for journal entry based upon the specific alarm.
19) Send surveillance interface commands to the surveillance system.
20) Automatically send an e-mail message.
21) Automatically send an alphanumeric page.
22) Have the alarm appear on the alarm monitoring window with a flashing colored coded bar across the alarm for high priority alarms.
23) Have the alarm, when acknowledged, display an alternative flashing color coded bar across the alarm than for the original alarm color.
24) Trigger a function list(s) when the alarm is acknowledged.
25) Require user logon for acknowledgment.
26) Have the ability to mark an alarm as "In Progress" where the system shall silence any repeating audio notifications on the workstation where the alarm was routed, and remove the alarm sprite notification on the graphical map. Additional operators' monitoring alarms shall be notified that the alarm has been marked "In Progress".

22. Alarm-Event Mappings:
    a. The SMS attributes in Alarm Attributes shall be assignable on a 'global' basis to all devices that share an alarm description. Thus, the 'Door Forced Open' alarm attributes shall apply to any door with a card reader that is forced open in the SMS. The SMS shall have the capability to assign a unique group of alarm attributes to specific device/alarm combinations to override the global settings for specific case settings. Each device/alarm combination shall have the ability to have its own unique attribute set if the system administrator desires.
23. System Downloads:
    a. The SMS shall provide for the downloading of data to the ISCs. Downloads shall load SMS information such as time zones, access levels, alarm configurations, cardholder information and card reader configurations.
    b. All ISCs on the SMS shall be capable of either full or selective downloads to individual intelligent system controllers, and bi-directionally so that alarms will still report to their respective alarm monitoring client workstations as cardholder information is being downloaded.
    c. Information on cardholder status, credential status, time zones or access levels shall download in real time as they are added, modified, or deleted from the SMS.
24. Portal Configuration Options:
    a. The SMS shall include the following options for each portal on the system:
        1) Allow user commands such as manual door unlock
        2) Rename auxiliary inputs
        3) Rename auxiliary outputs
        4) Independently supervise REX and DPS
        5) Configure REX and DPS as Normally Open or Normally Closed
        6) Deny if duress
        7) Assume door used
        8) Alarm masking
        9) Activate outputs

10) Two card control
11) Checkpoint
12) Do not activate strike on REX
13) The ability to allow system administrators to determine on a time-zone basis to log or not to log on a card reader by card reader basis
14) Access grants
15) Access denied
16) Card reader status alarms
17) The SMS shall allow for user definable door strike functionality for each card reader in the SMS
18) The SMS shall allow for each card reader to be selected as either an 'In' reader, 'Out' reader, or 'None' to allow for ease of reporting time and attendance basic 'Time In' and 'Time Out' data.
19) Enforce Use Limit: This option shall enable card use limits at the card reader. limiting the number of times that cardholders may use their credential to gain access at the card reader
20) Supervise Door: Sets the SMS so that the card reader door contact is wired as a supervised input

25. The SMS shall allow for one or more access points in a specified area to be armed and disarmed directly from a control keypad.
26. Real-Time, Live Video User Verification:
    a. The SMS shall have the capability of interfacing to a surveillance system and displaying a live video image next to a stored cardholder image record. This feature shall be system configurable.
27. Traces:
    a. The SMS shall allow for a live or historical trace on any ISC, ICM, alarm input, credential (cardholder), intrusion detection device, monitor zone, or card reader. If applicable, the SMS shall allow for a trace on any asset, intercom, or camera. Multiple traces may be run simultaneously. The SMS shall allow system operators to filter alarm types from the history trace window. Alarms that shall be filtered from the trace window are access granted alarms, access denied alarms, system alarms, duress alarms, and area control alarms.
    b. Destination Assurance: The system shall provide the ability to alert the system operator when a cardholder does not reach a required location and present their credential after entering at a designated checkpoint in a designated period of time.
28. Real-Time, Dynamic Graphical Maps:
    a. The SMS shall support graphical maps that display device and group status, function lists and video cameras dynamically in real time. The maps may be configured to appear on command or when specified alarms are selected for acknowledgment. Map device icons shall have the ability to dynamically change shape and/or color to reflect the current state of the device.
    b. The SMS shall support all map formats listed below:
        1) Adobe Photoshop (.psd)
        2) AutoCAD DXF (.dxf)
        3) Encapsulated Post Script (.eps)
        4) JPEG (.jpg)
        5) TIFF (.tif)
        6) Windows Metafile (.wmf, .emf)
        7) Windows Bitmap (.bmp, .dib)

c. The SMS shall support map hierarchies or maps within maps. There shall be no limit to the number of maps that shall be nested hierarchically with each other. Multiple maps may be displayed simultaneously.
d. The SMS shall support user defined icons for field hardware devices. The SMS shall also give system operators the ability to affect the mode of card readers, open doors, start a trace on a device, mask/unmask alarm inputs, and activate/deactivate/pulse an output from the map icons.
e. The graphical maps shall have the ability to be printed to a local printer.

2.04 ACCESS CONTROL GRAPHICAL USER INTERFACE (GUI)

A. A workstation based custom GUI shall be provided for complete display of real time system activity.

B. The GUI shall provide the following features:
1. Display in real-time, the status of devices by dynamically changing shape or color to indicate status.
2. Acknowledge alarm conditions.
3. Perform manual operations on all monitor and control points.
4. Perform graphic editing functions.
5. Customization of icons color or shape based on status.

C. Graphical representations shall be made of the following activity:
1. Cardholder Activity: Access granted (including duress), access denied, lost card used, stolen card used, inactive card used, unescorted visitor.
2. Input Point Activity: Input condition (normal, abnormal, cut, short, shunt, unshunt).
3. Output Point Activity: On status (automatic, by operator, by link), off status (automatic, by operator, by link), access level on, access level off.
4. Door Activity: Auto unlock, auto lock, closed, opened, forced open, left open, door switch cut, door switch shorted, REX status (cut, shorted, normal, abnormal), input unlock, operator lock, operator unlock.
5. Controller Activity: Controller on-line, controller off-line, controller communications normal, communications cut.
6. System Activity: System error, workstation start, workstation stop, printer off-line, printer unavailable, printer overflow, unknown card.
7. Regional Group Activity: Occupancy restriction (high limit, low limit), anti-pass back (entry, exit), policy violation, escort left, number of escorts, numbers of users, number of visitors.

D. The GUI shall display custom graphical screens, developed by the SMS vendor with electronic maps provided by Owner.

E. The system shall have the ability to automatically call up specific maps. Each input point shall be linked to a primary map.

F. Graphical editing software shall be included, allowing the Owner to create and edit the graphical screens.

G. Graphics screens shall be developed using a minimum of eight (8) colors from a palette of 64 available.

H. The system shall operate on a Windows workstation as provided and recommended by the SMS vendor.

I. Credentials:
1. Contactless Smart Cards: 13.56 MHz radio frequency identification electronics, passive design. Card shall meet ISO 15693 and ISO 14443B2 standards.
a. Maximum Dimensions: CR 79: 3.313" x 2.063" x 0.04", CR 80: 3.375" x 2.125" x 0.04".

b. Construction to be of PVC or polyester laminate
c. Each card shall contain a unique serial number.
d. Cards shall contain options for various memory capacities of 2k, 16k or 32k with a fixed number of application areas or areas which are sized by dynamic allocation.
e. Each application area shall contain a unique authentication key. The card and reader shall require matching keys in order to function together. All RF communication between card and reader shall be encrypted using a secure algorithm.
f. The card shall be protected with DES or 3DES encryption algorithms.
g. The cards shall be provided with custom keys uniquely matched to individual sites/customers to allow a non-interchangeable, high level of security through the use of formatting programs such as HID iClass Elite or Corporate 1000.
h. Cards shall be encoded with bit lengths that are compatible with all other components of the SMS.
i. Cards shall support programming and updating of custom applications after issue.
j. Cards shall be capable of having a photo and/or other graphical images printed directly on the surface of the card.
k. Provide optional slot punch-outs on the short and long edge of the card.
l. Provide multi-technology cards. Cards shall be individually numbered with sequential matching of internal and external numbers.
m. Cards shall be provided with a lifetime warranty; 15 months for the magnetic stripe.
n. Each credential shall contain a unique serial number.
o. Credential shall contain at least three memory capacities from 2k, 4k, 8k, 16k or 32k with associated allocation areas.
p. Each application area shall contain a unique authentication key. The credential and reader shall require matching keys in order to function together. All RF communication between the credential and reader shall be encrypted using a secure algorithm.
q. Credential shall be protected with DES or 3DES encryption algorithms.
r. The credentials shall be provided with custom keys uniquely matched to individual sites/customers to allow a non-interchangeable, high level of security through the use of HID iClass Elite formatting program.
s. The credential shall support programming and updating of custom applications after issue.
t. The credential shall be marked with an external ID number, either in inkjet or laser-etched numbering that matches the internal programmed ID number. If the external number does not match the internal number, a cross-reference chart shall be provided to the Owner.
u. Credential shall be provided with a lifetime warranty.

J. Credential Management:
1. The SMS shall support a Credential Management and Enrollment module that is integral to the SMS source code with the ability to create and maintain the cardholder database. Features shall include the ability to:
a. Add, modify and delete records based upon permissions
b. Capture photo images, biometric information and signatures
c. Print credentials
d. Boolean search on any single or multiple fields
e. Customization of screen layout and field names
f. Advanced customization of fields, field names and screen tabs (pages) with optional Forms Designing and Editing module
g. Determine single or multiple active credentials
h. Assign access levels and access groups

i. Bulk assignment/modification/deletion of access levels
j. Bulk deletion of cardholder records.
k. Native support for U.S. Government CHUID Standard
l. Limit the number of times the credential can be printed
m. Limit the access for searching the database based upon user defined criteria
n. Mobile badging operations.

2. The SMS shall support the following bar codes:
   a. Code 3 of 9 (3:1)
   b. Code 93
   c. UPCA
   d. EAN 13
   e. EAN 8
   f. Code 128 A
   g. Code 128 B
   h. Code 128 C
   i. Codabar
   j. PostNEt (Zip + 4 Postal)
   k. Code 3 of 9 (2:1)
   l. Interleaved 2 of 5 (2:1)
   m. PDF-417 (2D)
   n. Code 128 Auto
   o. UCC-128
   p. MSI Plessey
   q. Extended Code 3 of 9
   r. Extended Code 93
   s. 2D Aztec

2.05 PORTAL DEVICES

A. Credential Readers:
   1. Manufacturers:
      a. Identiv Utrust TS readers
   2. Multi-Technology:
      a. Compatible with 125 kHz proximity, 13.56 MHz Contactless Smart card, MIFARE, DESFire EV1.
      b. Backwards compatibility with legacy 13.56 MHz Contactless Smart cards and 125 kHz proximity access control formats, including 26, 32, 35, 37 bit as well as HID Corporate 1000 format.
   3. Card readers manufactured specifically for non-access control applications shall not be acceptable.
   4. FIPS 201 compliant.
   5. Provide compatibility with most access control systems by providing card data outputs in Wiegand and Clock/Data.
   6. Allow the firmware to be updated in the field without the need to remove the reader from the wall.
   7. Secure mounting methods using tamper resistant screws.
   8. An audio beeper that provides various tones to signify access granted, access denied, power up and diagnostics.
   9. Tri-color LED or three (3) LEDs for visual notification of various conditions.
   10. ISO1443A, 1443B and 15693 compliant.
   11. The ability to transmit an alarm from an integrated tamper switch.

12. Support dual authentication of identity through the combined use of access badge and personal identification number (PIN) on an integrated 12 key keypad.
13. PBT polymer or UL94 polycarbonate.
14. Read Range:
    a. Using 125 kHz cards or 13.56 MHz Contactless Smart cards, minimum operational read range shall not be less than one (1) inch after the readers have been installed in their permanent locations.
15. Operational voltage of 5-16 VDC, with operating temperature range of -31° F to 150° F, and rated for outdoor use with a minimum rating of IP55.
16. Readers and credentials shall be compatible with each other and shall be from the same manufacturer.
17. Available in sizes to be mounted to a standard single gang box or to a mullion. Maximum sizes:
    a. Single gang box mount, with or without keypad: 5.1" x 3.1" x 1.1"
    b. Mullion mount: 6.0" x 1.9" x 0.9"
18. Lifetime warranty against defects in material and workmanship.

B. Request-To-Exit Motion Detector:
1. Manufacturers:
    a. Bosch DS 160 Series
    b. Pre-approved equal
    c. Refer to drawings for approved manufacturers.
2. Door monitor with sounder alert. Sounder alert shall have adjustable volume.
3. Adjustable latch time.
4. Selectable fail safe/fail secure.
5. Activation LED.
6. 12 or 24 VDC operation.
7. Sequential logic input.
8. Two (2) Form C contacts.
9. Tamper switch.
10. Field of view masking.

C. Request-To-Exit Button:
1. Manufacturers:
    a. Dynalock 6290 Series
    b. Seco-Larm SD7213 Series
    c. RCI 991 Series
    d. Pre-approved equal
    e. Refer to drawings for approved manufacturers.
2. 0-60 second adjustable pneumatic action.
3. Contacts shall be one of the following:
    a. DPDT
    b. SPDT double break with isolated common
    c. DPST
    d. Normally closed SPST with normally open SPST
4. One and one-half inches (1-1/2") to two inches (2") red mushroom button.
5. Stainless steel or aluminum plate labeled "EXIT" or "PUSH TO EXIT".
6. Available in mullion mount.

D. Door Position Switch:
   1. Manufacturers:
      a. GE
      b. GRI
      c. Honeywell
      d. Pre-approved equal
   2. Interior or Perimeter Door:
      a. One (1) inch or 0.75 (3/4) inch diameter, recessed
      b. DPDT contacts
      c. 0.75" to 1.25" (3/4" to 1-1/4") gap for wood door
      d. Maximum 0.375" to 0.625" (3/8" to 5/8") gap for steel door
      e. Basis of Design: UTC/GE/Sentrol 1076D
   3. Steel Door:
      a. A rare earth magnet shall be used.
   4. Cage/Gate:
      a. Maximum 1.5 (1-1/2) inch gap
      b. DPDT contacts
      c. Three feet (3') stainless steel armored cable
      d. Aluminum construction
      e. Basis of Design: UTC/GE/Sentrol 2507AD

E. Cable:
   1. Composite cable is allowed, although sufficient conductors may not be available in composite cables for all portal configurations. Contractor shall be responsible for additional required cables beyond one composite cable to each portal to meet functional requirements of the system.
      a. Reader: 18 AWG, 3 pair, stranded, overall shield. Shield shall be grounded at control panel end only.
      b. Request to Exit Motion Detector: 22 AWG, 4 conductor, stranded.
      c. Door Position Switch: 22 AWG, 2 conductor, stranded.
      d. Request to Exit Button: 22 AWG, 4 conductor, stranded.
      e. Lock: Minimum 18 AWG, 4 conductor, stranded.
         1) Lock may require heavier gauge cable depending on door hardware solution power requirements. Contractor shall coordinate with door hardware provider for higher current devices and shall adjust the gauge of the lock cable accordingly.
      f. Auxiliary Devices: Refer to plans for requirements.

F. Locks and Door Hardware:
   1. Electric/electronic locks shall be furnished and installed by the door hardware provider.
   2. Access Control Contractor shall interface with and terminate cables to locks.
   3. Access Control Contractor shall coordinate with door hardware provider for specified sequences of operation at the various portals.
   4. Electrified cylindrical and electrified mortise locks shall have an integrated request-to-exit device.
   5. Electric strikes shall have an integrated latch bolt monitor, and the dead latch shall be seated properly so that the strike cannot be defeated by manipulation.
   6. Magnetic locks shall have a magnetic bond sensor.
   7. Refer to architectural specifications and/or the architectural door schedule.

G. Intercom: Axis TI8202

2.06 INTERFACES AND INTEGRATIONS

A. Video Surveillance Integration and Interface:
   1. The SMS shall be required to integrate with the surveillance system.
   2. The SMS integration to the surveillance system shall be classified as a high-level interface. The supported surveillance system manufacturers shall be those listed in Section 28 2300. Dry contact closure or other low-level interface methods are not acceptable. The SMS shall be capable of passing alarm information via a Serial RS232 interface with any surveillance system that utilizes ASCII commands, or by a TCP/IP protocol interface using APIs. The two systems may be from different or the same manufacturers.
   3. Command information sent through the high-level interface shall include input point, door event, terminal controller points, operator events and system events, with the associated surveillance system commands.
   4. The SMS vendor shall be responsible for providing the interface programming in a protocol that is understandable by the surveillance system.
   5. The SMS to surveillance system integration shall perform the following:
      a. Display a live video image next to a stored cardholder image record upon presentation of an access badge to a reader.
      b. Any alarm event in the SMS shall have the ability to be associated with a video clip in real time, with configurable pre- and post-event recording duration.
      c. SMS alarm events shall be capable of triggering a defined video sequence of operation, such as camera movement to a preset position.
      d. PTZ control via the SMS, including activating presets and starting/stopping tours.
      e. Video alarm acknowledgement, such as motion detection, and alarm reset shall be supported from the SMS.
      f. In the SMS, display a tiled screen of operator-selected live images in a similar format as what is viewable via the video management system alone.
      g. Ability to view recorded images based on operator selected date, time and duration through the SMS.
      h. Linking of an access control event to a video clip so that clicking on an event begins playing of that clip.
      i. Ability to click on a camera icon on the SMS map to display live video from that camera and to select recorded video from the same camera.
   6. Should the integration fail or malfunction after installation, the systems shall be able to operate independently until the problem(s) is resolved.

B. Email Interface Option:
   1. The SMS shall support an email interface seamlessly integrated within the SMS alarm monitoring module. System operators shall have the ability to manually or automatically send ASCII text email messages from the alarm monitoring module on demand regarding any alarm currently displayed in the main alarm monitoring window. Emails shall have to ability to be sent to multiple email accounts if desired. The SMS shall integrate with Microsoft Exchange Server.

C. Elevator Interface
   1. The SMS shall provide a relay based interface to the elevator system consisting of:
      a. The credential reader shall be located on the outside of the cab. The car call button shall not be operational until a valid credential is presented to the reader. After valid credential presentation, the car call button shall be functional for a period of time programmed in the SMS. This functionality does not prevent tailgating.

b. The credential reader shall be located in the cab. No floor buttons shall be functional until a valid credential is presented to the reader, except those floors that are at the exit level(s) and access must be possible for life safety reasons. After valid credential presentation, buttons only for those floors associated with that card's SMS-programmed access level(s) shall be functional for a period of time programmed in the SMS. This functionality does not prevent tailgating.
c. The credential reader shall be located in the cab. No floor buttons shall be functional except those floors that are at the exit level(s) and access must be possible for life safety reasons. After valid credential presentation, the floor button associated with that card shall be automatically activated.

2. The SMS shall provide an optional seamless integration to Destination Entry/Destination Dispatch system.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with the manufacturer's instructions and recommendations for installation of all products.

B. Provide all system wiring between all components as shown on the project drawings or as directed by the manufacturer, whichever is the more stringent requirement.

C. Network controllers shall be installed centralized in the nearest telecommunications room(s). Mount controllers to the structural walls in a location coordinated with other utilities. Coordinate exact location with Architect/Engineer prior to installation. Provide dedicated +120 VAC power circuit to the controllers using #12 AWG wiring from the nearest electrical power distribution panel board.

D. Provide wiring and connection to all electrified locking hardware devices. Complete programming and testing of all electrified locking hardware devices.

E. Install all credential readers in accordance with manufacturer's instructions where shown on floor plans, in accordance with the Americans with Disabilities Act (ADA) requirements. Provide wiring and connection to all credential readers. Complete programming, adjustment, and testing of all credential readers.

F. Provide wiring and connection to all hardware request-to-exit devices that are integral to electrified door hardware. Provide wiring and connection to all request-to-exit motion detectors. Complete programming and testing of all integrated request-to-exit devices. Where possible, avoid false activation by persons passing by but not exiting.

G. Install all request-to-exit motion detectors in accordance with manufacturer's instructions directly above the door frame, centered on the door opening. Adjust sensitivity to permit operation on motion of persons within 2'-0" of door. Avoid false activation by persons passing by where possible.

H. Install all request-to-exit pushbuttons in accordance with manufacturer's instructions where shown on floor plans, in accordance with the Americans with Disabilities Act (ADA) requirements. Provide wiring and connection to all request-to-exit pushbuttons. Complete programming, adjustment and testing of all request-to-exit pushbuttons.

I. Install all door alarm contacts in accordance with manufacturer's instructions either recessed in the door header or surface mounted as required. Provide wiring and connection to door alarm contact devices. Complete programming, adjustment and testing of all door alarm contacts.

J. Install all duress switches in accordance with manufacturer's instructions, surface mounted under counter in locations shown on plans. Verify exact mounting location with Owner prior to cable rough-in or installation. For hard wired devices, provide wiring and connection to duress switch devices. For wireless duress switch devices, mount receivers in accessible locations. Complete programming, adjustment and testing of all duress switch devices. Wireless testing shall include signal reception when transmitter is in all sections of the area in which it will be used in normal operations.

K. Install, wire, configure, adjust, program and test all access control system servers, workstations, badging workstations and other user interfaces.

L. Install, wire, configure, adjust, program, and test all specified interfaces and integrations between access control and other systems. Contractor shall provide all cabling, wiring, terminations, components, devices, accessories, hardware, software and other material and accessories necessary to complete all specified interfaces and integrations and make them fully operational.

M. All low voltage access control cabling shall be routed and supported completely separate from any and all other telecommunications or other low voltage system cabling.

N. Electronic access control system cabling shall not be spliced.

O. Flexible conduit is not allowed except with prior approval. Refer to Section 26 0533 for conduit requirements. Refer to Section 27 0528 for cable hanger and support requirements.

P. Each cable shall be appropriately identified, as defined on the record documents, at each end's termination point using pressure sensitive label strips.

Q. The conductor color code used in terminating system cabling at system devices shall remain consistent from device to device for each unique device type throughout the project.

R. Install and tighten all connectors in accordance with manufacturer's instructions using the appropriately designed tools recommended by the manufacturer for that purpose. Do not strip or damage connectors, terminals, or equipment by over tightening termination fasteners.

S. Grounding and Bonding Requirements:
   1. Provide a minimum of 6AWG bonding conductor from each electronic access control system control panel, power supply and surge suppression device to the nearest telecommunications grounding busbar. Actual bonding conductor size is determined by its length; refer to Section 27 0526 for grounding and bonding conductor sizing criteria.

T. Coordinate installation of all devices with other trades and utilities in the vicinity.

U. Cabling shall be plenum rated when installed outside conduit in plenum ceilings.

3.02 FIELD QUALITY CONTROL

A. Where these specifications require a product or assembly without the use of a brand or trade name, provide a product that meets the requirements of the specifications as supplied and warranted by the system manufacturer. If the product or assembly is not available from the system vendor, provide product or assembly as recommended by the system manufacturer.

B. Periodic observations will be performed during construction to verify compliance with the requirements of the specifications. These services do not relieve the Contractor of responsibility for compliance with the contract documents.

C. Furnish products listed and classified by Underwriters Laboratories, Inc. (UL) as suitable for purpose specified and indicated.

3.03 MANUFACTURER AND INTEGRATOR COMBINED FIELD SERVICES

A. Installation shall be performed by a factory-trained and certified Contractor.

B. The Contractor shall provide a comprehensive, site-specific customer planning guide for the system. The Contractor shall conduct conference(s) with the Owner prior to any installation to discuss the programming and configuration options of the system and the planning guide.

C. The Contractor shall include labor for all planning and all programming activities required to implement the Owner's access policies for each system point and each operator and administrator. Any software programmable access policy, within the bounds of the hardware specified, shall be included.

D. It shall be the responsibility of the Contractor to provide a complete, functional system as described by the design documents. These responsibilities include:
   1. Complete hardware setup, installation, wiring and software configuration of the system server, all workstations and all peripheral hardware.
   2. Complete programming of all operator software in accordance with the Owner's access policies determined by the planning guide conference(s).
   3. Manual data entry of cardholders based on a printed roster provided by the Owner.
   4. Configuration of the network software for operation of the system. Templates shall be established representative of all user access right levels.
   5. Programming of all cardholder database screens including cardholder information screens, report templates, queries, etc. Encoding of credentials shall be included.
   6. Programming of all custom graphic GUI screens including devices.
   7. Complete system diagnostic verification.

E. The SMS Installation Contractor shall be present at meetings to coordinate all door hardware requirements with the door hardware vendor.

3.04 SYSTEM DOCUMENTATION

A. Complete documentation shall be provided for the system. The documentation shall describe:
   1. All operational parameters of the system
   2. Complete documentation of programming and access policies
   3. Complete operating instructions for all hardware and software

B. The following sections shall be provided in the system documentation:
   1. System Administrator Manual: Provides an overview and a step-by-step guide and instructions detailing all system administrator responsibilities and functions.
   2. User Manual: A step-by-step guide and instructions detailing all system user functions.
   3. Alarm Monitoring Manual: A step-by-step guide and instructions detailing all alarm monitoring system functions and responsibilities.
   4. Technical Maintenance Manual: A comprehensive document providing all maintenance actions, system testing schedules, troubleshooting flowcharts, functional system layout, wiring diagrams, block diagrams and schematic diagrams.
   5. Refer to Part 1 for details.

3.05 SYSTEM TRAINING

A. All labor and materials required for on-site system training by a certified representative of the system manufacturer shall be provided. Training shall be conducted at the project site using the project equipment.

B. Coordinate training days and times with Owner.

C. Provide a training outline agenda describing the subject matter and the recommended audience for each topic.

D. At a minimum, the following training shall be conducted:
   1. System Administrators: A course detailing the system functions, configurations and operations. Provide training on all aspects of the system including data import/export, report, cardholder management, system workstation and server configuration and maintenance, software and hardware configuration and peripheral hardware operation.
   2. Operators: A course detailing the operational features of all aspects of the user interface. Topics shall include alarm monitoring functions, reports, error handling, alarm handling, output relay control, operation of integrated systems interface, and general overview of the report hardware.
   3. GUI Editing: Conduct detailed training on using the GUI editing software. Topics shall include the editing of existing graphical maps and the creation of new graphical maps.

E. Minimum on-site training times shall be:
   1. System Administrators: Eight (8) hours.
   2. Operators: Eight (8) hours.
   3. GUI Editing: Eight (8) hours.
   4. Integrations : Eight (8) hours.
   5. Four (4) additional hours of training each quarter for the 12-month period of the project warranty shall be provided. A minimum of half of this additional training shall be on site; the remainder may be support by telephone or email. Contractor shall document this training, including dates performed, trainer and Owner representative(s) present. Each phone call or email shall be documented as a minimum of 15 minutes duration.
   6. Operators and administrators are present 24 hours a day, 7 days a week. Contractor shall coordinate with Owner to provide training for all appropriate personnel, which may require Contractor to be present on site during non-business hours. Therefore, the hours in any or all categories defined above may be divided among the various shifts.

3.06 SYSTEM ACCEPTANCE

A. The SMS vendor shall submit for review a formal acceptance and system checkout program. The system checkout procedures shall include all system components, software and functionality. The Contractor shall perform the tests and document all results under the supervision of the manufacturer's systems engineer.

B. All operational scenarios, as defined by the customer planning guide, shall be tested to simulate the actual use of the system in the normal operating environment. The successful completion of these operational scenarios shall be documented.

C. The system shall not be accepted until all requirements of system documentation and training have been completed.

END OF SECTION

SECTION 28 2300
VIDEO SURVEILLANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Network Video Management System (NVMS).
B. Video Storage Solution
C. Cameras and Accessories.
D. Video Printer.
E. Equipment Racks.
F. Cabling.

1.02 RELATED WORK

A. Section 26 0533 - Conduit and Boxes
B. Section 26 0513 - Wire and Cable
C. Section 27 1500 - Horizontal Cabling Requirements
D. Section 28 0500 - Basic Electronic Safety and Security System Requirements
E. Section 28 3100 - Fire Detection and Alarm Systems
F. Section 28 1300 - Electronic Access Control

1.03 QUALITY ASSURANCE

A. NVMS Software Developer (Manufacturer): The NVMS system shall be a single-source manufacturer such that the single manufacturer develops, supports, and warranties the NVMS software solution. The manufacturer shall have three (3) years documented experience.
   1. The software developer shall be, at a minimum, a Microsoft Gold Certified Integrator and Partner for systems that reside in a Microsoft environment.
   2. The software developer shall be an active ONVIF member with current available product recognized by ONVIF as a Conformant Product.
B. Integrator/Installer (Contractor): The Contractor must be a NVMS-certified installation, service, and support company specializing in the selected manufacturer's product, with demonstrated prior experience with the selected manufacturer's system installation and programming.
   1. The installer shall retain a Microsoft MCSE or equivalent technician for the purposes of server deployment, software configuration, and system integration.
   2. The integrator must have local service representatives within 50miles of the project site.

1.04 REFERENCES

A. NFPA 70 - National Electrical Code
B. Electronic Industries Association (EIA) Video Surveillance Equipment Standards
C. UL 2044 - Standard for Commercial Closed Circuit Television Equipment
D. UL 3044 - Standard for Safety for Surveillance Closed Circuit Television Equipment

1.05 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 28 0500.

B. Product Data Submittal: Provide manufacturer's technical product specification sheet for each individual component type. Submitted data shall show the following:
   1. Compliance with each requirement of these documents.
   2. All component options and accessories specific to this project.
   3. Electrical power consumption rating and voltage.
   4. Heat generation for all power consuming devices.
   5. All required wiring shall be identified.
   6. Number of IP addresses that will be required from the Owner's Information Systems Department.
   7. Statement of Acceptability of Designed Server:
      a. If the Contractor agrees that the server(s) designed and described herein is acceptable for the chosen manufacturer's solution and meets the demand of the application, this shall be stated in writing and submitted as part of the shop drawing submittal.
      b. If the Contractor does not agree that the server(s) designed and described herein is acceptable for the chosen manufacturer's solution, Contractor shall itemize the quantity, technical specifications, and capacities of the servers required to support the functionality and device quantities required by the project drawings. Indicate the capacity utilization factor for each server.
      c. Contractor's bid shall include any required changes in server(s) capacity.
   8. Calculation for storage required using the criteria contained in the project drawings.
   9. Provide annual cost and all terms and conditions for the NVMS Software Maintenance Agreement. Include all additional costs and terms and conditions for any Annual Service Contracts provided by the Contractor for all services that are not included in the Software Maintenance Agreement.

C. System Drawings: Project-specific system CAD drawings shall be provided as follows:
   1. Provide a system block diagram noting system components and interconnection between components. The interconnection of components shall clearly indicate all wiring required in the system. When multiple pieces of equipment are required in the exact same configuration (e.g., multiple identical cameras), the diagram may show one device and refer to the others as "typical" of the device shown.

D. Sample format of site specific programming guides to be used for system planning/programming conference with Owner.

E. Meeting agenda for planning/programming conference required in Part 3 of this specification.

F. Submit detailed description of Owner training to be conducted at project end, including specific training time.

G. Quality Assurance:
   1. Provide materials documenting experience requirements of the manufacturer and installing contractor.
   2. Provide system checkout test procedure to be performed at acceptance. Test procedures shall include all external alarm events.

H. Coordination Drawings:
   1. Include all ceiling-mounted devices in composite electronic coordination files. Refer to Section 28 0500 for coordination drawing requirements.

1.06 SYSTEM DESCRIPTION

A. This specification section describes the furnishing, installation, commissioning and programming of a complete, turnkey, video surveillance system.

B. Performance Statement: This specification section and the accompanying project drawings are performance based, describing the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the equipment constraints described and the performance required of the system as presented in these documents, the vendor and the Contractor are solely responsible for determining all wiring, programming and miscellaneous equipment required for a complete and operational system.

C. Refer to the project drawings for model numbers for the Basis of Design for all equipment.

1.07 LICENSING REQUIREMENTS

A. All licenses required for system operation shall be included in the Contractor's bid. Licenses shall include, but not be limited to, server and workstation software, cameras, encoders/decoders, and any other licensing that is required by the manufacturer for operation of any system component.

1. Camera licenses shall be provided for all cameras listed on the Camera Schedule whether cameras are new or existing.
2. The system shall be provided with installed software capacity to accommodate a minimum quantity of 39cameras. The licensing for all 39cameras shall ***NOT*** be included in the Contractor's bid. Licensing shall only be included for the quantity of cameras shown on the Camera Schedule. However, the system's ability to support up to a total capacity of 39cameras shall ***ONLY*** require future payment of additional per-unit camera licensing fees by the Owner. In no case shall the Owner be required to upgrade the software provided in the Contractor's bid to achieve support for a total of 39 cameras, including the payment of any software upgrade fees, installing a different software version, etc.
3. If the manufacturer requires the purchase of a block of licenses (instead of selling a single license for a single device) the Contractor's bid shall include the appropriate block of licenses that accommodates all device quantities described by the project drawings.

1.08 PROJECT RECORD DOCUMENTS

A. Submit documents under the provisions of Section 28 0500.

B. Provide final system block diagram showing any deviations from shop drawing submittal.

C. Provide statement that system checkout test, as outlined in shop drawing submittal, is complete and satisfactory.

D. Provide final camera type and camera requirements schedules documenting all changes made during construction.

E. Warranty: Submit written warranty and complete all Owner registration forms.

F. Complete all operation and maintenance manuals as described below.

1.09 OPERATION AND MAINTENANCE DATA

A. Submit documents under the provisions of Section 28 0500.

B. Manuals: Final copies of the manuals shall be delivered within 14 days after completing the installation test. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of the contractor responsible for the installation and maintenance of the system and the manufacturer for each piece of equipment for each system. The manuals shall have a table of contents and labeled sections. The final copies delivered after completion of the installation test shall include all modifications made during installation, checkout, and acceptance testing. The manuals shall consist of the following:
   1. Hardware Manual: The manual shall describe all equipment furnished including:
      a. General description and specifications.
      b. Installation and check out procedures.
      c. System layout drawings and schematics.
      d. Alignment and calibration procedures.
   2. Software Manual: The software manual shall describe the functions of all software and shall include all other information necessary to enable proper installation, testing, and operation. The manual shall include:
      a. Definition of terms and functions.
      b. System use and application software.
      c. Graphical user interface use.
      d. Reports generation.
   3. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system including:
      a. Computers and peripherals.
      b. System startup and shutdown procedures.
      c. Use of system.
      d. Recovery and restart procedures.
      e. Use of report generator and generation of reports.
      f. Data entry.
      g. Operator commands.
      h. Alarm messages.
      i. System permissions functions and requirements.
   4. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

1.10 WARRANTY

A. Unless otherwise noted, provide warranty for one (1) year after Date of Substantial Completion for all materials and labor.

B. Onsite Work During Warranty Period: This work shall be included in the Contractor's bid and performed during regular working hours, Monday through Friday.
   1. Inspections: Perform one minor inspection six-months after Substantial Completion and one major inspection prior to the expiration of the warranty.
   2. Minor Inspections: Inspections shall include:
      a. Visual checks and operational tests of all equipment, field hardware, and electrical and mechanical controls.
      b. Mechanical adjustments if required on any mechanical or electromechanical devices.
      c. Install all available software updates, patches, or bug fixes available from the NVMS manufacturer.
   3. Major Inspections: Inspections shall include all work described under paragraph Minor Inspections and the following work:

a. Clean all equipment, including interior and exterior surfaces.
b. Perform diagnostics on all equipment, including all system software diagnostics, and correct all diagnosed problems.
c. Adjust all camera alignments that have become out of alignment from their documented position at Substantial Completion.
d. Install all available software updates, patches, or bug fixes available from the NVMS manufacturer.
e. All warrantable system deficiencies during the Major Inspection shall be remedied under warranty at no cost to the Owner.

C. Operation: Upon the performance of any scheduled adjustments or repairs, verify operation of the NVMS system.

D. Emergency Service: The Owner will initiate service calls when the NVMS system is not functioning properly. Qualified personnel shall be available to provide service within the distance defined above. The Owner shall be furnished with telephone number(s) where service personnel can be reached 24/7/365.

E. Records and Logs: Keep records and logs of each task completed under warranty. The log shall contain all initial settings upon Substantial Completion. Complete logs shall be kept and shall be available for review on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the NVMS system.

F. Work Requests: Record each service call request on a service request form. The form shall include the model and serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing what must be done, the amount and nature of the materials used, the time and date work started, and the time and date of completion. Deliver a record of the work performed within five (5) days after work is accomplished.

G. System Modifications: Make any recommendations for system modification in writing to the Owner. No system modifications shall be made without prior approval of the Owner. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected. To the fullest extent possible, the Owner shall be provided with electronic restorable versions of all configurations prior to the modifications being made.

H. Software: Provide all software updates during the period of the warranty and verify operation in the system. These updates shall be accomplished in a timely manner, fully coordinated with NVMS system operators, shall include training for the new changes/features enabled, and shall be incorporated into the operations and maintenance manuals, and software documentation.

I. Refer to the individual product sections for further warranty requirements of individual system components.

1.11 SOFTWARE MAINTENANCE AGREEMENT/ANNUAL SERVICE CONTRACT

A. Provide annual cost and all terms and conditions for the Software Maintenance Agreement (SMA) provided by the NVMS manufacturer and/or the Contractor.

B. The Owner will enter into a contract directly with the vendor. This specification is not a contract between the Owner and the vendor to perform these services. The cost and terms of the SMA ***may*** be used by the Owner for NVMS solution selection.

PART 2 PRODUCTS

2.01 NETWORK VIDEO MANAGEMENT SYSTEM - GENERAL REQUIREMENTS

A. The network video management system (NVMS) shall be an enterprise-class client/server based video security solution that provides management of digital video, audio and data across a TCP/IP network.

B. The VMS shall utilize network switch ports provided by the Owner for all required IP connections. Provide the Owner with a complete list of all IP ports required.

C. ONVIF Compliance:
   1. The NVMS system shall match the ONVIF profile of the specified cameras.

D. The NVMS system shall be an "open system."
   1. The open system shall support third party storage solutions, including:
      a. Network Attached Storage (NAS) devices.
      b. Storage Area Networks (SAN) for ***primary*** or archival storage purposes. Primary support for SAN shall be defined as:
         1) The ability to directly record to SAN device without first recording to an NAS or DAS.
         2) The NVMS is provided with a user experience that makes the video recorded to the SAN transparent to the user. This shall be defined as:
            a) Full search, bookmarking, and other software features for finding, marking, locating, and identifying video are supported by the NVMS for video recorded to a SAN in an identical way to video that is recorded to an NAS or DAS.
            b) No loading of the video from the SAN into the NVMS shall be required.
            c) Full playback, windowing of camera video, archiving, and exporting is supported by the NVMS for video recorded to the SAN in an identical way as video recorded to an NAS or DAS.
   2. The system must have a published API/SDK permitting third party integrations to the product without restrictions.
   3. The NVMS shall support active directory using LDAP protocol.

E. The NVMS system shall consist of the following hardware/software components:
   1. Software:
      a. Server and client software
      b. Recording services, archival services, and storage management
      c. Configuration tools
   2. System storage as specified on the project drawings.
   3. Cameras and related hardware as specified on the project drawings.
   4. Hardware: Servers, workstations, and miscellaneous hardware (keyboard, mouse, KVM) as specified on the projects drawings.
   5. Network electronics and related hardware and software as specified on the project drawings.

F. Video from any camera on the system (on the LAN, WAN or Internet) shall be capable of being viewed from single or multiple workstations simultaneously at any time, limited only by network bandwidth.

G. The NVMS shall support simultaneous displaying of live (30 fps) video of a minimum of 16 cameras while the video monitoring screen is configured in a 16-camera split configuration. In no case shall the frame rate of the camera be required to be restricted to less than 30 fps to display a 16-camera split view.

H. Simultaneous display and recording of every camera shall be supported with independent user-adjustable frame rates that can be set differently for the display stream and the recording stream. These independent settings shall be unique per camera.

I. The NVMS monitoring software shall support any combination of recorded and live video in any multiple camera split view, including viewing recorded video and live video from the same camera.

J. The NVMS shall support continuous recording and event-based recording simultaneously. This shall be capable of being set on a per camera basis.

K. Viewing of video (live and recorded) shall be possible from client software from any client hardware that is connected to the security LAN/WAN or Internet (through appropriate firewalls). In addition, system administration shall be permitted from remote client hardware.

2.02 NVMS MANUFACTURERS

A. Approved Manufacturer:
   1. Genetec Milestone

2.03 NVMS SERVER REQUIREMENTS

A. The NVMS shall operate on the most currently available version of Windows 2008 Server Operating System. The server software shall be a multi-tasking, multi-threading application system architecture designed specifically for the Windows environment.

B. The server shall communicate on a TCP/IP based Ethernet LAN capable of utilizing 100/1000BaseT.

C. The server shall be provided by the Owner.

D. The server(s) requirements have been calculated based on the NVMS Basis of Design manufacturer noted above. By submitting a bid, the Contractor acknowledges that the calculated server requirements listed here may not be sufficient for a listed alternate, acceptable manufacturer selected by the Contractor. The Contractor shall modify the calculated server requirements listed herein based on the calculated requirement of the chosen manufacturer. The server requirements for the basis of design are as follows:
   1. Server Quantity and Location: Refer to project drawings for quantity of servers required and their location.
   2. Server Hardware Specification:
      a. Enterprise class server meeting the manufacturer's minimum performance requirements for the system.
      b. Rack mount configuration.
      c. Dual, redundant, hot swappable power supplies.
      d. Desk-mount 24" LCD monitor, keyboard and mouse.

2.04 NVMS CLIENT REQUIREMENTS

A. The NVMS PC workstation(s) shall be provided by the Owner.

B. The workstation(s) for the basis of design are as follows:
   1. Workstation Quantity and Location: Refer to project drawings for quantity of workstations required and their location.
   2. Workstation Hardware Specification:
      a. Provide workstation with performance requirements that meet manufacturer's recommendation.
      b. One (1) minimum 19" flat screen LCD monitor.
      c. Operating System: Latest version of Microsoft Windows.

C. Refer to drawings for approved manufacturers.

2.05 NVMS SYSTEM DETAILED REQUIREMENTS

A. Network Requirements: The NVMS shall support Ethernet 100/1000 BaseT.
   1. Network protocols shall be supported including TCP/IP, IPX, and UDP.
   2. The network interface shall allow remote access of the NVMS from anywhere on the end-user's LAN/WAN or Internet (behind firewall).
   3. The system shall permit limiting of frame rate transmission to individual clients.
   4. Both Multicast and Unicast shall be supported.
   5. All transmission of system data shall be secured using Secure Socket Layer (SSL) security on the TCP/IP network.
   6. Simple Network Management Protocol (SNMP) shall be supported.

B. Video Formats:
   1. The NVMS shall support MPEG-4, H.264, and H.265 compression formats.
   2. The system shall support any single stream of bandwidth up to 90Mbit/sec at 30 fps at 4872 x 3248 resolution with no system performance degradation, assuming appropriate network bandwidth.
   3. Video shall be recorded using a 256-bit encryption algorithm with authentication (watermarking) software suitable for evidentiary proceedings. The watermarking feature shall provide evidence of altered video.
      a. The video shall be watermarked with the authentication key/signature during recording of live video to the drive.
      b. A video player shall be provided with the NVMS system.
         1) The player shall have the ability to validate the authentication upon playback.
         2) This authentication shall provide the storage media name, camera name, video time, and user information.
         3) The authentication shall have the ability to be password protected.
   4. Resolution:
      a. The camera resolution shall be user selectable on a per-camera basis. Selecting or changing resolution shall not require a restart of the application, server, or workstation.
      b. The system shall support the following resolutions:
         1) VGA Resolutions: QVGA (320 x 240), VGA (640 x 480), SVGA (800 x 600), XVGA (1024 x 768), 4xVGA (1280 x 960).
         2) Megapixel Resolutions: SXGA (1280 x 1024: 1.3MP), SXGA + EXGA (1400 x 1050: 1.4 MP), UXGA (1600 x 1200: 1.9MP), WUXGA (1920 x 1200: 2.3MP), QXGA (2048 x 1536: 3.1MP), WQXGA (2560 x 1600: 4.1MP), QSXGA (2560 x 2048: 5.2MP), 3296 x 2472: 8MP, 4000 x 2672: 11MP, 4864 x 3248: 16MP, 6576 x 4384: 29MP.
            a) 16:9 and 4:3 formats shall be supported.
         3) HDTV Resolutions: 720p, 1080p in 16:9 format.

C. Remote Clients:
   1. The NVMS system shall be capable to view live video or playback recorded video over the LAN/WAN or the Internet from any PC or mobile device. An industry standard Web Browser (e.g., Internet Explorer, Firefox, Chrome) shall be the only software required to view non-authenticated video from a remote PC.
      a. Any plug-ins (e.g., ActiveX, Java, HTML5) required to view remote video shall be capable of being pushed to the user's PC at the time of initiating the remote video viewing session.
      b. Remote viewing shall be supported whether the remote client is:

1) Inside the firewall containing the NVMS.
2) Outside the firewall containing the NVMS.
3) Accessing the NVMS through a VPN.

2. Remote Client Features:
   a. Display live video.
   b. Digital zooming and panning of fixed cameras.
   c. PTZ camera control in real time, including adjusting PTZ lock and dwell times.
   d. Ability to access video from all accessible recording devices.
   e. Priority-based camera control takeover.
   f. Customizable camera viewing screen split configurations that are retained under the user login between remote client sessions.

D. Mobile Clients (Apps):
   1. The NVMS shall include a mobile video viewing application for the iOS/AppleAndroid operating system.
      a. The iOS application shall be a single universal application supporting both the iPhone and iPad resolutions.
      b. The Android application shall be a universal application that supports Android smartphones and Android tablets.
   2. Features:
      a. The mobile client shall permit viewing of live video or playback of recorded video.
      b. Split screen video display shall be supported. The split screen shall permit live and recorded video simultaneously in the screen split. The screen split layout shall be retained between mobile client sessions.
      c. Provide time synchronization of the video of different cameras to account for mobile network latency to ensure that live video from multiple cameras is time synchronized.
      d. The mobile client shall be optimized with video compression to support video viewing on mobile networks. The mobile client shall maintain a minimum of 7 fps per camera on a mobile network performing at 200 Kbit/s with a latency of 200ms.
      e. All transmission of system data shall be secured using Secure Socket Layer (SSL) security at a minimum.

E. Workstation Client Software Requirements:
   1. The client software for the NVMS shall run as an application on the most current available version of Windows or Apple PC. The client software shall not require a PC more robust than that defined above in the section entitled "NVMS CLIENT REQUIREMENTS." Should the workstation client software require a PC configuration more robust than that defined herein, the cost of upgrading the workstation hardware to the more robust requirement shall be paid by the Contractor.
   2. The client software shall provide video signal detection and provide alerts whenever video is lost on any input channel.
   3. Updates to the client software shall be capable of being pushed to all clients from the NVMS server.
   4. The client software shall provide a graphical mapping feature. The graphical map shall accommodate the importation of CAD files, or custom development of floor plans or site plans to create a to-scale or not-to-scale graphical representation of the system layout including all cameras.
      a. For site cameras, the graphical map shall consist of an overall site plan showing all exterior cameras. Buildings and other physical entities on the site shall be graphically represented.
         1) The buildings shown on the site plan shall visually indicate to the user that cameras are located inside that building's interior, if applicable.

b. The user shall be able to click a building that contains cameras to obtain a new graphical layout of that building. Once the building interior layout graphical map is on screen, interior cameras shall be represented by icons.
c. The user shall have the ability to navigate back to the main (previous) graphical map via a single-click graphical icon.

5. Camera Configuration:
   a. Each camera shall be configurable for an alphanumeric character name.
   b. The system shall allow for the setup and adjustment of brightness, contrast, archiving, motion detection, and Pan/Tilt/Zoom on a per camera basis.
   c. The NVMS shall support a separate frame rate for recording and a separate frame rate for viewing for every camera input (assuming the camera provides two streams). These frame rates shall be capable of being independently set for each camera input.
   d. The NVMS shall support the PTZ control of analog NVMS cameras through the encoders.
   e. The compression algorithm formats MPEG4, H.264 and H.265 shall be supported in the same system and shall be individually selectable on a per-camera basis.
   f. Each individual camera shall be capable of having individual camera settings that shall include (at a minimum):
      1) Continuous recording.
      2) Motion-based recording capability shall be provided including:
         a) Motion as determined by the NVMS software using entire screen motion detection and user defined area triggers.
         b) Motion as determined at the camera.
         c) Motion trigger by digital inputs from external trigger systems such as contact closures, alarm inputs, POS integration, etc. Motion triggers received by external trigger inputs shall be recorded by the event recording capabilities of the NVMS and identifiable on a timeline during playback and in reports.
         d) Motion triggers received by external trigger inputs shall be recorded by the event recording capabilities of the NVMS and identifiable on a timeline during playback and in reports.
      3) Alarm-initiated recording.
         a) When a camera enters alarm recording mode, the NVMS shall have the capability of changing to different camera settings for the recorded video during the duration of the alarm mode. The settings capable of being changed shall include the frame rate and the resolution. These setting changes shall be configurable in advance per camera by the User through the software GUI.
      4) Time-based recording on a preset schedule.
      5) Manual (user) activation of the start and stop of the recording process through the GUI.
         a) The NVMS software shall prevent any user from manually starting and stopping the recording of video based on that user's login credential.
      6) Defined pre-event and post-event recording buffers shall be provided for all non-continuous recording events.
      7) Each camera shall be capable of having unique storage retention settings.
   g. The NVMS shall support audio recording utilizing the built-in audio recording capability of audio-equipped IP cameras.

F. Software Security Requirements:

1. All users shall be capable of being authenticated against Active Directory using LDAP, before being granted system access. Should the Owner not use Active Directory, the NVMS shall provide a built-in login and credential management tool to permit rules-based access rights on a per-user basis.
2. The access rights shall be selectable on a per-user basis. In addition, user groups shall be capable of being assigned whereby each user group has a common set of access rights. Users shall be capable of being assigned to these user groups by the system administrator.
3. Access rights available for customization shall include:
    a. Live Video Viewing:
        1) Use of PTZ controls.
        2) Start and stop of manual recording.
        3) Access to and exclusive from individual cameras and monitors.
        4) Access to system settings.
        5) Ability to define video blocking positions of PTZ cameras for certain users.
    b. Viewing Recorded Video:
        1) Ability to export recorded video. including email.
        2) Access to system archiving and backup.
        3) Ability to watch recorded video from individual cameras.
        4) Ability to delete recorded video.
    c. Camera Setup:
        1) Add or remove cameras from the system.
        2) Change camera settings including resolution and frame rate.
        3) Change motion detection and other defined triggers.
    d. General Settings:
        1) Change client software settings.
        2) Ability for user to configure or change custom viewing screen configurations.
        3) Modify server settings.
        4) Change recording or bandwidth settings.
        5) Configure users.
        6) Access and configure external messaging capabilities.
        7) View, print, save and clear the system log.

G. Pan/Tilt/Zoom (PTZ) Control:
1. The NVMS shall support PTZ control from any client, including remote and mobile clients.
2. The following PTZ features shall be supported:
    a. Priority Levels
    b. Device Group Control
    c. PTZ Override (Lockout)
    d. Proportional PTZ Control
    e. Preset Lock via video screen
    f. Preset Tour

H. Video Archiving:
1. The archiving feature shall be hardware independent, providing the ability to utilize commercial off-the-shelf mass storage devices as archived video destinations, including optical DVD, DAS, NAS, SAN, and other external storage drives.
2. The archiving software shall provide the ability to manage and store video information from multiple recorded video locations to a central location.

3. Each NVMS server shall have the ability to set its own unique archiving settings. Video shall automatically be archived based on user-defined "percentage full" settings. When the NVMS reaches the designated capacity threshold, video shall be automatically copied to the archive storage destination, and space on the source of the recorded video shall be released for overwrite by new video information using a first-in, first-out algorithm.
    a. Exception: Video marked or tagged by the user or by automated alarm inputs shall be retained by the archiving process despites its location in the first-in, first-out timeline.
4. Regardless of the video's storage location (local or in the archive), the NVMS software shall automatically retrieve video associated with an event on demand by the user in response to a search, browse, or other retrieval action. The actual storage location of the video shall be transparent to the user.
    a. Exception: Video archived to removable media shall require prompting to the user to insert the appropriate media.
5. Archiving shall be capable of being scheduled such that archiving will only run during certain hours defined by the Owner.
6. The NVMS solution shall be permitted to utilize advanced algorithms for managing onboard storage such as reducing the frame rate of recorded video for the oldest video as an alternative to completely removing the video using a first-in, first-out algorithm. If this option exists in the NVMS software, it must have the following features:
    a. Ability of the Owner to completely disable the feature.
    b. Ability to set a minimum frame rate that the system will not exceed.
    c. Ability to set the feature on a per-camera basis.

I. Video Viewing Layouts:
1. The NVMS shall support the ability to save the list of camera views currently being displayed, along with the currently selected template, with a user-defined name to be loaded as needed by the system operator.
2. System operators shall have the ability to define multiple viewing templates that can be recalled and configured on an as-needed basis.
3. This feature shall be subject to the access rights provided by the system administrator through their login credential.

J. Still Image Capture/Save:
1. During playback or monitoring of video, the system shall have the ability to create and save a still picture. This operation shall not affect any other operation and shall not alter the recorded video. The file format shall be an industry standard format (JPEG, TIFF) allowing for file transfer via e-mail, printing, or file transfer to other media.
2. This feature shall be subject to the access rights provided by the system administrator through their login credential.

K. Export Video Clip to File:
1. The NVMS shall have to ability to save and export recorded video to a file for sharing and reviewing video clips. The start and end times for each video segment shall be user defined. The exported video clip shall be viewable via a standard media player.
2. This feature shall be subject to the access rights provided by the system administrator through their login credential.

L. Automated Motion Video Searching:
1. The system shall support advanced automated motion video searching against pre-recorded video. The automated motion video search shall analyze frames in a video segment to detect motion activity from image to image. It shall display thumbnail images of the frames with activity, complete with a histogram depicting the relative amount of activity within each frame.

2. The search shall be defined by selecting a specific camera and a specific time period in which the suspected activity took place. All motion events associated with that camera and time period shall be displayed in either a trace or thumbnail format for review.
3. Motion shall be capable of being restricted to any user-defined area of the screen as drawn by the user using a windowing tool in the software.

M. Video System Analytics (VSA):
1. The NVMS shall provide an embedded Video System Analytics solution.
2. The result of a trigger of an VSA shall be user definable and shall include:
   a. Marking video.
   b. Adjusting recording characteristics including frame rate and resolution.
   c. Activating changes in the monitoring of cameras, including showing full screen video of the triggered camera.
   d. Providing screen prompting to the system operator.
3. The set of Intelligent Video Analysis algorithms shall provide the following functionality:
   a. Alert Types:
      1) Smart Video Motion Detection. This VSA shall have algorithms to filter out minor vibrations. The sensitivity of this filter shall be user adjustable. This VSA shall also provide motion masking where the user can define an area of the frame where motion will be ignored.
      2) Camera Tampering. When the VSA detects a camera is moved from its original position, when the camera view is obstructed, or when the focus is changed, this VSA shall activate.
      3) Sudden Change in Light Intensity. This VSA shall trigger when there is an extreme change in ambient light - light to dark or dark to light. The sensitivity of this VSA shall be user definable.
      4) New Object in Scene. This VSA shall detect an object that was not present when the VSA originally learned the scene or that has been inserted into the scene in a user defined area in the field of view.
      5) Object Removed from Scene. When an object that was present when the VSA originally learned the scene view has been removed from the scene, this VSA shall activate. This VSA shall be capable of being applied to a window of the total field of view as defined by the user.
      6) Specific Object Detected in Scene. This VSA shall trigger when an object is detected that is defined by specific properties including people, automobiles, or an object of a specific color.
      7) Congestion in Defined Area. This VSA shall occur when the VSA detects congestion in a specific area of the scene as defined by the user.
      8) Directional Motion VSA shall occur when the VSA detects an object moving in a direction specified in the setup of this feature.
      9) Object Crosses a Defined Region. This VSA shall detect an object moving across a virtual boundary or into a defined area from a specified direction.
      10) Moving Object Stops. This VSA shall detect when a moving object in the scene ceases to move.
      11) Static Object Starts to Move. VSA shall occur when the VSA detects when a static object in the scene starts to move.
      12) Object Moves Too Fast. This VSA shall trigger when an object is moving faster than a pre-defined speed.
      13) Loitering. This VSA shall detect when a person or group of people in the scene slows down or ceases to move for a specified period of time.
      14) Detection of a Human Face. This VSA shall trigger when the VSA detects a frontal view of a human face.

15) People Counting. This VSA shall be used when a camera is positioned in a top-down view of an entry/exit portal. This feature shall provide an alarm with a positive count for entry and a negative count for exit.

b. The VSA shall support the ability to store the graphical output for a specific event for use with VSA alarms. This feature shall allow the graphical output of a specific event to be stored as a file and later used as an overlay to be used and associated with an alarm for historical searching.

c. The VSA shall support full video resolution during video processing.

d. The VSA shall support video infrared imaging.

N. Intelligent Audio Analysis:

1. The NVMS shall provide the ability to perform analysis on audio streams associated with recorded video.
2. Supported audio analytics shall include high pitched sounds, impact sounds, or other dramatic changes to a defined ambient noise threshold.
3. When searching for these audio alarms, the search shall include video stored locally or on an archive destination.

O. The NVMS shall provide up to 10 different and independent programmable recording schedules.

1. The schedules may be programmed to provide different record frame rates for day, night, and weekend periods, as well as holidays and exception days.
2. Advanced task schedules may also be programmed that could specify allowed log-on times for user groups, when events may trigger alarms, and when data backups and archiving should occur.

P. The VMS shall support Dual Authorization logon. It shall function as follows:

1. Dual Authorization user groups may be created.
2. Logon pairs, consisting of any two normal user groups, may be assigned to each Dual Authorization user group.
3. A separate set of privileges and priorities can be assigned for each Dual Authorization user group.
4. For each user group assigned as part of a logon pair, it shall be configurable whether the group can:
   a. Log on either individually or as part of the logon pair.
   b. Log on only as part of the logon pair.
5. If a user that is part of logon pair logs on individually, then the user shall receive the privileges and priorities of the user's assigned user group. If the same user logs in as part of a logon pair, then the user shall receive the privileges and priorities assigned to the Dual Authorization group to which the pair is assigned.

Q. The NVMS shall auto-discover cameras and encoders. Device detection shall support devices in different subnets.

R. The NVMS shall be designed in such a way that server downtime or loss of communication to the server does not affect the functionality of the recording services. Normal recording and motion recording shall continue during server downtime.

2.06 NVMS RECORDING REQUIREMENTS

A. The NVMS shall provide management of the recording and playback of video, audio, and data (bookmarking, alarm data, etc.).

B. The NVMS shall provide unlimited cloud archiving of video.

C. Cameras, unless otherwise noted on the Camera Schedule(s), shall be assumed to be recording 24 hours per day, 7 days per week, 365 days per year. Network Video Recorder (NVR) Hardware Platform:
   1. The NVR shall be defined as a storage device for recording IP video streams from IP cameras or from analog cameras that have been encoded to IP. In both cases, the NVR shall record IP streams from cameras or encoders located anywhere on the IP network without being direct-cable connected to the NVR.
   2. Refer to the project drawings for specific requirements, model numbers, and basis of design for the NVR.
   3. NVR Configuration:
      a. The NVR shall contain one hard drive for the operating system and software, and all hard drive storage required to achieve the required storage retention.
      b. Provide with RAID 6 hard disk controller configuration for the video storage hard drives.
   4. The NVMS shall provide a failover function where an NVR can be assigned as a backup to other NVRs. When an assigned NVR goes out of service, the failover NVR takes over the responsibilities of the failed NVR. When the primary NVR returns to service, the control shall be automatically transferred back to the primary NVR.
   5. It shall be possible to assign a redundant NVR to every NVR for use in normal operation of all NVR(s) in the system. The redundant NVR shall record the same streams as the primary NVR. The redundant NVR shall have its own disk drives where it shall store the recorded data.
      a. It shall be possible to view the data recorded by the redundant NVR in the client software. The redundant NVR shall have camera symbols that can be placed in the camera selection tree. These cameras shall have the same name as the cameras of the primary NVR. An indication shall be provided to indicate that the camera names are located on the redundant NVR.

2.07 NVMS ALARM REQUIREMENTS

A. The NVMS shall provide the capability to accept external alarm triggers in the following formats:
   1. Momentary or maintained low voltage contact closures
   2. Digital I/O (0 / 10V DC)
   3. RS-232 integration
   4. Custom integration

B. Alarms shall be capable of being scheduled such that they are only active during defined times.

C. The NVMS shall allow alarms to be individually restricted to specific user groups or users.

D. A single alarm event shall be capable of activating a series of output events including:
   1. Mark recorded video.
   2. Initiate an email, text message, or both.
   3. Initiate an on-screen alarm prompt in a segmented "Alarm Queuing Window."
   4. Modify recorded video settings including resolution and frame rate.
   5. Modify video viewing options including bringing associated video full screen on any output.

E. The alarm queue shall display alarms in order of their priority, with rows for higher priority alarms always displayed above lower priority alarm rows. The display order for equal priority alarms shall be selectable between new alarms displayed above existing alarms or new alarms displayed below existing alarms.

F. Alarm Processing: The video management system shall operate as follows:
   1. When an alarm is accepted by a user, it shall be removed from the other users' alarm lists.

2. The user shall be able to cancel acceptance of any alarm that has been previously accepted. In this case, the alarm shall re-appear in the alarm lists of all members of the user groups assigned to this alarm.

G. The NVMS shall support the association of workflows with alarms. Workflows shall consist of action plans and comment boxes. An action plan shall display a text document, HTML page, or web site that typically contains instructions for handling the alarm. Comments entered in the comment boxes shall be logged in the system logbook.
1. The NVMS shall be configurable to force an alarm workflow. In this case, the alarm cannot be cleared until the workflow is processed.

H. The NVMS shall offer the possibility to automatically clear alarms when the originating event condition is no longer true.

I. Alarms shall be capable of being configured to send cameras to defined positions.

2.08 NVMS INTERFACES AND INTEGRATIONS

A. Security Management System Integration:
1. Refer to the project drawings for all information regarding the Security Management System (SMS).
2. The NVMS shall be integrated with the SMS to provide communication and alarm functionality between the two systems defined as follows, at a minimum:
a. Any alarm/event in the SMS shall have the ability to be associated with a digital video clip in real time.
1) The NVMS shall support user-defined video marking that includes time before and after the alarm event.
2) SMS alarm events shall be capable of triggering a defined video sequence of operation.
b. The NVMS shall support NVMS PTZ control via the SMS video interface.
c. The integration shall support bidirectional alarm monitoring, alerting, and acknowledgement for either system from either system.
1) Both alarm acknowledgement and alarm reset shall be supported.
d. Video Camera Groups/Video Camera Tours:
1) The NVMS shall support camera grouping to allow for video camera tours in the SMS Alarm Monitoring Module.
2) An unlimited number of camera groups shall be supported in the SMS, and each camera group shall support an unlimited number of cameras. Cameras within a camera group shall be capable of spanning any storage media. Individual cameras shall have the ability to be placed into multiple camera groups.
3) The SMS shall provide for video camera tours that rotate live video between each of the cameras defined in the video camera group at a user-defined increment. The time increment shall be user definable in whole seconds.
3. The integration shall be:
a. An integrated product from a single manufacturer, such that a single manufacturer supplies, supports, and warrants the entire solution including the integration.
b. An integration of two separate companies through ONLY an open API/SDK. The API/SDK integration must be complete, functional, and in use in the marketplace. The ability to integrate through an API/SDK without the integration being done in the marketplace is not acceptable. Custom or proprietary integrations are not acceptable.

B. Additional Integration Requirements:
1. Relays from devices connected to the system shall be controllable from command scripts, the NVMS SDK, and icons on the user interface.

2. Input and relay state changes from devices connected to the system shall be recognizable as events in the NVMS.
3. The video management system shall be capable of monitoring third party equipment using SNMP protocols.
4. The video management system shall provide a software interface that allows third-party software to generate events in the video management system.
5. The NVMS shall allow third-party software to include up to 10 data fields and an alarm ID, along with the virtual input event.
    a. These fields shall be searchable in the system logbook.
    b. The virtual input data shall be capable of being displayed in playback mode synchronously with the associated video.

C. SDK Integration:
1. The video management system shall provide a documented Software Development Kit (SDK) to allow integration with third-party software.
2. The SDK shall expose all functionality of the command scripts, including, for example:
    a. Control of operator workstation image window layout
    b. Sending messages to specific workstations
    c. Assignment of cameras, documents, URLs, and maps to operator client workstation image panes
    d. Assignment of cameras to analog monitors connected to encoders
    e. Dome control
    f. Alarm generation
    g. Recording mode control
    h. Exporting of recorded data
    i. Relay control
3. SDK functionality shall be password protected.

D. Point of Sale (POS) Interface:
1. The SMS shall support integration with the POS equipment that provides cash register event annunciation in the alarm monitoring console. These events/transactions shall have the same attributes as all other alarm events in the SMS.

E. Video Wall Integration:
1. Shall support a streaming video server (SVS) when installing the video management software. The SVS shall be capable of retrieving live video from any manufacturer's video recorder and project the video onto a video wall.

F. OPC Server:
1. The VMS shall provide an OPC server for integration into third-party software systems, such as building management systems.
2. The OPC interface shall follow the OPC Alarms and Events standard.

2.09 ENCODERS

A. Digital video encoder (Encoder) shall transmit video across the network for remote viewing and recording by the NVMS.

B. Simultaneous transmission of multiple channel video across the LAN and WAN to connected network digital video recorders and master workstations shall be provided.

C. Encoders shall be configurable remotely from the network.

D. Encoders shall be capable of a minimum of 10 simultaneous viewing/recording streams per encoder.

E. The LAN interface shall be 100/1000 Mbps, TCP/IP Unicast with DHCP support.

F. Encoders shall feature an auto-reboot function that shall automatically initiate a reboot of the encoder when the system detects that the encoder is not responding.

G. PTZ control of a PTZ camera connected to the encoder shall be supported from the user interface application over Ethernet.

H. Video motion detection shall be built into the encoder. Video motion detection shall be monitored by the NVMS to only transmit over the network and record when motion is detected. This feature shall be capable of being turned off. When turned off, motion detection shall be capable of being done at the NVMS rather than at the encoder.

I. Refer to drawings for the technical requirements and model numbers for the encoders.

2.10 NVMS CABLING

A. Refer to Division 27 for all cabling requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with the manufacturer's instructions and recommendations for installation of all products.

B. Provide all system wiring between all components as shown on the project drawings or as directed by the manufacturer, whichever is the more stringent requirement.

C. Mount all cameras in the approximate locations shown on the drawings. Coordinate installation with other trades and utilities in the vicinity. Cameras containing fixed lenses, moved by more than 1'-0" from their location shown on the drawings, shall have a new lens calculation performed by the Contractor. Provide Architect/Engineer with results of lens calculation before proceeding with installation.

D. Coordinate with Owner's IT Department to acquire network connections as well as any network configuration information, such as IP numbers, that will be required to connect NVMS to Owner network (if applicable).

E. Provide all low voltage and +120 VAC power to all devices as required for proper system operation. Refer to Division 26 specification sections for further requirements.

F. All low voltage security wiring shall be routed and supported separately from all other telecommunications cabling.

G. Cabling shall be plenum rated when installed outside of conduit in plenum ceilings.

3.02 FIELD QUALITY CONTROL

A. Where these specifications require a product or assembly without the use of a brand or trade name, provide a product that meets the requirements of the specifications as supplied and warranted by the system vendor. If the product or assembly is not available from the system vendor, provide product or assembly as recommended by the system vendor.

B. Periodic observations will be performed during construction to verify compliance with the requirements of the specifications. These services do not relieve the Contractor of responsibility for compliance with the project drawings.

C. It shall be the Contractor's responsibility to correct all inadequate picture quality issues prior to acceptance of the system.

3.03 MANUFACTURER'S FIELD SERVICES

A. Installation shall be performed by a factory-trained and certified Contractor.
   1. Provide a comprehensive, site-specific customer planning guide for the system. Conduct a conference with the Owner prior to any installation to discuss the programming options of the system and the planning guide. The result of this planning guide shall be the determination of the system options for each device and for the software.

B. Include labor for all planning and all programming activities required to implement the Owner's operational preferences for each device and software. Any software programmable option, within the bounds of the capabilities of the hardware specified, shall be included.

C. Provide a complete, functional system as described by the project drawings. These responsibilities include:
   1. Complete hardware setup, installation, wiring, and software configuration of the system, including all remote operator locations and all peripheral hardware.
   2. Complete programming of all hardware and software options in accordance with the Owner's preferences as determined by the planning guide conference.
   3. Programming of all custom graphic GUI screens including devices.
   4. Complete system diagnostic verification.

D. Provide an authorized manufacturer representative to commission the system and ensure that facility-wide standards and project setup procedures are adhered to.

3.04 SYSTEM ACCEPTANCE

A. Submit for review a formal acceptance and system checkout program. The system checkout procedures shall include all system components and software. Perform the tests and document all results under the supervision of the manufacturer's system engineer.

B. All operational scenarios, as defined by the customer planning guide, shall be tested to simulate the actual use of the system in the normal operating environment. The successful completion of these operational scenarios shall be documented.

3.05 SYSTEM DOCUMENTATION

A. Complete documentation shall be provided for the system. The documentation shall describe:
   1. All operational parameters of the system.
   2. Complete documentation of all programming and options.
   3. Complete operating instructions for all hardware and software.

B. The following sections shall be provided in the system documentation:
   1. System Administrator Manual: Provides an overview and a step-by-step guide and instructions detailing all system administrator responsibilities and functions.
   2. User Manual: A step-by-step guide and instructions detailing all system user functions.
   3. Technical Maintenance Manual: A comprehensive document providing all maintenance actions, system testing schedules, troubleshooting flowcharts, functional system layout, wiring diagrams, block diagrams, and schematic diagrams.

3.06 SYSTEM TRAINING

A. All labor and materials required for on-site system training by a certified representative of the system manufacturer shall be provided. Training shall be conducted at the project site using the project equipment.

B. Provide two weeks advanced notice of training to the Owner.

C. Provide a training outline agenda describing the subject matter and the recommended audience for each topic.

D. At a minimum, the following training shall be conducted:
   1. System Administrators: A course detailing the system functions and operations. Provide configuration training on all aspects of the system.
   2. Users: Provide a detailed course outlining the operational features of all aspects of the user interface. Topics shall include alarm monitoring functions, reports, error handling, alarm handling, output relay control, and general overview of the report hardware.
   3. GUI Editing: Conduct detailed training on using the GUI editing software. Topics shall include the editing of existing graphical maps and the creation of new graphical maps.

E. Minimum on-site training times shall be:
   1. System Administrators: Three (3) days.
   2. Users: One (1) day.
   3. GUI Editing: One (1) day.

NVMS Bid Inventory Form

Item	Cost/Other
Total fixed (lump sum cost) for the entire project:	
Itemize the total fixed lump sum cost as follows:	
Software cost for NVMS including all implementation services.	
Cost for all camera hardware and associated accessories.	
Itemize software cost for the following (show the math):	
Fixed, non-reoccurring flat base cost (if any)	
Fixed, non-reoccurring per-camera licensing fee (if any)	
Recurring flat base cost (if any - do NOT include optional software maintenance agreement costs)	
Recurring flat per-camera licensing fee (if any)	
Client workstation licensing fees (if any)	
Remote Client licensing fees (if any)	
Mobile Client licensing fees (if any)	
Itemize all other license fees not included above.	
Add all required and optional software maintenance agreement costs (do NOT include in bid cost).	
Acknowledge receipt of addenda by writing addendum number to the right.	_____ through _____ inclusive

Include below Server Acknowledgement Statement per Section 28 2300, Article 2.3, Paragraph D.
List below all separate software options, licensing or other monetary features that the Integrator interprets as not being requested by this RFP, but that are available from the NVMS manufacturer for purchase. Attach separate document if needed.

END OF SECTION

SECTION 28 2605
RESCUE ASSISTANCE COMMUNICATION

PART 1 GENERAL

1.01 DESCRIPTION

A. General:
   1. Furnish all labor, materials, tools, equipment and services for a complete area of Rescue Assistance Communication System as indicated in Contract Documents and as required by the American with Disabilities Accessibility Guidelines (ADAAG).
   2. Completely coordinate with work of all other trades.
   3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.02 QUALITY ASSURANCE

A. Transistors, capacitors, resistors, integrated circuits and other components shall not be operated to exceed their rated values. Design systems for 24-hour continuous operation.

1.03 SUBMITTALS (REFER TO SECTION 28 0500)

A. Product Data:
   1. Technical data on each product including finishes.
   2. Description of system operation.
   3. Riser diagrams and system data.
   4. Equipment design considerations for future expansion when indicated.
   5. Materials list and backbox schedule (including unique backboxes).

B. Project Data:
   1. Operating and Maintenance Data: Refer to Section 28 0500.
      a. Factory-prepared operation and service manual for each system.
      b. Include operation details, schematics, wiring diagrams, color coding, terminal numbers and component values for printed-circuit boards.
      c. Owner Instruction Reports: Refer to Section 28 0500.

1.04 OPERATION

A. General: Provide two way audible/visual communication between a master annunciator station and the area of rescue assistance communication stations.

1.05 SYSTEM OPERATION

A. The master annunciator panel shall be located as defined on the drawings. Calls placed between rescue assistance stations and the master annunciator panel shall be identifiable at the master annunciator panel to indicate which station has placed a call. The master annunciator panel shall include both a handset and a speakerphone to allow two-way communication to each station. Upon activation of an emergency pushbutton at call stations, a call will automatically be placed to the master annunciator panel. If no one answers the call, it shall automatically dial 911 operators at the City of Inglewood at (310) 412-8770.

B. Rescue assistance stations shall be located on each level above and below the first floor of the building within elevator lobbies.

C. Call stations shall provide audible and visual indication that a call has been placed.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Talkaphone AOR Series

B. Rath IP Series

C. Housing Devices, Inc. ADA-1000 Series

D. Simplex 5115 Series

E. Cornell 4800 Series

2.02 EQUIPMENT

A. Master Remote Annunciator shall consist of a modular arrangement of intercom 'ON' and flashing red zone LED indicators in multiples of four zones. The annunciator panel shall include a "push to talk" and an audible alarm device with a sound level of not less than 90 dB at 30 cm. The panel shall be constructed of 0.125" thick clear anodized aluminum. Permanent silk-screened zone designations shall be provided on the panel as well as a designation strip. Backbox and panel dimensions will vary depending upon system configuration and number of zones required.

B. Power source shall be a transformer rated for total system devices with an optional battery-backed DC power supply with battery supply for continuous operation of 90 minutes.

C. Wiring to call station shall be supervised. In the event of a wire fault, a yellow LED zone indicator on the annunciator shall illuminate and a repeating audio alarm shall sound.

D. Remote rescue assistance call station shall consist of one momentary switch with LED, incandescent lamp not acceptable, and one audible alarm device with a minimum sound level of not less than 70 dB at 30 cm all mounted on a one gang stainless steel plate. Permanent silk-screened designations shall be provided on the plate.

E. Wiring shall consist of 22 gauge (minimum) wire or as indicated on drawings. Three conductors plus one shielded pair are required between each rescue assistance call station and the annunciator panel not to exceed 3,000 feet. Power wire shall be 12 gauge (minimum). Two conductors are required between the power supply or transformer and the annunciator panel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install all components and complete system as indicated and in accord with manufacturer's recommendations and instructions.

B. All cabling shall be installed to meet the applicable requirements for pathway survivability. Cabling installation shall consist of the following:
   1. 2-hour fire rated circuit integrity (CI) cable
   2. 2-hour fire rated cable system
   3. 2-hour fire rated enclosure or protected area

C. Contractor is to provide and install a typewritten list in a Plexiglas frame permanently fastened to the wall next to the master rescue assistance annunciator panel to indicate the building location of each of the remote area of rescue assistance call stations and to which annunciator zone and LED they correspond.

D. Contractor is to provide a typewritten list of area of rescue assistance communication instructions in a Plexiglas frame permanently fastened to the wall next to each remote switch and the annunciator panel to explain the operation of the system.

E. Provide code-required signage acceptable to the Authority Having Jurisdiction at each call station location.

3.02 SYSTEM TESTING

A. Test each component and complete system for proper operation, including all modes. Perform correctional work when required. Testing shall be done in the presence of the Owner's Representative(s).

3.03 OWNER PERSONNEL INSTRUCTION

A. Instruct maintenance and staff personnel in complete operation, including actual staff use of system, by authorized distributor personnel. Arrange timing of the session in writing to best coordinate with Owner's working hours. Allow four (4) hours of training. This training session shall be videotaped by the Contractor.

3.04 SPARE PARTS

A. Provide one spare remote station.

END OF SECTION

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SECTION 28 3111
BUILDING INTRUSION DETECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Intrusion detection system requirements.
B. Alarm control unit.
C. Keypads.
D. Initiating devices.
E. Alarm notification appliances.
F. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.
B. Section 08 7100 - Door Hardware: Electrically operated locks and door holder devices to be monitored and controlled by intrusion detection system.
C. Section 26 0526 - Grounding and Bonding for Electrical Systems.
D. Section 26 0533.13 - Conduit for Electrical Systems.
E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
F. Section 28 1000 - Access Control: For interface with intrusion detection system.
G. Section 28 2000 - Video Surveillance: For interface with intrusion detection system.
H. Section 28 4600 - Fire Detection and Alarm.

1.03 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
D. UL 365 - Police Station Connected Burglar Alarm Units and Systems; Current Edition, Including All Revisions.
E. UL 609 - Local Burglar Alarm Units and Systems; Current Edition, Including All Revisions.
F. UL 634 - Connectors and Switches for Use with Burglar-Alarm Systems; Current Edition, Including All Revisions.
G. UL 636 - Holdup Alarm Units and Systems; Current Edition, Including All Revisions.
H. UL 639 - Intrusion-Detection Units; Current Edition, Including All Revisions.
I. UL 864 - Control Units and Accessories for Fire Alarm Systems; Current Edition, Including All Revisions.
J. UL 1037 - Antitheft Alarms and Devices; Current Edition, Including All Revisions.

K. UL 1076 - Proprietary Burglar Alarm Units and Systems; Current Edition, Including All Revisions.

L. UL 1610 - Central-Station Burglar-Alarm Units; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate compatibility of devices for the installed locations with work provided under other sections or by others.
      a. Doors and Windows: See appropriate Division 8 sections.
      b. Fences and Gates: See appropriate Division 32 sections.
   2. Coordinate the placement of sensors and keypads with millwork, furniture, equipment, etc. installed under other sections or by others.
   3. Coordinate the work with other installers to provide communication lines required for alarm control unit connection to central station.
   4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Conduct meeting with facility representative and other related equipment manufacturers to discuss intrusion detection system interface requirements.

C. Sequencing:
   1. Do not install sensors and keypads until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each system component. Include ratings, configurations, standard wiring diagrams, dimensions, finishes, service condition requirements, and installed features.
   1. Motion Detectors: Include detailed motion detection coverage range diagrams.

C. Shop Drawings: Include plan views indicating locations of system components and proposed size, type, and routing of conduits and/or cables. Include system interconnection schematic diagrams. Include requirements for interface with other systems.

D. Design Data: Include standby battery calculations.

E. Certify that proposed system design and components meet or exceed specified requirements.

F. Evidence of qualifications for installer.

G. Evidence of qualifications for maintenance contractor (if different entity from installer).

H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

I. Manufacturer’s detailed field testing procedures.

J. Field quality control test reports.

K. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
   1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

L. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

M. Maintenance contracts.

N. Project Record Documents: Record actual locations of system components and installed wiring arrangements and routing.

O. Software: One copy of software not resident in read-only memory.

P. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Fuses: Two for each type and size installed.
   3. Extra Initiating Devices: One for each type installed.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with intrusion detection systems of similar size, type, and complexity and providing contract maintenance service as a regular part of their business; authorized representative of control unit manufacturer.
   1. Contract maintenance office located within 50 miles of project site.

E. Maintenance Contractor Qualifications: Same entity as installer.

F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum two year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 INTRUSION DETECTION SYSTEM REQUIREMENTS

A. Provide new intrusion detection system consisting of all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Alarm Control Unit: New addressable alarm control panel located as indicated.

C. Combination fire/intrusion systems are not permitted.
   1. Where combination fire/intrusion systems are specifically indicated or permitted in Section 28 4600 or approved by Electrical Engineer.
   2. Where approved by authority having jurisdiction.
   3. Where alarm control units also comply with requirements of Section 28 4600, including being listed and labeled as complying with UL 864.

D. Initiating Device Requirements:
   1. Protected Premises: Entire building as indicated.
   2. Provide magnetic contacts to monitor opened/closed position for:
      a. All perimeter doors and windows.
      b. Designated interior doors.
      c. All roof access doors and hatches.
      d. All overhead doors.
      e. All perimeter hatch doors (e.g. compactor hatches).
   3. Provide motion detectors to detect intruder in designated areas.
   4. Provide photoelectric beams to detect intruder in designated areas.
   5. Provide glass break detectors to monitor:
      a. Designated perimeter windows.
   6. Provide seismic sensors to detect tampering for:
      a. Safes.
      b. ATM machines.
   7. Provide asset protection sensors to monitor:
   8. Provide hold-up/panic switches for:
      a. All cash registers; provide hold-up/panic button, money clip switch, and foot rail switch.
      b. Cash office; provide hold-up/panic button.
   9. Provide water sensors to detect presence of water for:
      a. Basements.
      b. Air conditioning condensation drip pans.
      c. Areas beneath water heaters.
      d. Refrigeration drain basins.
      e. Designated restrooms.
      f. Areas with sump pumps.
   10. Provide temperature sensors to detect:
      a. Temperatures above selected setpoint for designated freezer/refrigeration units.
      b. Temperatures above selected setpoint for designated server rooms.
      c. Temperatures below selected setpoint for designated sprinkler riser rooms.
   11. Provide humidity sensors to detect:
      a. Humidity above selected setpoint for designated server rooms.

12. Provide power loss sensors to detect an extended power failure for:
    a. All freezer/refrigeration units.

E. Alarm Notification and Reporting Requirements:
1. Activate alarm notification at alarm control unit and associated keypads/annunciators with appropriate zone information displayed.

F. Interface with Other Systems:
1. Provide products compatible with other systems requiring interface with intrusion detection system.
2. Interface with access control system as specified in Section 28 1000.
    a. Capable of affecting access for designated doors for selected intrusion detection system events.
    b. Capable of affecting intrusion detection system status for selected access control system events.
3. Interface with video surveillance system as specified in Section 28 2000.
    a. Capable of activating video surveillance system and controlling camera inputs/video outputs for selected intrusion detection system events.
4. Interface with electrically operated door hardware as specified in Section 08 7100.
    a. Capable of locking/unlocking/releasing designated doors for selected intrusion detection system events.

G. Provide products listed, classified, and labeled as suitable for the purpose intended.
1. Local Alarm Units and Systems: Listed and labeled as complying with UL 609.
2. Central Station Alarm Units: Listed and labeled as complying with UL 1610.
3. Proprietary Alarm Units and Systems: Listed and labeled as complying with UL 1076.
4. Police Station Connected Alarm Units and Systems: Listed and labeled as complying with UL 365.

H. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B, consumer application.

2.02 ALARM CONTROL UNIT

A. Manufacturers:
1. Addressable Alarm Control Panel:
    a. Bosch Security Systems: www.boschsecurity.us/#sle.
    b. Digital Security Controls (DSC); a brand of Tyco International: www.dsc.com/#sle.
    c. Honeywell International, Inc: www.security.honeywell.com/#sle.
2. Conventional (Non-Addressable) Alarm Control panel:
    a. Digital Security Controls (DSC); a brand of Tyco International: www.dsc.com/#sle.
    b. Honeywell International, Inc: www.security.honeywell.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.
4. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer.

B. Alarm Control Panel: Modular construction.
1. Enclosure: Lockable; provide tamper protection.
2. Power Supply:
    a. Primary Power: 120 VAC; provide suitable transformer/power supply; supervised for loss of AC power.

b. Secondary Power: Standby battery; provide suitable capacity for minimum standby time required by listing requirements, applicable codes, and authority having jurisdiction, but not less than four hours; provide suitable battery charger; supervised for low battery condition; protected from accidental reversal of battery leads.

C. Alarm Initiating Circuits: Supervised.
1. Hardwired Zones: Supports both normally closed and normally open conventional (non-addressable) initiating devices.
2. Addressable Zones: Supports addressable initiating devices and modules using multiplexed polling loops.
3. Wireless Zones: Supports wireless devices using wireless receivers and repeaters.
4. Minimum Number of Zones Supported: Equivalent to basis of design.

D. Alarm Notification Circuits: Supervised.

E. Communications Interfaces: Supervised.
1. Supports system reporting to central station receivers via integral interface or accessory interface modules using:
a. Telephone lines.
b. Digital cellular network.
c. Internet/intranet (IP addressing).
d. Long-range radio (LRR).
2. Supported Reporting Format(s): Compatible with central station.
3. Supports split reporting.

F. Keypads: Supervised.
1. Minimum Number of Keypads Supported: Equivalent to basis of design.

G. Peripheral Devices: Supervised; provide tamper protection.

H. Output Relays:
1. Relay Modules: Form C relays (normally open and normally closed); provide tamper protection.
2. Programmable to respond to system events, according to defined scheduling, or by manual activation from keypad.
3. Minimum Number of Output Relays Supported: Equivalent to basis of design.

I. User Codes:
1. Each user code to be individually assignable to any defined authority level for configurable access to system features and functions.
2. Minimum Number of User Codes Supported: Equivalent to basis of design.

J. Partitions:
1. Each partition to operate independently with individually programmable annunciation, control, and reporting functions.
2. Supports common partition shared by other assigned partitions.
3. Each zone to be individually assignable to any partition.
4. Each keypad to be individually assignable to any partition.
5. Each output relay to be individually assignable to any partition.
6. Each user code to be individually assignable to any partition.
7. Minimum Number of Partitions Supported: Equivalent to basis of design.

K. Scheduling:
1. Provide time/calendar-based scheduling capability for automated system control.
2. Supports open/close schedules for control of arming/disarming and reporting.
3. Supports timed events including, but not limited to:

a. Point bypass/unbypass.
b. Relay activate/deactivate.
4. Supports automatic adjustment for daylight savings time.
5. Supports holiday schedules.

L. Event Log:
1. Stores system events including time, date, partition, zone, and user code where applicable.
2. Supports viewing of event log on keypads.
3. Supports viewing of event log on remote PC.
4. Supports printing of event logs on local printer.
5. Minimum Number of Events Stored: Equivalent to basis of design.

M. Features:
1. Capable of being programmed locally or remotely.
2. Capable of being armed via key switch.
3. Supports panic/duress codes.
4. Supports force arming.
5. Supports cross zoning.
6. Supports swinger bypass.
7. Supports walk test mode.
8. Supports user interface via:
a. Telephone.
b. Web browser.
c. Mobile device.
d. Pager.
e. Personal wireless device.

2.03 KEYPADS

A. Manufacturer: Same as manufacturer of alarm control unit.

B. Provides interface to alarm control unit for system control and remote annunciation.

C. Provides visual notification of system status and zone information.

D. Provides audible notification to indicate system status, entry/exit delay, and alarm situations; provide separate distinguishable sounds for alarm and trouble conditions.

E. Keypad Type: Only LCD or graphic touch screen keypads are acceptable. Do not use LED keypads.

F. Graphic Touch Screen Keypads: Displays system status and zone information using plain English on graphic display; touch screen interface.

G. LCD Keypads: Displays system status and zone information using plain English on alphanumeric display; illuminated keys.

H. LED Keypads: Displays system status and zone information using LED indicators; illuminated keys.

I. Keypad Color: To be selected by Architect from manufacturer's available standard colors.

J. Basis of Design Products:

2.04 INITIATING DEVICES

A. Manufacturers: Same as manufacturer of alarm control units where possible.
1. Substitutions: See Section 01 6000 - Product Requirements.

B. General Requirements:
   1. Provide devices suitable for intended application and location to be installed.
   2. Outdoor Units: Weather resistant, suitable for outdoor use.
   3. Addressable Systems:
      a. Addressable Devices: Individually identifiable by control unit.
      b. Provide suitable addressable modules for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
   4. Wireless Devices:
      a. Reports sensor status to control panel via self-contained or separate accessory wireless transmitter.
      b. Sends periodic check-in signals to control panel for reporting of missing devices.
      c. Reports low battery condition before its battery becomes too discharged to power the transmitter.
      d. Provide tamper protection.

C. Contacts:
   1. Listed and labeled as complying with UL 634.
   2. Magnetic Contacts: Encapsulated reed switch(es) and separate magnet; designed to monitor opened/closed position of doors or windows.
      a. Use standard security contacts (not balanced magnetic type) unless otherwise indicated.
      b. High Security Contacts: Balanced magnetic type; designed to activate upon attempts to defeat contact through external magnetic tampering.
   3. Contact Color: To be selected by Architect from manufacturer's available standard colors.

D. Motion Detectors:
   1. Listed and labeled as complying with UL 639.
   2. Passive Infrared (PIR) Motion Detectors: Designed to detect intruder by sensing movement of thermal energy between zones.
   3. Dual Technology PIR/Microwave Motion Detectors: Designed to detect intruder using combination of passive infrared technology (by sensing movement of thermal energy between zones) and microwave technology (by sensing frequency shifts in emitted and reflected high frequency microwave signals).

E. Photoelectric Beams:
   1. Listed and labeled as complying with UL 639.
   2. Designed to activate upon interruption of pulsed infrared light beam between transmitter and receiver.
   3. Furnished with adjustable beam blocking time required for activation.

F. Glass Break Detectors:
   1. Listed and labeled as complying with UL 639.
   2. Suitable for the glass type to be monitored.
   3. Accurately discriminates false alarms from true glass break events.
   4. Furnished with selectable sensitivity.

G. Seismic Sensors:
   1. Listed and labeled as complying with UL 639.
   2. Designed to detect vibrations from intrusion attempts using tools including, but not limited to, hammers, drills, torches, and explosives.

H. Asset Protection Sensors:
   1. Listed and labeled as complying with UL 1037.

I. Hold-Up/Panic Switches:

1. Listed and labeled as complying with UL 634 or UL 636 as applicable.
2. Hold-Up/Panic Buttons: Manual push button operation.
3. Money Clip Switches: Designed for installation in cash drawers; activates upon removal of bill from switch.
4. Foot Rail Switches: Floor-mounted; designed for easy foot operation while minimizing possibility of false alarms.

J. Water Sensors:
1. Designed to activate upon detecting presence of water or other non-flammable conductive liquids.

K. Temperature Sensors:
1. Designed to activate upon detecting temperatures above or below selected setpoints.

L. Humidity Sensors:
1. Designed to activate upon detecting humidity levels above or below selected setpoints.

M. Power Loss Sensors:
1. Designed to activate upon detecting loss of power.

2.05 ALARM NOTIFICATION APPLIANCES

A. Manufacturers: Same as manufacturer of alarm control units where possible.
1. Substitutions: See Section 01 6000 - Product Requirements.

B. Provide alarm notification appliances suitable for connection to control unit outputs.

C. Outdoor Units: Weather resistant, suitable for outdoor use.

D. Bells: Motor-driven.
1. Size: 10 inches, nominal.
2. Minimum Sound Output: 80 dB at 10 feet (1 m).

E. Sirens: Speaker with self-contained siren driver.
1. Minimum Sound Output:
a. Indoor Units: 100 dB at 3 feet (1 m).
b. Outdoor Units: 110 dB at 3 feet (1 m).
2. Provide tamper switches for outdoor units.

F. Strobes:
1. Color: Clear.
2. Provide tamper switches for outdoor units.

G. Basis of Design Products:

2.06 ACCESSORIES

A. Provide components as indicated or as required for connection of alarm control unit to devices and other systems indicated.

B. Provide wireless receivers and repeaters as indicated or as required for communication between wireless devices and alarm control unit; provide tamper protection.

C. Provide cables as indicated or as required for connections between system components.

D. Provide end-of-line resistors (EOLR) as required for supervision of hardwired zones.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of system components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive system components.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to system.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Wiring Method: Unless otherwise indicated, use cables (not in conduit).
   1. Use listed plenum rated cables in spaces used for environmental air.
   2. Install wiring in conduit where required for rough-in, where required by authority having jurisdiction, and where exposed to damage.
   3. Conduit: Comply with Section 26 0533.13.
   4. Conceal all cables unless specifically indicated to be exposed.
   5. Cables in the following areas may be exposed, unless otherwise indicated:
      a. Equipment closets.
      b. Within joists in areas with no ceiling.
   6. Route exposed cables parallel or perpendicular to building structural members and surfaces.

D. Provide grounding and bonding in accordance with Section 26 0526.

E. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

F. Identify system wiring and components in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

C. Prepare and start system in accordance with manufacturer's instructions.

D. Inspection and testing to include, at a minimum:
   1. Test each initiating device for proper response by alarm control unit.
      a. Test glass break detectors using only manufacturer's recommended glass break simulation test units.
   2. Test for proper operation of alarm notification appliances.
   3. Test for proper operation of output relays.
   4. Test for proper operation of communication interfaces and central station reporting.

5. Test for proper interface with other systems.

E. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 ADJUSTING

A. Program system parameters according to requirements of Owner.

3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.

D. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of four hours of training.
   3. Instructor: Manufacturer's authorized representative.
   4. Location: At project site.

3.07 PROTECTION

A. Protect installed system components from subsequent construction operations.

3.08 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide to Owner, a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of intrusion detection system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

C. Conduct site visit at least once every three months to perform inspection, testing, and preventive maintenance. Submit report to Owner indicating maintenance performed along with evaluations and recommendations.

D. Provide trouble call-back service upon notification by Owner:
   1. Include allowance for call-back service during normal working hours at no extra cost to Owner.

2. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

END OF SECTION

SECTION 28 4600
FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire alarm system design and installation, including all components, wiring, and conduit.

B. Transmitters for communication with supervising station.

C. Replacement and removal of existing fire alarm system components, wiring, and conduit indicated.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.

B. Section 14 2400 - Hydraulic Elevators: Elevator systems monitored and controlled by fire alarm system.

C. Section 21 1300 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.

D. Section 23 3300 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

E. Section 27 5129.13 - Rescue Assistance Signal Systems: Two-way emergency communication systems for areas of refuge/rescue assistance.

1.03 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

F. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Drawings must be prepared using AutoCAD Release 2018.

C. Evidence of designer qualifications.

D. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
   1. Copy (if any) of list of data required by authority having jurisdiction.
   2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
   4. System zone boundaries and interfaces to fire safety systems.
   5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
   6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
   7. List of all devices on each signaling line circuit, with spare capacity indicated.
   8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
   9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
   10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
   11. Certification by the manufacturer of the control unit that the system design complies with the contract documents.
   12. Do not show existing components to be removed.

E. Evidence of installer qualifications.

F. Evidence of instructor qualifications; training lesson plan outline.

G. Evidence of maintenance contractor qualifications, if different from installer.

H. Inspection and Test Reports:
   1. Submit inspection and test plan prior to closeout demonstration.
   2. Submit documentation of satisfactory inspections and tests.
   3. Submit NFPA 72 "Inspection and Test Form," filled out.

I. Operating and Maintenance Data: See Section 01 7800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
   1. Complete set of specified design documents, as approved by authority having jurisdiction.
   2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
   3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
   4. List of recommended spare parts, tools, and instruments for testing.
   5. Replacement parts list with current prices, and source of supply.
   6. Detailed troubleshooting guide and large scale input/output matrix.
   7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
   8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

J. Project Record Documents: See Section 01 7800 for additional requirements; have one set available during closeout demonstration:
   1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.

2. "As installed" wiring and schematic diagrams, with final terminal identifications.
3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

K. Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
3. Certificate of Occupancy.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer , with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.

B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.

C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.

C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Alarm Control Units and Accessories - Basis of Design: Simplex Fire Alarm System.

B. Initiating Devices and Notification Appliances:
1. Same manufacturer as control units.
2. Provide initiating devices and notification appliances made by the same manufacturer, where possible.

C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIRE ALARM SYSTEM

A. Fire Alarm System: Provide modifications and extensions to the existing automatic fire detection and alarm system:
   1. Provide all components necessary for a complete operational fire alarm system, regardless of whether shown in the contract documents or not.
   2. Protected Premises: Entire building shown on drawings.
   3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
      a. ADA Standards.
      b. The requirements of the local authority having jurisdiction , which is City of Inglewood's Building Safety Division.
      c. Applicable local codes.
      d. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
   4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
   5. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.
   6. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
   7. Program notification zones and voice messages as directed by Owner.
   8. Master Fire Alarm Control Unit: New, located at 1st floor Delivery/Work room next to existing FACP.

B. Supervising Stations and Fire Department Connections:
   1. Public Fire Department Notification: By remote supervising station.
   2. Remote Supervising Station: UL-listed central station under contract to facility.
   3. Means of Transmission to Remote Supervising Station: Digital alarm communicator transmitter (DACT), 2 telephone lines.

C. Circuits:
   1. Initiating Device Circuits (IDC): Class B, Style A.
   2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
   3. Notification Appliance Circuits (NAC): Class B, Style W.

D. Power Sources:
   1. Primary: Dedicated branch circuits of the facility power distribution system.
   2. Secondary: Storage batteries.
   3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
   4. Each Computer System: Provide uninterruptible power supply (UPS).

2.03 EXISTING COMPONENTS

A. Existing Fire Alarm System: Remove existing components indicated and incorporate remaining components into new system, under warranty as if they were new; do not take existing portions of system out of service until new portions are fully operational, tested, and connected to existing system.

B. Clearly label components that are "Not In Service."

C. Remove unused existing components and materials from site and dispose of properly.

2.04 FIRE SAFETY SYSTEMS INTERFACES

A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
   1. Sprinkler water control valves.
   2. Dry-pipe sprinkler system pressure.
   3. Dry-pipe sprinkler valve room low temperature.
   4. Elevator shut-down control circuits.

B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
   1. Sprinkler water flow.
   2. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.

C. Elevators:
   1. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.
   2. Elevator Machine Room Heat Detector: Shut down elevator power prior to hoistway sprinkler activation.
   3. Sprinkler pressure or waterflow: Shut down elevator power prior to hoistway sprinkler activation.

D. HVAC:
   1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.

E. Doors:
   1. Smoke Barrier Door Magnetic Holders: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor. Refer to Section 08 7100.
   2. Electromagnetic Door Locks on Egress Doors: Unlock upon activation of any alarm initiating device or suppression system in smoke zone that doors serve as egress from. Refer to Section 08 7100.

2.05 COMPONENTS

A. General:
   1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
   2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.

B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.

C. Addressable Fire Alarm Control Unit - Basis of Design: Replace existing Simplex FACP with a new 4100ES with emergency voice communication system.

D. Remote Annunciators: New Simplex annunciator panel with Microphone.

E. Initiating Devices:
   1. Addressable Systems:
      a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
      b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
   2. Manual Pull Stations: Simplex.
   3. Smoke Detectors: Simplex.

4. Heat Detectors: Simplex.
5. Addressable Interface Devices: Simplex.

F. Notification Appliances:
1. Speakers: Simplex.
2. Speaker/Strobes: Simplex.

G. Circuit Conductors: Copper or optical fiber; provide 200 feet extra; color code and label.

H. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.

I. Locks and Keys: Deliver keys to Owner.

J. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
2. Provide one for each control unit where operations are to be performed.
3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
4. Provide extra copy with operation and maintenance data submittal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and the contract documents.

B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.

C. Obtain Owner's approval of locations of devices, before installation.

D. Install instruction cards and labels.

3.02 INSPECTION AND TESTING FOR COMPLETION

A. Notify Owner 7 days prior to beginning completion inspections and tests.

B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.

E. Provide all tools, software, and supplies required to accomplish inspection and testing.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

G. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.03 OWNER PERSONNEL INSTRUCTION

A. Provide the following instruction to designated Owner personnel:
1. Hands-On Instruction: On-site, using operational system.
2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.

B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
   1. Initial Training: 1 session pre-closeout.

C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
   1. Initial Training: 1 session pre-closeout.

D. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

3.04 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
   1. Be prepared to conduct any of the required tests.
   2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
   3. Have authorized technical representative of control unit manufacturer present during demonstration.
   4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
   5. Repeat demonstration until successful.

3.05 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
   1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
   2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
   3. Record keeping required by NFPA 72 and authorities having jurisdiction.

C. Provide trouble call-back service upon notification by Owner:
   1. Provide on-site response within 2 hours of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
   3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

D. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

E. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.

F. Comply with Owner's requirements for access to facility and security.

END OF SECTION

SECTION 31 1000
SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Clearing and grubbing of the site, including the removal of debris, vegetation, foreign objects, concrete slabs and foundations, asphalt paving, portland concrete paving and curbs, site lighting and bases, site walls, area drains and catch basins, unwanted existing underground utilities and drain lines, conduits, trees, and other site construction as indicated and as required for grading the site suitable for constructing the proposed project.

1.02 RELATED REQUIREMENTS

PART 2 PRODUCTS

2.01 MATERIALS

A. Sedimentation Barrier: See Section 01 5713 - Temporary Erosion and Sediment Control.

B. Fill Material: As indicated in the Project Geotechnical Report and approved by the Geotechnical Engineer.

PART 3 EXECUTION

3.01 PREPARATION

A. Erect barriers, fences, guard rails, enclosures, and shoring to protect personnel, structures, the public, and site improvements and utilities to be maintained intact.

B. Protect and maintain benchmarks and survey control points from disturbance during construction.

C. Locate and clearly flag trees and vegetation to remain or be relocated.

D. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to the Owner.

3.02 SITE CLEARING

A. Comply with additional requirements specified in Section 01 7000 - Execution and Closeout Requirements.

B. Fill depressions caused by clearing and grubbing operations with material satisfactory to the geotechnical engineer unless further excavation or earthwork is indicated.

C. Place fill material in horizontal layers in accordance with the recommendations in the project geotechnical report and compact each layer to a density satisfactory to the geotechnical engineer.

3.03 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths is encountered in a manner to prevent intermingling with underlying subsoil or other waste.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3.04 EXISTING UTILITIES AND BUILT ELEMENTS

A. Coordinate work with utility companies; notify before starting work and comply with local requirements; obtain required permits.

B. Protect existing utilities, utility structures, and associated appurtenances to remain from damage.

C. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Owner's Representative not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's Representative written permission.

D. Do not disrupt public utilities without permit from authority having jurisdiction.

E. Protect existing structures and other elements that are not to be removed. Remove unwanted existing utilities as indicated or as uncovered by work, and cap in a manner conforming to Code. Determine status of utility lines encountered that are not shown on the Contract Drawings. If abandoned, remove and dispose of in proper manner.

F. Install sedimentation barrier according to Section 01 5713 - Temporary Erosion and Sediment Control.

G. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
   1. Arrange with utility companies to shut off indicated utilities.
   2. Check with local jurisdiction for any needed inspection permits.

3.05 CLEARING AND GRUBBING

A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, trash enclosure area, paving, lawns, and planting beds.

B. Clear site after relocating vegetation in accordance with ANSI A300 Part 6.

C. Preservation of existing vegetation: The construction schedule shall consider the amount and duration of soil exposed to erosion by wind, rainfall, and vehicle tracking and seek to minimize disturbed soil during the rainy season. A schedule shall be prepared that shows the sequencing of construction activities with installation of maintenance of soil stabilization and sediment control BMPs.

D. Do not remove or damage vegetation beyond limits indicated on drawings.

E. Install substantial, highly visible fences at least 6 feet high to prevent inadvertent damage to vegetation to remain:
   1. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
   2. Around other vegetation to remain within vegetation removal limits.

3. See Section 01 5000 for fence construction requirements.

F. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum subsoil disturbance.

3.06 REMOVED VEGETATION PROCESSING

A. Do not burn, bury, landfill, or leave on-site, except as indicated on drawings.

3.07 SITE IMPROVEMENTS

A. Remove existing above and below grade improvements as indicated and as necessary to facilitate new construction.

B. Demolish and completely remove existing construction as indicated from the site, including subsurface conditions designated to be removed or required to be removed to facilitate the work of the proposed project.
   1. Demolish asphalt, concrete, and masonry in small sections. Continuously wet down debris to prevent creation of dust or fire hazard.
   2. Fragments: Remove from the site asphalt and concrete fragments exceeding 6 inches in maximum dimension.

3.08 DEBRIS

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and windblown debris from public and private lands.

END OF SECTION

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SECTION 31 2200
GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rough grading.

1.02 RELATED REQUIREMENTS

A. Section 31 1000 - Site Clearing.
B. Project Geotechnical Report.
C. Standard Specifications for Public Works Construction (Greenbook); current edition.

1.03 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with the Standards Specifications for Public Works Construction (Greenbook); current edition.
B. Perform work in accordance with Project Geotechnical Report.

PART 2 PRODUCTS

2.01 MATERIALS

A. Gravel: Excavated on-site.
   1. Graded according to ASTM D2487 Group Symbol GW, GP, or SP.
B. Fill Material: As indicated in the Project Geotechnical Report and approved by the Geotechnical Engineer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify survey bench mark and intended elevations for grading areas are as indicated.
B. Verify the absence of standing or ponding water.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.
B. Stake and flag locations of known utilities.

C. Locate, identify, and protect above- and below-grade utilities to remain.

D. Provide temporary means and methods to remove standing or ponding water from areas prior to grading.

E. Protect site features to remain, including but not limited to bench marks, survey control points, and fences.

3.03 ROUGH GRADING

A. Excavate and fill subgrade material to elevations indicated on plans.

B. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
   1. Remove sod, grass, and any other vegetation before stripping top soil.
   2. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
   3. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
   4. Strip topsoil to depth indicated on drawings.

C. Horizontally bench existing slopes greater than 1:4.

D. Replace displaced subgrade in accordance with Section 31 2323.

E. Remove and replace unsuitable materials as specified fill.

3.04 FINE GRADING

A. Scrape and spread subgrade material uniformly smooth and without disruptions as indicated on drawings.

3.05 SOIL REMOVAL

A. Stockpile topsoil to be re-used on site; remove remainder from site.
   1. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water and other erosion control measures.
      a. Limit height of topsoil stockpiles to 72 inches.
      b. Do not stockpile topsoil within plant protection zones.
      c. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or resued.

B. Stockpile subsoil to be re-used on site; remove remainder from site.

3.06 TOLERANCES

A. Top Surface: Plus or minus 1/2 inch.

3.07 FIELD QUALITY CONTROL

A. Compaction density testing shall be as described in the Project Geotechnical Report and as approved by the Geotechnical Engineer.

3.08 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Remove unused stockpiled subsoil. Grade stockpile area to prevent standing water.
C. Leave site clean and raked, ready to receive work.

END OF SECTION

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SECTION 32 0190
LANDSCAPE MAINTENANCE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, material, equipment and services required to maintain landscape in a healthy growing condition and in a neat and attractive appearance throughout the maintenance period.

1.02 RELATED REQUIREMENTS

A. Division 32 Section Landscape Irrigation

B. Division 32 Section Landscape Work

1.03 QUALITY ASSURANCE

A. The Maintenance Contractor shall be experienced in horticulture and landscape maintenance, practices and techniques, and shall provide sufficient number of workers with adequate equipment to perform the work during the maintenance period.

1.04 MAINTENANCE PERIOD

A. Continuously maintain the entire project area during the progress of the work and during the ninety (90) calendar-day maintenance period until final acceptance of the project by the Landscape Architect,
   1. Maintenance Period begins after all punchlist and corrective items have been accepted by the Landscape Architect and owner.

B. Maintenance period shall not start until all punch list items are addressed, when all elements of construction, planting and irrigation for the entire project are in accordance with Plans and Specifications. A prime requirement is that all lawn and landscape areas shall be planted and that all lawn areas shall show an even, healthy stand of grass seedlings which shall have been mown twice. If such criteria are met to the satisfaction of the Landscape Architect, a written notification shall be issued to establish the effective beginning date of maintenance period.

C. Any day of improper maintenance, as determined by the Landscape Architect, shall not be credited as an acceptable maintenance period day. The maintenance period shall be extended on a daily basis if the work is not in accordance to the Plans and Specifications. Project shall not be segmented into maintenance areas or phases, unless authorization of the Landscape Architect is obtained.

D. Maintenance shall continue beyond the ninety (90) day maintenance period, as required, until final acceptance is given by the Landscape Architect.

E. Contractor shall provide protection to the project site during the maintenance period.

F. A phased maintenance period will not be accepted.

1.05 GUARANTEE AND REPLACEMENT

A. Guarantee: All plant material and other materials installed under the Contract shall be guaranteed against any and all poor, inadequate or inferior materials and/or workmanship or improper maintenance, as determined by the Landscape Architect, and shall be replaced by the Contractor at his expense. Warranty periods are as follows:
   1. Trees, vines, and shrubs: One Year
   2. Groundcover and Turf: One year.

B. Replacement: Any materials found to be dead, missing, declining or not in a satisfactory or healthy condition during the maintenance period shall be replaced immediately. The Landscape Architect shall be sole judge as to the condition of material. Material to be replaced within the guarantee period shall be replaced by the Contractor within five (5) days of written notification by the Landscape Architect or owner. All replacement materials and installations shall comply with the Plans and Specifications. Any plant missing due to suspected theft shall be replaced by the Contractor. If the Contractor suspects that theft may be a problem, the Contractor shall provide written documentation to the owner that security on this site needs to be intensified.

C. The Contractor may relieve himself of theft responsibility if after the security notice, with no result, a written notice to the owner shall be given that plant material will not be replaced for theft or vandalism due to lack of site security being maintained. This procedure may take place only during the Landscape Maintenance Period.

1.06 OBSERVATION SCHEDULE

A. Normal progress observations shall be requested by the Contractor from the Landscape Architect as per observations listed in specifications Division 32 Section "Landscape Work."

1.07 FINAL ACCEPTANCE OF THE PROJECT

A. Upon completion of all project work, including maintenance period, the Landscape Architect will, upon proper written request, make an observation to determine final project acceptability. Provide minimum a 14 business day notice for final observation.

B. Where observed work does not comply with the Plans and Specifications, replace rejected work and continue specified maintenance period until reinspected by the Landscape Architect and determined to be acceptable. All replacement materials and installations shall be in accordance with the Plans and Specifications. Remove rejected work and materials immediately from project. Prior to the date of final observation, Contractor shall provide the Landscape Architect with all Record Drawings and close out documents in accordance with the Plans and Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials used shall either conform to Specifications in other sections or shall otherwise be acceptable to the Landscape Architect. The Landscape Architect shall be given a monthly record of all herbicides, insecticides and disease control chemicals used and irrigation scheduled. The amendments listed herein are for Bidding purposes only. The final amendment types and rates shall be determined by the Agronomic Soils Test.

B. Turf maintenance fertilizer: shall be "Best Turf Supreme 16-6-8":
   1. 16% nitrogen

2. 6% phosphoric acid
3. 8% potash

C. Slow Release maintenance fertilizer: shall be "Best Superturf 25-5-5 with Polyon" and shall consist of the following percents by weight:
1. 25% nitrogen
2. 5% phosphoric acid
3. 5% potash

PART 3 - EXECUTION

3.01 GENERAL MAINTENANCE

A. General: Proper maintenance, including watering, weeding, mowing, edging, fertilization, rolling of turf, replacement and infill of mulch replacement of jute mesh, infill of settled areas, repairing and protection shall be required until entire project is finally accepted, but in any event for a period of not less than the specified maintenance period after planting.

B. Watering: Thoroughly water to insure vigorous and healthy growth until work is accepted. Water in a manner to prevent erosion due to application of excessive quantities of water. When hand watering use a water wand to break the water force. Supplemental hand water as required to maintain and encourage the proper growth of new and existing plant material.

C. Weeding:
1. Keep plant basins, turf areas and areas between plants free of weeds. Control weeds with pre-emergent herbicides. If weeds develop, use legally approved herbicides and hand remove. Avoid frequent soil cultivation that destroys shallow roots. Weeding also shall be included in all paved areas including public or private sidewalks.
2. Hand weed as required in addition to the application of weed control herbicides and pre-emergent to maintain all areas free of weeds including turf species other than the specified species. Periodic or predetermined weeding schedules may not be adequate and should be supplemented.
3. Apply a final application of pre-emergent herbicide at the end of the maintenance period, just prior to final acceptance.

D. Tree basins in turf areas: Remove turf from around each tree to create a 4'- 0" diameter basin depending on tree size.

E. Pruning
1. Trees: Prune trees to select and develop permanent scaffold branches; to eliminate narrow V-shaped branch forks that lack strength; to reduce toppling and wind damage by thinning out crowns; to maintain a natural appearance and to balance crown with roots. All trees shall be maintained and pruned in accordance with the accepted practices of the American Society of Consulting Arborists (ASCA). Prune only as directed by the Registered Consulting Arborists and Landscape Architect.
2. Shrubs: Same objectives as for trees. Shrubs shall not be clipped into balled or boxed forms unless such is required by the landscape plans. All pruning cuts shall be made to lateral branches, buds or flush with the trunk. Stubbing and heading shall not be permitted.
3. Only skilled workers shall perform pruning work in accordance with standard horticultural pruning practices. Remove from the project all pruned branches and material. Remove and replace any plant material excessively pruned or malformed resulting from improper pruning practices at no additional costs to the owner.

4. Improperly pruned plant material as determined by the Landscape Architect is to be replaced at no cost to the owner.

F. Staking and Guys: Stakes and guys shall remain in place through the guarantee period and shall be inspected and adjusted to prevent rubbing that causes bark wounds. Remove nursery stake from all trees that are staked with lodgepole stakes per specifications. Provide supplemental staking or guying as required during high wind events to prevent damage to trees. Any damaged tree caused by high winds must be replaced by the contractor at no cost to the owner.

G. Insect, Animal, Rodent and Disease Control: Maintain proper control with legally approved materials as required as part of the Contract.

H. Protection: The Contractor shall maintain protection of the planted areas. Damaged areas shall be repaired or replaced at the Contractor's expense.

I. Trash: Remove trash weekly in all planted areas, pedestrian walkways and parking areas. Maintain all areas free of trash, clippings, and debris at all times.

J. Replacement: As per Guarantee and Replacement Specifications of this Section.

K. Fertilization: Fertilize all planting areas, during and just prior to end of maintenance period with the slow release maintenance fertilizer as indicated in the agronomic soils report.

L. Watering: Planting areas shall be watered at such frequency as weather conditions require to replenish soil moisture below root zone and to establish healthy plant material.
1. Contractor is responsible for water audits and payment of any local penalties by local water districts at no additional cost to the Owner.

3.02 LAWN AND TURF MAINTENANCE

A. Mowing and Edging
1. Initial mowing of turf will commence when the grass has reached a height of two and one-half (2-1/2) inches. The height of cut will be two (2) inches. After initial establishment maintain Bermuda and creeping grasses at 1½” and fescues or rye grass at 2”. Mowing will be at least every 4-6 days for the second through fifth cuttings, and at least once per week after that for fescue. Bermuda grass is to be mowed minimum twice a week. Bent grass is to be mowed daily. Turf must be well established and free of bare spots and weeds to the satisfaction of the Landscape Architect prior to final acceptance.
2. Excess grass clippings shall be picked up and removed from the site and premises. Let turf areas dry out enough so that mower wheels do not skid, tear or mark the lawn. Edges shall be trimmed at 90 degrees to pavement, at least weekly or as needed for neat appearance. Clippings shall be removed from paved and planting areas, etc. and disposed of from the site.

B. Watering: Lawns shall be watered at such frequency as weather conditions require to replenish soil moisture below root zone and to establish healthy strands of grass.
1. Contractor is responsible for water audits and payment of any local penalties by local water districts at no additional cost to the Owner.

C. Disease control: Control turf diseases throughout the maintenance period with legally approved fungicides and herbicides. Replace any damaged or infected grass.

D. Weed Control:
1. Control broad leaf weeds with selective, legally approved herbicides throughout maintenance period.
2. A final application of selective herbicide shall be applied at the end of the landscape maintenance period, acceptance, just prior to final acceptance.

3. Hand weed as required in addition to the application of weed control herbicides and pre-emergent to maintain all areas free of weeds including turf species other than the specified species. Periodic or predetermined weeding schedules may not be adequate and should be supplemented.

E. Fertilization:
1. During maintenance period an application of turf maintenance fertilizer, as specified, shall be made at thirty (30) day intervals from the date of maintenance period start at a rate of five (5) pounds per 1,000 square feet, and as required by the agronomic soils report.
2. Final application (just prior to final acceptance) shall be made with the slow-release maintenance fertilizer as required by the agronomic soils report.
3. Replacement: At conclusion of maintenance period a final observation of lawn and turf areas shall be made. Remove diseased areas and unhealthy strands of grass from the site; do not bury into the soil. Replant areas with material and in a manner as specified on the Plans and Specifications at no additional cost to the Owner. All grass is to be fully grown with 100% coverage with a suitable thatch layer prior to turnover and final acceptance.

F. Arborist: Provide a written report and recommendations as required by the landscape architect if any plant material is in the sole opinion of the landscape architect, declining, stressed, infested, or otherwise not growing at the anticipated growth rate. The report is to include Agronomic Soils Test Data and recommendations and be provided at no cost to the owner.

3.03 IRRIGATION SYSTEM

A. System Observation: The Contractor shall check all systems for proper operation. Lateral lines shall be flushed out after removing the last sprinkler head or two at each end of the lateral. All heads are to be adjusted as necessary for unimpeded head to head coverage.

B. Valves: Contractor shall set, and verify that all pressure regulating valves to the operating pressure specified on the drawings.

C. Controllers: Set and program automatic controllers for seasonal water requirements. Give the Owner's Representative instructions on how to turn off system in case of emergency.

D. If the irrigation system is designed and specified to be operable from a central irrigation computer controller located off site, or a standard controller on site. The contractor shall demonstrate to Landscape Architect, Owner's Representative and future maintenance contractor that the central irrigation system is fully installed and operational from this off site control system as described and specified. Contractor shall make all adjustments as necessary to insure this operation prior to final acceptance.

E. Contractor shall set up and coordinate training for the Maintenance Contractor (Provider) on the irrigation controller, and pump with the manufactures representative. Maintenance period shall not end, and the project will not be accepted until this training has been completed.

F. Repairs: Repair all damages to irrigation system at the Contractor's expense. Repairs shall be made within twenty-four (24) hours or sooner to prevent damage to site improvements.

3.04 CLEANING

A. During maintenance work, keep pavements clean and work area in an orderly condition. Haul away and remove all debris from landscape areas, and do not leave any clippings, fertilizer, amendments and / or other material from landscape planting and/or maintenance period.

B. Powerwash all pavement and flatwork as necessary to remove all staining and tire marks on surfaces caused by maintenance or construction vehicles, prior to final acceptance.

END OF SECTION

SECTION 32 1123
AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aggregate base course.

B. Permeable Aggregate base for Synthetic Turf (Non-athletic)

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading: Preparation of site for base course.

B. Section 32 1216 - Asphalt Paving: Finish and binder asphalt courses.

C. Section 32 1313 - Concrete Paving: Finish concrete surface course.

D. Section 32815 - Synthetic Turf Surfacing (Non-Athletic)

E. Project Geotechnical Report.

1.03 REFERENCE STANDARDS

A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil–Aggregate Subbase, Base, and Surface Courses; 2017 (Reapproved 2021).

B. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2022, with Errata .

C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.

D. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012 (Reapproved 2021).

E. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).

F. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)); 2012 (Reapproved 2021).

G. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2015.

H. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017, with Editorial Revision (2020).

I. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2023.

J. Standard Specifications for Public Works Construction (Greenbook); current edition.

K. California State Department of Transportation Standard Specifications (Caltrans); current edition.

L. Project Geotechnical Report.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Materials Sources: Submit name of imported materials source, location, and gradation of the material.

C. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

D. Compaction Density Test Reports.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Aggregate Storage, General:
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.
   3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aggregate Base: Crushed aggregate base, conforming to Greenbook, Section 200-2.2.

B. Permeable Aggregate Base for Synthetic Turf (Non-athletic)
   1. Uniformly mixed processed stone.
   2. Aggregate shall be durableand not exceed 12% loss of materials.
   3. Permeability requirements: 20 inches / hour.
   4. Permeable Base Gradation

Sieve	Percent Passing by Weight Base Aggregate Layer
1 inch	100%
0.75 inch	90-100%
0.50 inch	80-100%
0.375 inch	70-100%
No. 4	50-85%
No. 8	30-65%
No. 16	10-50%
No. 30	0-35%
No. 60	0-15%
No. 100	0-8%
No. 200	0-2%

C. Herbicide: Commercial chemical for weed control, registered by the EPA.

2.02 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for general requirements for testing and analysis of aggregate materials.

B. Where aggregate materials are specified using ASTM D2487 classification, testing of samples for compliance will be provided before delivery to site.
C. If tests indicate materials do not meet specified requirements, change material and retest.
D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the work are as indicated.
B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.02 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

A. Spread aggregate over prepared substrate to a total compacted thickness as indicated on plans.
B. Place aggregate in maximum 4 inch layers and roller compact to specified density.
C. Level and contour surfaces to elevations and gradients indicated.
D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
E. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
G. Permeable Aggregate Base for Synthetic Turf
    1. Contractor shall apply water to the aggregate on site to attain and maintain 90% to 100% of the optimum moisture content.
    2. Prior to placement, remove any excess of contaminated backfill from any existing drainage trenches.
    3. Should any separation of the materials occur during any stage of the spreading or stockpiling, the Contractor must immediately remove and dispose of segregated material and correct or change handling procedures to prevent further separation. Double handling of materials should be avoided.
    4. Contractor shall utilize laser-controlled equipment for the garding of the permeable aggregate to ensure accuracy in grading tolerances.
    5. Each layer must be spread uniformly with equpment that will not cause perceptible separation in gradation (segregation of the Permeable aggregate base), preferably a self-propelled paving machine, or a small grader or low ground pressure (LPG) dozer.
    6. Contractor shall grade the surface of the processed staone acceptable to receive the final synthetic turf surface system.
    7. The permeable aggregate base shall be compacted to a minimum compaction of 90% and maximum compaction of 93%. (ASTM D698)
    8. The area should be compacted at 2 inch increments to ensure uniform compaction throughout the entire area.

9. Permeable Aggregate Base Testing
    a. Test samples shall be taken (at minimum of) one sample per every 10,000 square feet or as otherwise directed by the Owner's Representative. Final in-place aggregate shall have a percolation rate of note less than 20 inches per hour.
        1) ASTM F2898 (Overflow)
    b. If at any time the permeable base does not meet specifications, it shall be the Contractor's responsibility to rstore the processed stone based to the required grade and density.
    c. When the Contractor has independantly confirmed that the site is in compliance with all above listed requirements, he shall schedule a final inspection by the qualified FieldTurf installer. Any idefiiciencies uncovered during this inspection must be remedied to the satisifaction of the installer before the base system will be considered acceptable.

H. Apply herbicide per manufacturer requirements.

3.04 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.

B. Scheduled Compacted Thickness: Within 1/4 inch.

C. Variation From Design Elevation: Within 1/2 inch.

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for general requirements for field inspection and testing.

B. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.

C. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with AASHTO T 180, ASTM D698 ("standard Proctor"), or ASTM D1557 ("modified Proctor").

D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

E. Proof roll compacted aggregate at surfaces that will be under slabs-on-grade.

3.06 CLEANING

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 32 1216
ASPHALT PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single course bituminous concrete paving.
B. Double course bituminous concrete paving.
C. Surface sealer.

1.02 RELATED REQUIREMENTS

A. Section 31 2200 - Grading: Preparation of site for paving and base.
B. Section 32 1123 - Aggregate Base Courses: Aggregate base course.
C. Section 32 1313 - Concrete Paving: Concrete substrate.
D. Section 32 1313 - Concrete Paving: Concrete curbs.
E. Section 321723 - Pavement Markings
F. Project Geotechnical Report.

1.03 REFERENCE STANDARDS

A. AI MS-2 - Asphalt Mix Design Methods; 2015.
B. AI MS-19 - Basic Asphalt Emulsion Manual; 2008.
C. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 2009a.
D. ASTM D3549 Standard Test Method for Thickness of Height of Compacted Asphalt Mixture Specimens (2018).
E. ASTM D2950 Standard Test Method of Density of Bituminous Concrete in Place by Nuclear Methods (2020).
F. Standard Specifications for Public Works Construction (SSPWC,Greenbook); current edition.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with Standard Specifications for Public Works Construction (SSPWC) and the California Department of Transportation (Caltrans), latest editions and supplements for asphalt paving work.
B. Obtain materials from same source throughout.

1.05 **SUBMITTALS**

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1.06 FIELD CONDITIONS

A. Do not place asphalt when ambient air or base surface temperature is less than 50 degrees Fahrenheit and rising, or surface is wet or frozen.

B. Place bitumen mixture when temperature is not more than 15 F degrees below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 PRODUCTS

2.01 MATERIALS

A. Asphalt Concrete: Greenbook, Section 203-6.

B. Aggregate Base Course: Section 321123.

2.02 ASPHALT PAVING MIXES AND MIX DESIGN

A. Parking lots including drive aisles and parking spaces:
   1. Wearing course: III-C3 PG 64-10 per SPPWC Section 203-6.5.
   2. Base course: III-B3 PG 64-10 per SPPWC Section 203-6.5.

B. Playgrounds/Hardcourts/Playcourts.
   1. Wearing course: III-D PG 64-10 per SPPWC Section 203-6.5.
   2. Base course: III-B2 PG 64-10 per SPPWC Section 203-6.5.

C. Submit proposed mix design of each class of mix for review prior to beginning of work.

2.03 SOURCE QUALITY CONTROL

A. Test mix design and samples in accordance with AI MS-2.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

3.02 AGGREGATE BASE COURSE

A. See Section 32 1123.

3.03 PREPARATION - TACK COAT

A. Apply tack coat in accordance with SPPWC (Greenbook), Section 302-5.4.

B. Apply tack coat to existing pavement including planed surfaces, between hot mix asphalt layers, and to vertical surfaces of curbs, gutters, construction joints and milled pavements.

3.04 PLACING ASPHALT PAVEMENT - SINGLE COURSE

A. Install work in accordance with SPPWC (Greenbook) 302-5.

B. Place asphalt within 24 hours of applying primer or tack coat.

C. Place to a maximum thickness per SSPWC 302-5.

D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.05 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

A. Install work in accordance with SPPWC (Greenbook) 302-5.

B. Place asphalt base course within 24 hours of applying primer or tack coat.

C. No pavement course shall be less than 1 1/2 inches in compacted thickness. If finish pavement thickness is 3 inches or less it shall be laid as single course.

D. No pavement course shall be more than 4 inches in compacted thickness.

E. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

F. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.06 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.

B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.

C. Variation from True Elevation: Within 1/2 inch.

3.07 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for quality control.

B. Provide final surfaces of uniform texture, conforming to required grades and cross sections.
   1. Test in-place asphalt concrete courses for compliance with requirement for density, thickness, and surface smoothness.
      a. Density:
         1) Field test density of compacted asphalt surface course shall be determined by a properly calibrated nuclear test gage in accordance with ASTM D2950.
      b. Thickness:
         1) Thickness of compacted paving shall conform to ASTM D3549 based on core test.
         2) In-place compacted thicknessess shall conform to the dimensions indicated on the contract drawings. Variation from indicated thicknesses shall not exceed plus-or-minus 1/4-inch.

C. Flood Testing
   1. Flood Test: Before acceptance, all pavements in the presence of the project inspector shall be water tested to ensure proper drainage. The contractor shall provide water for this purpose. The flooding shall be conducted with a water tank truck. Depressions where the water ponds to a depth of more than 1/8-inch shall be filled or the slope corrected to provide proper drainage. The edges of the fill shall be feathered and smoothed so that the joint between the fill and the original surface is invisible. No standing water shall remain 1-hour after test.

3.08 PROTECTION

A. Immediately after placement, protect pavement from mechanical injury for 2 days or until surface temperature is less than 140 degrees F.

END OF SECTION

SECTION 32 1313
CONCRETE PAVING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Parking lots.
B. Curbs and gutters.
C. Walks.
D. Stairs and ramps.
E. Mow strips.
F. Wheel stops.
G. Pavement marking paint.
H. Detectable warnings.

1.02 RELATED REQUIREMENTS

A. Divison 00 Section Available Project Information (Geotechnical Report)
B. Division 03 Section Cast-in-Place Concrete
C. Division 05 Section Metal Fabrications
D. Division 05 Section Pipe and Tube Railings.
E. Division 05 Section Decorative Metal Railings
F. Division 31 Section Grading
G. Division 32 Section Architectural Site Concrete
H. Division 32 Section Concrete Paving Joint Sealants
I. Division 32 Section Chain Link Fences and Gates

1.03 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: Fly ash and other pozzolans, and ground granulated blast-furnace slag, subject to compliance with requirements.

1.04 PREINSTALLATION CONFERENCE

A. Conduct conference at Project site two weeks prior to start of work of this section. Required attendance of all affected installers.
    1. Review methods and procedures related to concrete paving, including but not limited to, the following:
    2. Concrete mixture design
    3. Testing and inspection procedures.
    4. Concrete finishes and finishing.
    5. Cold- and hot-weather concreting procedures.
    6. Curing procedures.

7. Construction joints.
8. Forms and form-removal limitations.
9. Reinforcement accessory installation.
10. Concrete repair procedures.
11. Protection of cast-in-place architectural site concrete.
12. Review special testing and inspection procedures.
13. Placement sequence and schedule.
14. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
    a. Contractor's superintendent.
    b. Ready-mix concrete manufacturer.
    c. Concrete paving subcontractor.
    d. District's or Client's Representative
    e. Architect's Representative
    f. Inspector of Record
    g. Provide meeting minutes for pre-installation conference

1.05 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Proprietary admixtures, pigments, curing compounds, hardeners, sealers, form-release agents, etc.: Indicate compatibility with other materials used.
   2. Stenciling material

B. LEED Submittals:
   1. Product Data for Credit MR credit 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating costs for each product having recycled content.

C. Samples for Initial Selection: For each type of product, finish, ingredient, or admixture requiring color selection.
   1. Submit full range of manufacturer’s standard and custom range of colors and products for review and selection. Provide custom colors on samples as required. Upon selection of color, submit 12”x12” sample of material in the specified color finish for review by Landscape Architect in addition to the specified mock ups.
   2. Stencil Shop Drawing submittal to Architect for approval is required before mock up work for stenciling is to begin.
   3. Wheel Stops: 6 - 7 inches wide in cross section; with fasteners.
   4. Preformed Traffic-Calming Devices: 6 inches long showing cross section; with fasteners.

D. Design Mixtures: Submit proposed mix designs and test data for each class of concrete and for each method of placement.
   1. Prepare mix designs on the basis of field experience (preferred) and/or trial mixes, in compliance with California Building Code (CBC), Chapter 1903A.
   2. Prepare mix designs on the basis of field experience (preferred) and/or trial mixes, in compliance with California Building Code (CBC), Chapter 1903.
   3. Mix designs shall be prepared, stamped and signed by a structural or civil engineer registered in the State of California.
      a. Mix designs shall be reviewed by the Architect (AOR) and Structural Engineer of Record (SEOR).
   4. Identify for each mix design submitted the method by which proportions have been selected.

a. For mix designs based on trial mixtures, include trial mix proportions, test results, graphical analysis and show required average compressive strength f'c results. Provide gross weight and yield per cubic yard of trial mixes.
b. Indicate quantity of each ingredient per cubic yard of concrete and percentages.
c. Indicate type and quantity of admixtures proposed or required.
d. Indicate water to cement ratio by weight.
e. Measured slump.
f. Measured air content.
g. Provide shrinkage test results.

5. Multiple mix designs or multiple manufacturers shall not be permitted for the same application.

E. Provide maximum 5% fly ash; ground granulated blast-furnace slag, and/or silica fume content as Portland cement replacement in all concrete.

F. Submit proposed alternate design mixtures for review by the Architect and SEOR when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

G. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Shop drawings should include details such as reveals, recessed lights, handrails, or other elements requiring steel coordination.
1. Coordinate with and identify the details of the Contract Drawings on the shop drawings.
2. Comply with ACI 315, part B and CRSI requirements.

H. Construction Joint Layout: Indicate proposed construction joints required to construct the structure. Submit dimensioned drawing indicating layout of construction joints, contraction (control) joints, dowelled joints, decorative scoring and placement sequence of concrete if different than layout indicated on plans.
1. Location of construction joints are subject to approval of the Architect.
2. All form seams are to align with construction joints or reveals.

I. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.

J. Pavement-Marking Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

K. Stencil Shop Drawings(stamped concrete): Indicate modular size and pattern of stencil for concrete. Drawings shall reflect a plan, which denotes the location of the stamped pattern stencil based on stencil module size.

L. Qualification Data: For qualified ready-mix concrete manufacturer (batch plant) and installer of detectable warnings.

M. Welding Certificates: Submit certifications signed by AWS Certified Welding Inspector of prequalified welding procedures, qualifications of welding procedures unless prequalified, qualifications of welding operators and qualifications of welders.

N. Material Certificates: For the following, submit manufacturer data, test results, and technical information for aggregate, sand and cement, submit ½ cubic foot physical sample. For sealant submit manufacturer color standard and custom palette together with physical samples:
1. Cementitious materials.
2. Aggregates and sand.
3. Steel reinforcement and reinforcement accessories.

4. Fiber reinforcement.
5. Admixtures.
6. Curing compounds.
7. Applied finish materials.
8. Bonding agent and epoxy adhesives.
9. Joint fillers.
10. Sealer
11. Sealant.
12. Pigments.

O. Material Test Reports: For each of the following:
1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

P. Detectable Warning Device Warranty: Submit copies of manufacture's five year warranty for each of these products and manufacturer custom and standard color palette.

Q. Field quality-control reports.
1. Submit copies of delivery tickets complying with ASTM C 94 for each load of concrete delivered to the site. Tickets shall include all information required by the referenced standard.

R. Minutes of pre-installation conference.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with CBC Chapter 19A.
1. Chemical products field-applied to concrete shall comply with the air quality requirements of authorities having jurisdiction.
2. Comply with requirements of local, State and other authorities having jurisdiction for work performed within public right-of ways.

B. Regulatory Requirements: Comply with CBC Chapter 19.

C. Chemical products field-applied to concrete shall comply with the air quality requirements of authorities having jurisdiction.

D. Comply with requirements of local, State and other authorities having jurisdiction for work performed within public right-of ways.

E. Industry Standards: Comply with the following unless modified by requirements in the Contract Documents.(Plans and specifications)
1. ACI 301, "Specifications for Structural Concrete".
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials".
3. ACI 302.1R, "Guide for Concrete Floor and Slab Construction".
4. ACI 304R, "Guide for Measuring, Mixing, Transporting, and Placing Concrete".
5. ACI 305R, "Hot Weather Concreting".
6. ACI 306.1, "Standard Specification for Cold Weather Concreting".
7. ACI 318, "Building Code Requirements for Structural Concrete".
8. ACI 347, "Guide to Formwork for Concrete".
9. ACI SP-66, "ACI Detailing Manual".
10. CRSI, "Manual of Standard Practice".
11. CRSI, "Placing Reinforcing Bars".

F. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of cast-in-place, surface-applied unit-paver-type detectable truncated dome products.

G. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

H. Source Limitations for Concrete Paving: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties. Secure all material required for the duration of the project as needed to ensure consistent quality in appearance.

I. Welding Qualifications: Comply with CBC Chapter 17A.
   1. Qualify welding procedures and welding personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel" prior to performing any welding.
   2. Qualify welding inspection personnel according to AWS QC1, "Standard for AWS Certification of Welding Inspectors."

J. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

K. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

L. ACI Publications: Comply with ACI 301 unless otherwise indicated.

M. Mockups: Before casting concrete paving, build mockups to verify selections made under Sample submittals and to fully demonstrate typical joints (including expansion and saw cut joints), surface finish, texture, color tolerances, standard of workmanship and completed product. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
      a. Paving Modules: Construct at least one 4 ft. x 4 ft. mockup of each color, finish, and mix design of special paving module, including stenciled areas, banding and curbs
      b. Radial Paving Patterns: Construct at least one 180 sq. ft. mockup of curved or radial paving patterns.
      c. Retarder Finishes: Mock ups shall clearly demonstrate an even finish. No blotchy or light areas.
      d. Abrasive-Blast Finishes: Mockups shall clearly demonstrate 3 levels of depth of cut for abrasive-blast finishes for Architect's review.
      e. Stairs: Construct minimum 2 risers and treads X 4’ long with nosing grooves and stained color within groves for each color and finish specified.
      f. Mow Strip: minimum 6’ long for each specified width and color.
      g. Stenciled Letters or Graphics: minimum 4 letters and one full size graphic for each size, font setting and finish. Mock up to be set on concrete pavement or wall matching conditions of final install.
      h. Truncated Domes: minimum 3’X6’ long set in concrete with concrete base and grout.
   2. Build mockups full-size, matching site concrete components indicated on the Drawings. Mock-ups shall be complete in every detail, including joints, reveals, edges, chamfers, etc. Include complex joinery conditions where necessary to integrate to other Project components as indicated including multiple pour conditions. Mockups should be provided for each finish, color, joint and detail specified.
   3. Maintain accurate records of variables associated with each mockup to facilitate the matching of accepted mockups during actual construction.

4. Demonstrate curing, cleaning, and protecting of cast-in-place concrete paving, finishes, and contraction and expansion joints, as applicable.
5. Mockup Acceptance: Obtain Architect's approval of mockups before casting architectural site concrete and paving.
    a. The Architect may reject mockups that, in the Architect's sole judgment, do not demonstrate an acceptable completed product, including, but not limited to, color, joint work, surface finish, texture, tolerances, and standard of workmanship
    b. The Architect may require modifications to mockups to obtain acceptable results.
    c. The Architect may require modifications to mockup repairs to obtain acceptable results.
    d. The Architect may require removal and reconstruction of mockups to obtain acceptable results. Multiple mock ups maybe required.
    e. Contractor shall provide additional mockups as required to obtain results acceptable to the Architect at no additional cost to the Owner.
6. Mockup Disposition: Accepted mockups shall not become part of the completed Project. Maintain mockup onsite for the duration of construction and until all work has been accepted. Remove and legally dispose mockups after acceptance of final installed work. prior to Project Completion. If sufficient permanent concrete paving work has been completed, Contractor may submit a written request to Architect to transfer quality control for concrete paving from the accepted mockups to one or more designated portions of the permanent work.
7. Provide written meeting minutes for each mock up review indicating items reviewed, approvals, rejections, connections, or other action items.

1.07 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending, damage, and rust.
    1. Label bundles with durable identification tags. Maintain reinforcement identification after bundles are broken.
    2. Store reinforcement to avoid excessive rusting or fouling with grease, oil, dirt or other bond-weakening contaminants.
    3. Avoid damaging applied coatings, if any, on steel reinforcement.

PART 2 - PRODUCTS

2.01 FORMS

A. Formwork: / Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth surfaces.

1. Set forms to alignment, grade and required dimensions. Formwork shall not deviate more than 1/4 inch from required vertical positions and 1/4 inch from required horizontal positions. Exposed Surfaces: Provide faced plywood panels complying with, or equivalent to, DOC PS 1, Structural I. Provide minimum 7-ply plywood and provide balance sheets for panels coated one-side only. Furnish in largest practicable sizes to minimize number of joints. Provide Medium-Density Overlay (MDO) panels or high density overlay (HDO) panels, with mill-applied release agent and edge sealant. Provide one of the following panels, or comparable substituted product:
   a. Olympic Panel Products, "B-Matte 333 MDO Concrete Form." Overlay Color: Brown.
   b. Pacific Laminate Products, "ProFace MDO." Overlay Color: Black.
   c. Sylvan Products, LLC, "Armor Ply MDO" Overlay Color: Brown.
2. Hold forms rigidly in place by stakes, clamps, spreaders, and braces at 3 feet on centers, and where required to ensure rigidity.
3. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.
4. Place joint filler or backer rod on vertical surfaces in contact with concrete paving.
5. Benders or thin plank forms may be used on curves, grade changes, or curb returns. Back forms for curb returns may be made of ½-inch thick benders cleated together for full depth of the curb.
6. Keep forms in place until concrete is sufficiently hard to prevent damage to concrete.
7. Reuse of Forms:
   a. Do not reuse forms if there is any evidence of surface wear or defect which would impair quality of surface or edge.
   b. Thoroughly clean and properly coat forms before reuse.
   c. Do not use forms from previous projects.
8. Provide new forms specifically purchased for this project. Reuse of forms from past projects or contractors stock will not be accepted.

B. Curved Work: Kerf back of plywood form-facing panels, or use accepted flexible or curved forms for curved work with a radius of 100 feet or less.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.
   1. Obtain written acceptance of form release agent from integral colored concrete pigment manufacturer.
   2. Form-release agents shall be non-staining and can cause no visual effect to the finish.
   3. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.02 REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

B. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.
   1. Provide two-component "Speed Dowel System" manufactured by Greenstreak.

C. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

D. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
   1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

F. Zinc Repair Material: ASTM A 780.

G. Fiber Reinforecement
   1. **Required for topping slab only.**
   2. SikaFiber 800 Stealth. Follow manufactures recommendations.

2.03 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
   1. Portland Cement: ASTM C 150, Type II/V, gray, unless white cement is required to achieve colors indicated.
      a. Fly Ash: none accepted.

B. Normal-Weight Aggregates: ASTM C 33, complying with building code. Provide aggregates from a single source. All aggregates shall be free of materials with deleterious reactivity to alkali in cement when tested in accordance with ASTM C 289.
   1. Comply with CBC section 1903A.
   2. Comply with CBC section 1903.
   3. On grade concrete paving: Maximum Coarse-Aggregate Size: 1 inch nominal.
      a. Hard rock(crushed) mix; no pea gravel will be accepted.
   4. Topping slab concrete paving: Maximum Coarse-Aggregate size: 3/8 inch nominal.
      a. Hard rock(crushed) mix, no pea gravel will be accepted.
   5. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
      a. Color to be white to light no dark material.

C. Exposed Aggregate for topping slab: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
   1. Aggregate to match existing topping slab.
   2. Aggregate Sizes: 3/8 to 1/2 inch nominal.

D. Water: Potable and complying with ASTM C 94/C 94M.

E. Shrinkage-Reducing Admixture: Commercially formulated, shrinkage inhibitor capable of reducing initial shrinkage by 80% and long-term shrinkage by 50%. Provide product suitable for use with either air-entrained or non-air-entrained concrete as appropriate to structural member and project location.
   1. Products: Subject to compliance with requirements, provide the following(as required):
      a. Meet ASTM C494 requirements
         1) Euclid Chemical Company (The), an RPM company; EUCON SRA, SRA+.
         2) Grace Construction Products, W. R. Grace & Co.; Eclipse Floor, Eclipse Plus.
         3) Sika Corporation; Control 40.

F. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Davis Colors - Hydrotint(Liquid)
   2. Color: Provide samples to match existing integral colored concrete.

2.04 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry or cotton mats.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete. Provide products with not more than 100g/L volatile organic content.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. BASF Construction Chemicals, LLC; Confirm.
      b. Conspec by Dayton Superior; Aquafilm.

c. Nox-Crete Products Group; MONOFILM.

E. Clear, Waterborne, Membrane-Forming Curing Compound (Colored Concrete): Provide products that are acceptable to concrete color pigment manufacturer complying with ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of sealers with no glossy finish and compatible with specified sealer. Provide products with not more than 100g/L volatile organic content.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Sinak Corporation; The Cure3D

F. All curing materials should be dissipating without leaving a shiny, cloudy, or glossy finish. Curing material does not substitute requirement of a sealer.

2.05 STENCIL MATERIALS

A. Stencils: Manufacturer's standard, moisture-resistant paper or reusable plastic stencils, designed for use on concrete.

B. Shop drawings for all stencils.

C. Products: Subject to compliance with requirements.

2.06 HARDENERS AND SEALERS

A. Penetrating Liquid Floor and Horizontal Surface Treatment (Sealer): Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate water-based lithium quartz materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. Materials hsall be compatible with concrete admixtures and shall be recommended by manufacturer for intended use. Provide product with 0g/L volatile organic content.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Sinak Corporation; Concrete Sealer HLQ 125.

2.07 AGGREGATE BASE

A. Granular Fill: Class II crushed aggregate per Section 26 of Cal-Trans standards. Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

B. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch (9.5-mm), 20 to 10 / 10 to 30 percent passing a No. 100 (0.15-mm) sieve, and at least 0-5 percent passing No. 200 (0.075-mm) sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.08 RELATED MATERIALS

A. Joint Fillers:
   1. 1/4" thickness.
      a. Ceramar by W.R. Meadows. A closed cell isomeric polymer synthetic foam ASTM D 5249, Type 2 .
      b. Deck-O-Foam polyethylene by W.R. Meadows. A closed cell expansion joint fille ASTM D 4819

B. Bonding Agent: ASTM C 1059, Type II, non-re-emulsifiable. Provide proprietary products composed of latex polymers.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. W. R. Meadows, Inc.; “Acry-Lok”.

b. Grace Construction Products, W. R. Grace & Co.; "Daraweld C".
c. Larsen Products Corp., "Weld-Crete".

C. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete, and for anchoring dowels to hardened concrete.

D. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of reveal specified.
1. Provide W. R. Grace "Top-Cast".

2.09 DETECTABLE WARNING MATERIALS

A. General: All detectable warning systems shall comply with Americans with Disabilities Act (28 CFR Part 36 ADA Standards for Accessible Design, Appendix A, Section 4.29.2 Detectable Warnings on Walking Surfaces), and CBC requirements (Section 11B-24, 11B-705 and others). All detectable warning materials shall have raised truncated domes with a base diameter of nominal 0.90 inch (22.9 mm), tapering to a top diameter of 0.45 inch (11.4 mm),a height of nominal 0.20 inch (5.08 mm), and a center-to-center spacing of 2.35 inches (59.7 mm) nominal. The orientation of the dome pattern for all panels shall be parallel with the panel edges. Detectable warning materials shall visually contrast with surrounding areas.
1. California Compliance Warranty: All detectable warning systems shall be approved by DSA-AC. If not approved, DSA will accept a written five (5) year product warranty provided by the manufacturer of detectable warning products and directional surfaces. Such warranty shall indicate compliance with architectural standards as published in the current edition of the California Building Standards Code, and also include durability criteria which indicate that the shape, color fastness, confirmation, sound-on-cane acoustic quality, resilience, and attachment will not degrade significantly for at least five (5) years after initial installation. As defined by the State, "not degrade significantly" means that the product maintains at least 90 percent of its approved design characteristics, as determined by the enforcing agency.

B. Safety Step TD (Surfaced Truncated Domes)
1. Tradtional System
2. Ramp Up System
a. Power Bond option
3. Color: Yellow
4. Contact 909-514-1608; sales@safetysteptd.com

C. Concrete Paver Detectable Dome Warning System: Provide standard size precast architectural concrete paving units for installation in sand or mortar beds.
1. Basis-of Design Product: Provide the following, or comparable substitute product:
a. Wausau - ADA-2 Truncated dome pavers.
1) 12 inches by 12 inches, with 2 3/8 inches thickness.
2) Color A-40 Yellow (Federal Yellow No. 33538)

2.10 PAVEMENT MARKINGS

A. Color: [As indicated].

B. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.

1. Color: White, green, unless otherwise indicated. Use for non-accessible striping, directional arrows, numbering, and lettering.
2. Accessibility Color: Paint accessibility lines and markings blue color equal to Color No. 15090 per Federal Specification 595C.

2.11 WHEEL STOPS

A. Wheel Stops: Precast, air-entrained concrete, 3000 to 4000 -psi minimum compressive strength, 5-1/2 to 6 inches high by 6 to 7 inches wide by 48 inches long at singles stalls and 72 to 96 inches long at shared stalls. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
   1. Dowels: Galvanized steel or rebar, 1/2 inch in diameter, 18-inch minimum length.

2.12 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
   1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
   2. Proportioning:
      a. The proportioning of ingredients shall be such that the concrete can be readily worked into forms and around reinforcement under the conditions of placement to be used, without segregation or excessive bleeding.
      b. When proportioning by weight of loose, dry material, 94 pounds of cement shall be considered 1 cubic foot.
         1) Float/Broom Finish: Coarse aggregate 50 percent-50 percent fine aggregate.
         2) Exposed Aggregate Finish: Coarse aggregate 65 percent, fine aggregate 35 percent.
      c. Total water content shall not exceed 35 gallons per cubic yard of concrete.
      d. Weighing equipment shall be accurate within 1 pound and shall be adjustable for varying aggregate moisture content.
      e. A beam auxiliary shall register any part of the last 100 pounds of each aggregate. The aggregate hopper shall have a volume adjustment.
   3. Prepare compressive strength data for both 7-day and 28-day strengths.
      a. The 7-day compressive strength shall be at least 60 percent of the required 28- day strength.
      b. The 28-day compressive strength shall be as indicated.
      c. Provide drying shrinkage test data at 28 days, from not less than 3 test specimens.

B. Proportion mixtures to provide normal-weight concrete with the following properties:
   1. Typical Compressive Strength (28 Days): Provide the following minimum compressive strength (28 days) for concrete paving unless otherwise indicated: 3000 psi.
   2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50-0.60.
   3. Slump Limit: 4 inches, plus or minus 1 inch, unless indicated otherwise.
      a. Slump Limit (High-Range Water-reducing Admixture): 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture, plus or minus 1 inch, unless indicated otherwise.

C. Air Content, Exterior Exposed Concrete: Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having the following air entrainment for all exposed concrete with a weathering probability of severe or moderate per ACI-318-19, ACI 305R, and ACI 306R.

1. Provide air entrainment of 6.0 percent, plus or minus 1.5 percent at point of delivery for 1-inch and 3/4-inch nominal maximum aggregate size, if required unless indicated otherwise.

D. Limit "drying shrinkage" after 28 days of curing hardened concrete to 0.045 percent of the original concrete volume.

E. Limit water-soluble, chloride-ion content in hardened concrete to [0.15] [0.30] [1.00] percent by weight of cement.

F. Chemical Admixtures: Admixtures may only be used if they are incorporated into the accepted concrete mix designs. Use admixtures according to manufacturer's written instructions.
1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
2. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
3. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

G. Liquid Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with accepted mockup.

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M [or ASTM C 1116/C 1116M when fiber reinforcement is used]. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 and 90 deg. F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg. F (32 deg. C), reduce mixing and delivery time to 60 minutes.

B. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

C. Integral Colored Concrete Mixes: Add pigments at the concrete batch plant. Minimum batch size shall be three (3) yards. The same brand of cement, source of sand, and water/cement ratio shall be maintained for each load of the same color.
1. Batching Procedure: Before adding color-conditioning admixture, the mixing drum shall be thoroughly cleaned and wetted with approximately 40 gallons of the mix water and/or a portion of the aggregates. After cleaning and wetting of the drum, add the specified quantity of admixture correctly packaged for the mix design and batch quantity. Proceed with normal batching of balance of ingredients. After loading is complete, mix at mixing speed for a minimum of 15 minutes. Do not add water after a portion of the load has been discharged.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
2. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Grading."

C. Proceed with concrete paving installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.03 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

C. Slope stair and step treads at not less than 1.0 percent and not more than 2.0 percent cross slope to drain.

3.04 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.05 JOINTS

A. General: Form construction, isolation or expansion joint, and saw cut / contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
   1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Isolation (Expansion) Expansion Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
   1. Locate expansion joints at intervals of 20 feet maximum unless otherwise indicated.
   2. Extend joint fillers full width and depth of joint and recess 1 inch from finish surface where no joint sealant is indicated.
   3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
   4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
   5. Break steel at expansion joints.
   6. Dowels- provide prefabricated ‘speed dowel’ assemblies.

C. Saw Cut (Control) Joints: Form weakened-plane saw cut joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth plus 1/4 inch of the concrete thickness, as follows, and to match jointing of existing adjacent concrete paving:
   1. Continue steel reinforcement across sawcut joints unless otherwise indicated.

D. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/8-inch radius unless otherwise noted. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.06 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in. Notify other trades as necessary to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, and side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
   1. When air temperature has fallen to or is expected to fall below 40 deg. F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg. F (10 deg C) and not more than 80 deg. F (27 deg C) at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

M. Hot-Weather Placement: Comply with ACI 305R (ACI 305R M) and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below 90 deg. F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

N. Provide sand and base materials as indicated.

3.07 **FLOAT/BROOM FINISHING**

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
   1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
   2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture. Required to meet slip coefficient requirement.
   3. Portland cement concrete paving shall be stable, firm, and slip resistant and shall comply with **CBCSections 11B-302** and **11B-403**.

3.08 **EXPOSED AGGREGATE FINISHING(COURSE AGGREGATE)**

A. Protect all surroundings from overspray of liquid materials, including, but not limited to, adjacent horizontal surfaces, windows, roofs, walkways, drives, and landscaping.
   1. Apply surface protectant and /or plastic sheeting, sufficently taped in place.

B. Ensure to screed surface of concrete evenly to designated slope shown on approved civil grading plans.

C. Prepare concrete for retarder finish as recommended by retarder manufacturer.
   1. Do not use tools that may force the aggregate away from the surface creating a non-uniform surface after exposure.
   2. Screed or strike off the surface in two (2) directions using a wooden or metal straight edge to achieve the proper elevation in a sawing motion back and forth.
   3. Allow the bleed water to evaporate from the surface.
   4. Float concrete using a wooden hand/bull float.
   5. Do not overwork the surface, as this tends to drive the aggregate down away from the surface to be exposed.
   6. Float to a uniform appearance.

D. Mix surface retarder thoroughly prior to each use.

E. Apply surface retarder per manufacturers recommendations.

F. Remove surface retarder per manufacturers recommendations.

3.09 DETECTABLE WARNINGS

A. Detectable Warnings, General: Install detectable warnings as part of the concrete paving placement sequence. Set true to line and elevation. Comply with maximum slope and cross-slope requirements for accessible walkways.
   1. Blockouts: Form blockouts in concrete and asphalt pavements for installation of detectable paving units.
      a. Tolerance for Opening Size: Plus 1/4 inch, no minus.

B. Detectable warnings surfaces shall comply with **CBC Section 11B-705.1.**

C. Detectable warning surfaces shall be yellow conforming to **FS 33538 of Federal Standard 595C,** except for locations at curb ramps, islands, or cut through medians where color used shall contrast visually with that of adjacent walking surfaces, either light-on-dark or dark-on-light. **CBC Sections 11B-705.1.1.3 and 11B-705.1.1.5.**

D. Detectable warning surfaces shall differ from adjoining surfaces in resiliency or sound-on-cane contact. **CBC Section 11B-705.1.1.4.**

E. Provide 5 year minimum warranty per **DSA Bulletin 10/31/02, revised 04/09/08.**

F. Precast Concrete Detectable Warning Tiles: Comply with approved plans and details along with manufacturer's written instructions.

G. Cast-in-Place Detectable Warning Panel: Comply with manufacturer's written instructions.

H. Surface-Mounted Detectable Warning Tiles: Comply with manufacturer's written instructions. Do not install directly over asphalt pavements.

3.10 CONCRETE PROTECTION, CURING AND SEALING:

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306R for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

F. Seal Concrete: Apply specified sealer in accordance with manufacturer's recommendations.
1. Apply full strength in two coats with airless sprayer at the manufacturer's recommended rate.
2. After the first coat is completely dry, apply second coat at right angles to the first coat.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117, the Americans with Disabilities Act, the CBC and as follows:
1. Elevation: 1/8 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/8 inch. Surface must properly drain.
4. Surface Discontinuities: Maximum 1/4 inch, subject to further limitations of accessible routes.
5. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
6. Lateral Alignment and Spacing of Dowels: 1/4 inch.
7. Vertical Alignment of Dowels: 1/8 inch.
8. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/8 inch per 12 inches of dowel.
9. Joint Spacing: 3 inches, except joint position shall be within 1/4 inch of objects in alignment with joint such as benches, light poles, pull boxes, etc.
10. Sawcut Joint Depth: Plus 1/4 inch, no minus.
11. Joint Width: Plus 1/16 inch, no minus.

B. Stair Treads: Stair treads within a run shall be constructed equally and shall shed water away from the path of travel. Maximum tread slope down from riser to nosing in direction of travel: 1.0 percent, plus or minus 0.5 percent. Maximum tread cross-slope perpendicular to direction of travel: 1.8 percent, plus 0.2 percent, minus 1.0 percent or as required to shed water.

C. Ramps: Ramps shall shed water away from the path of travel. Maximum ramp slope in direction of travel: 8.33 percent. Maximum ramp cross-slope perpendicular to direction of travel: 1.8 percent, plus 0.2 percent, minus 1.0 percent or as required to shed water.

3.12 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils. Provide markings with a minimum width of 3 inches.
1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb./gal.

E. Accessible parking spaces serving a particular building or facility shall be located, and dispersed if serving more than one accessible entrance, on the shortest accessible routes to an entrance or to mulitple accessible entrances. **CBC Section 11B-208.3.1.**

F. Accessible parking spaces in a parking facility not serving a particular building or facility shall be located on the shortest accessible route to an accessible pedestrian entrance of the parking facility. **CBC Section 11B-208.3.1.**

G. Minimum number of required accessible parkng spaces shall be provided in accordance with **CBC Table 11B-208.2** for each parking facility provided.

H. For every six or fraction of six accessible parking spaces, at least one shall be an accessible van parking space. **CBC Section 11B-208.3.1.**

I. Accessible parking spaces and access aisles shall comply with **CBC Section 11B-502** and shall be dimensioned to the cenerlines of the marked lines as follows:
   1. Parking spaces and access aisles shall be mareked according to **CBC figures 11B-502.2, 11B-502.3, and 11B-502.3.3**. Their surfaces shall comply with **CBC Section 11B-302** and shall be at the same level with the slopes not steeper than 1:48 in any direction. **CBC Section 11B-502.4.**
   2. Parking spaces shall be 9'x18' minimum and van parking spaces shall be 12'x18' minimum with an adjacent access aisle of 5'x18' minimum. Access aisles shall be placed on either side of the parking spaces except be located on the passenger side for van parking spaces. Van parking spaces shall be permitted to be 9'x18' minimum where the access aisle is 8'x18' minimum.
   3. Access aisles shall be marked by a blue painted borderline around their perimeter. The areas within the blue borderlines shall be mareked with hatched lines a maxiumum of 36" on center in a color contrasting with that of the aisle surface, preferably blue or white. Access aisle markings may extend beyond the minimum requied length. **CBC Section 11B-502.3.3**
   4. Access aisles(parking spaces as well- similar application) shall not overlap the vehicular way. **CBC Section 11B-502.3.4**
   5. A verticle clearance of 8'-2" minimum shall be provided for accessible parking spaces, access aisles, and vehicular routes serving them. **CBC Section 11B-502.5**

J. At least one passenger loading zone shall be provided in every continuous 100 linear feet of loading zone space, or fraction thereof, complying with **CBC Section 11B-209 and 11B-503** as follows:
   1. Vehicle pull-up spaces shall be 8' x 20' minimum. Access aisles shall be 5' x 20' minimum and shall be adjacent and parallel to the vehicular pull-up spaces. They shall be the same level with slopes not steeper than 1:48 in any direction. **CBC Section 11B-503.4.**
   2. Access aisles for passenger drop-off and loading zones shall be marked with a painted borderlines around their perimeter. The areas within the borderlines shall be marked with hatched lines a maxiumum of 36" on center in a color contrasting with that of the aisle surface. **CBC Section 11B-503.3.**
   3. A vertical clearance of 9'-6" minimum shall be provided for vehicle pull-up spaces, access aisles, and a vehicular route serving them connecting a vehicular entrance and a vehicular exit. **CBC Section 11B-503.5.**

3.13 WHEEL STOPS

A. Securely attach wheel stops to paving with not less than two #4 galvanized steel dowels or rebar, minimum 18 inches long, located at one-quarter to one-third points. Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain at least one composite sample for each 20 cu. Yd., or fraction thereof of each concrete mixture placed each day.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg. F and below and when it is 80 deg. F and above, and one test for each composite sample.
   5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
   6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
      a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Owner, Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.15 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, cracked, chipped, stained or defective or that does not comply with requirements in this Section as determined by Landscape Architect. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude all but pedestrian traffic from paving for at least 28 days after placement. When construction traffic is permitted, maintain paving as clean as possible by providing adequate surface protection and by removing surface stains and spillage of materials as they occur.
   1. Rubber tire marks are unacceptable in the completed construction.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Project Completion inspections.

E. Repair of damaged, defective or rejected concrete is not permitted. Remove all concrete from expansion joint to expansion joint or greater as required to provide a constant continuous finish.

3.16 FINAL CLEANING

A. Remove all excess concrete, form materials, over pours, waste, etc., and legally dispose off-site.

B. Provide a final acid and power wash for all concrete paving surfaces. Do not use any material that will affect the appearance of the concrete.

C. All over pours in planting areas should be removed prior to landscape operations.

D. Clean concrete paving to remove stains, markings, dust, and debris.

END OF SECTION

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SECTION 32 1373
PAVEMENT JOINT SEALERS

PART 1 - GENERAL

1.01 SECTION INCLUDES: RELATED DOCUMENTS

A. Exterior joint sealant for non-traffic surfaces.

1.02 RELATED REQUIREMENTS

A. Division 32 Section Concrete Paving.

1.03 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch- (13-mm-), and 1/4-inch (6.4-mm) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

D. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

B. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

C. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

D. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.

E. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

F. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.06 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

B. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).

C. When joint substrates are wet or covered with frost.

D. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

E. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.02 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Landscape Architect from manufacturer's full range.

2.03 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Multicomponent Pourable Urethane Sealant (Sealant #1):
   1. Available Products:
      a. Pecora Corporation; Urexpan NR-200.
      b. Sika Corporation, Inc.; Sikaflex - 2c SL.
   2. Type and Grade: M (multicomponent) and P (pourable).
   3. Class: 25.
   4. Use Related to Exposure: T (traffic).
   5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

D. Multicomponent Nonsag Urethane (Sealant #2):
   1. Available Products:

a. Pecora Corporation; Dynatred.
b. Sika Corporation, Inc.; Sikaflex - 2c NS

2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

2.04 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.05 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of backer materials.
2. Do not stretch, twist, puncture, or tear backer materials.
3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

F. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.04 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

3.06 SCHEDULE

A. Horizontal Joints, less than 5 percent slope; Sealant No. 1.

B. Horizontal Joints, grades steeper than 5 percent; Sealant No. 2

C. Vertical Joints; Sealant No. 2

END OF SECTION

SECTION 32 1713
PARKING BUMPERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Precast concrete parking bumpers and anchorage.

1.02 REFERENCE STANDARDS

A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
B. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
C. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
D. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
E. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2023.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide unit configuration, dimensions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Parking Bumpers: Precast concrete, conforming to the following:
   1. Nominal Size: ____ inches high, ____ inches wide, ____ feet long.
   2. Cement: ASTM C150/C150M, Portland Type I - Normal; gray color.
   3. Concrete Materials: ASTM C330/C330M aggregate, water, and sand.
   4. Reinforcing Steel: ASTM A615/A615M, deformed steel bars; unfinished, strength and size commensurate with precast unit design.
   5. Air Entrainment Admixture: ASTM C260/C260M.
   6. Concrete Mix: Minimum ____ psi compressive strength after 28 days, air entrained to _____ percent.
   7. Embed reinforcing steel, and drill or sleeve for two dowels.
B. Dowels: Steel, unfinished; 1/2 inch diameter, ____ inch long, pointed tip.
C. Dowels: Cut reinforcing steel, 1/2 inch diameter, ____ inch long, pointed tip.
D. Dowels: As indicated on drawings.
E. Adhesive: Epoxy type.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install units without damage to shape or finish. Replace or repair damaged units.
B. Install units in alignment with adjacent work.
C. Fasten units in place with 2 dowels per unit.

END OF SECTION

SECTION 32 1723
PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Parking lot markings, including parking bays, crosswalks, arrows, curb markings, and ISA symbols.

1.02 RELATED REQUIREMENTS

A. Section 32 1216 - Asphalt Paving.

B. Section 32 1313 - Concrete Paving.

1.03 REFERENCE STANDARDS

A. AASHTO MP 24 - Standard Specification for Waterborne White and Yellow Traffic Paints; 2015 (Reapproved 2020).

B. California MUTCD - Manual of Uniform Traffic Control Devices for Streets and Highways; State of California Department of Transportation (FHWA's MUTCD as amended for use in California); current edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.

C. Certificates: Submit for each batch stating compliance with specified requirements.
   1. Painted pavement markings.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.

1.08 SEQUENCING

A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of markings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Painted Pavement Markings:
   1. Dunn-Edwards Corporation; Vin-L-Stripe Specialty Interior/Exterior Flat Zone Marking Paint.
   2. Sherwin Williams: Setfast Acrylic Traffic Paint.
   3. Pervo Paint Company: Acrylic Traffic Paint.
   4. Vista Paint Corporation: Traffic Paint.
   5. Equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Identify existing markings for removal.

B. Verification of Conditions: Verify that pavement is dry and ready for installation.

C. Notify Architect of unsatisfactory conditions before proceeding.

3.02 PREPARATION

A. Establish survey control points for locating and dimensioning of markings.

B. Place barricades, warning signs, and flags as necessary to alert approaching traffic.

C. Clean surfaces prior to installation.
   1. Remove dust, dirt, and other debris.
   2. Remove rubber deposits, existing paint markings, and other coatings.

D. Temporary Markings: Apply as directed by Architect.

E. Apply paint stencils by type and color at necessary intervals.

3.03 REQUIREMENTS

A. Accessible parking spaces serving a particular building or facility shall be located, and dispersed if serving more than one accessible entrance, on the shortest accessible routes to an entrance or to multiple accessible entrances. CBC Section 11B-208.3.1.

B. Accessible parking spaces in a parking facility not serving a particular building or facility shall be located on the shortest accessible route to an accessible pedestrian entrance of the parking facility. CBC Section 11B-208.3.1.

C. Minimum number of required accessible parking spaces shall be provided in accordance with CBC Table 11B-208.2 for each parking facility provided.

D. For every six or fraction of six accessible parking spaces, at least one shall be an accessible van parking space. CBC Section 11B-208.2.4.

E. Accessible parking spaces and access aisles shall comply with CBC Section 11B-502 and shall be dimensioned to the centerline of the marked lines as follows:
   1. Parking spaces and access aisles shall be marked according to CBC Section 11B-502.2, 11B-502.3, and 11B-502.3.3. Their surfaces shall comply with CBC Section 11B-302 and shall be at the same level with slopes not steeper than 1:48 in any direction. CBC Section 11B-502.4.
   2. Parking spaces shall be 9' x 18' minimum and van parking spaces shall be 12' x 18' minimum with an adjacent access aisle of 5' x 18' minimum. Access aisles shall be placed on either side of the parking spaces except be located on the passenger side for van parking spaces. Van parking spaces shall be permitted to be 9' x 18' minimum where the access aisle is 8' x18' minimum.
   3. Access aisles shall be marked by a blue painted borderline around their perimeter. The area within the blue borderlines shall be marked with hatched lines a maximum of 36" on center in a color contrasting with that of the aisle surface, preferably blue or white. Access aisle markings may extend beyond the minimum required length. CBC Section 11B-502.3.3.
   4. Access aisles (parking spaces as well - similar application) shall not overlap the vehicular way. CBC Section 11B-502.3.4.
   5. A vertical clearance of 8'-2" minimum shall be provided for accessible parking spaces, access aisles, and vehicular routes serving them. CBC Section 11B-502.5.

F. At least one passenger loading zone shall be provided in every continuous 100 linear feet of loading zone space, or fraction thereof, complying with CBC Section 11B-209 and 11B-503 as follows:
   1. Vehicle pull-up spaces shall be 8' x 20' minimum. Access aisles shall be 5' x 20' minimum and shall be adjacent and parallel to the vehicular pull-up spaces. They shall be the same level with slopes not steeper than 1:48 in any direction. CBC Section 11B-503.4.
   2. Access aisles for passenger drop-off and loading zones shall be marked with a painted borderlines around their perimeter. The areas within the borderlines shall be marked with hatched lines a maximum of 36" on center in a color contrasting with that of the aisle surface. CBC Section 11B-503.3.
   3. A vertical clearance of 9'-6" minimum shall be provided for vehicle pull-up spaces, access aisles, and a vehicular route serving them connecting a vehicular entrance and a vehicular exit. CBC Section 11B-503.5.

G. Bus loading zones and bus stops shall comply with CBC Sections 11B-209 and 11B-810.2 as follows:
   1. Boarding and alighting areas shall be 8' x 5' minimum, with 8' measured perpendicular to the curb or vehicle roadway edge, and with 5' measured parallel to the vehicle roadway. Slopes in 8' direction shall be 1:48 maximum. Slopes in 5' direction shall be the same as that of the roadway, to the maximum extent practicable. CBC Figure 11B-810.2.2.
   2. Bus shelters shall provide a minimum 30" x 48" clear floor or ground space (36" x 48" or 36" x 60" as applicable in an alcove), with slopes not steeper than 1:48 in any direction, entirely within the shelter complying with CBC Section 11B-305.
   3. Bus shelters shall be connected by an accessible route complying with CBC Section 11B-402 to a boarding and alighting area complying with CBC Section 11B-810.2. CBC Figure 11B-810.3.

H. Electric Vehicle Charging Stations:
   1. Where electric charging stations are provided, they shall be provided in accordance with CBC Section 11B-228.3, Table 11B-228.3.2.1 and CBC Section 11B-812.

2. Accessibility requirements for Public Use or Common Use EVCS facilities:
    a. Vehicle spaces and access aisles serving them shall comply with CBC Section 11B-302. Access aisles shall be at the same level as the vehicle space they serve. Changes in level, slopes exceeding 1:48, and detectable warnings shall not be permitted in vehicle spaces and access aisles. CBC Section 11B-812.3.
    b. Vehicle spaces, access aisles serving them and vehicular routes serving them shall provide a vertical clearance of 8’-2” minimum. CBC 11B-812.4.
    c. Accessible routes between EVCS parking, equipment and the building or facility served shall be provided per CBC Section 11B-812.5.
    d. Vehicle spaces for van accessible, standard accessible, ambulatory, and drive-up EVCS shall meet minimum length and width requirements per CBC Section 11B-812.6.
    e. Accessible EVCS stalls shall be marked “EV Charging Only” per CBC Section 11B-812.9 and Figure 11B-812.9.
    f. Access aisles for van accessible and standard accessible EVCS shall meet minimum length and width requirements and be marked per CBC Section 11B-812.7 the color of the perimeter, hatch lines and “No Parking” letters shall contrast with the surface color (blue color required for use at non-EVCS accessible parking shall not be used). Effective July 1, 2021, where one parking space and one electric vehicle charging space share an access aisle, access aisle marking shall comply with Section 11B-502.3.3 and shall not be required to comply with Section 11B-812.7.2. Additionally, where four or fewer total EVCS are provided within a facility, the access aisle for non-angled van accessible spaces may be located on either the driver or passenger side of the vehicle space. See CBC 11B-812.7.1 exception and 11B-812.7.2 exception.
    g. Where four or fewer total EVCS are provided, identification with an International Symbol or Accessibility (ISA) shall not be required.
    h. Where five to twenty-five total EVCS are provided, one van-accessible EVCS shall be identified with an ISA complying with section CBC Section 11B-703.7.2.1. The required standard accessible EVCS shall not be required to be marked with and ISA.
    i. Where twenty-six or more EVCS are provided, all required van-accessible, and all required standard accessible EVCS shall be identified with an ISA.
    j. The required ISA identification sign shall be reflective with a minimum 70 square inches; shall be visible from the EVCS it serves. The sign shall be permanently posted either immediately adjacent to the vehicle space or within the projected vehicle space at the head end of the vehicle space. Signs identifying van accessible vehicle spaces shall contain the designation “Van Accessible”. Signs shall be minimum 60” above the finish surface except that if the sign projects into a pedestrian circulation area, they shall be minimum 80” above finish surface per CBC Section 11B-812.8.
    k. Ambulatory EVCS complying with CBC Section 11B-812.6.3 shall be required where 26 or move EVCS are provided per CBC table 11B-228.3.2.

3.04 INSTALLATION

A. General:
    1. Position pavement markings as indicated on drawings.
    2. Field location adjustments require approval of Architect.

B. Painted Pavement Markings:
    1. Apply in accordance with manufacturer's instructions.
    2. Apply in accordance with California MUTCD manual for details not shown.
    3. Obliterating Paint: Apply as necessary to cover existing markings completely.

4. Marking Paint: Apply uniformly, with sharp edges.
   a. Applications: One coat.
   b. Wet Film Thickness: 0.015 inch, minimum.
   c. Stencils: Lay flat against pavement, align with striping, remove after application.
   d. Length Tolerance: Plus or minus 3 inches.
   e. Width Tolerance: Plus or minus 1/8 inch.

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Perform field inspection for deviations from true alignment or material irregularities.

C. If inspections indicate work does not meet specified requirements, rework and reinspect at no cost to Owner.

D. Allow the pavement marking to set at least the minimum time recommended by manufacturer.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals for additional requirements.

B. Temporary Markings: Remove without damaging surfaces.

3.07 PROTECTION

A. Prevent approaching traffic from crossing newly applied pavement markings.

B. Replace damaged or removed markings at no additional cost to Owner.

C. Preserve survey control points until pavement marking acceptance.

END OF SECTION

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SECTION 32 3113
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Posts, rails, and frames.

B. Wire fabric.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete anchorage for posts.

B. Section 33 7900 - Site Grounding.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a (Reapproved 2022).

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

F. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.

G. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.

H. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric; 2017 (Reapproved 2022).

I. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework; 2018 (Reapproved 2022).

J. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2018 (Reapproved 2022).

K. ASTM F1665 - Standard Specification for Poly(Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used with Chain-Link Fence; 2008 (Reapproved 2022).

L. CLFMI CLF-PM0610 - Product Manual; 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.

C. Shop Drawings: Indicate in plan layout and elevation, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.
D. Manufacturer's Installation Instructions: Indicate installation requirements, post foundation anchor bolt templates, and _____.
E. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines _____.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

A. Posts, Rails, and Frames:
B. ASTM A1011/A1011M, Designation SS; hot-rolled steel strip, cold formed to pipe configuration, longitudinally welded construction, minimum yield strength of 50 ksi; zinc coating conforming to ASTM F1043 and ASTM F1083.
C. Wire Fabric:
D. ASTM A392 zinc coated steel chain link fabric.
E. Conform to CLFMI CLF-PM0610.
F. Ready-mixed, complying with ASTM C94/C94M; normal Portland cement; 3,000 psi strength at 28 days, 4 inch slump; 1 inch nominal size aggregate.

2.02 COMPONENTS (O.D. SIZE)

A. Line Posts: 2.38 inch diameter.
B. Corner and Terminal Posts: 2.88 inch diameter.
C. Gate Posts: 4 inch diameter.
D. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
E. Gate Frame: 1.66 inch diameter for welded fabrication.
F. Fabric: 2 inch diamond mesh interwoven wire, 6 gage, 0.1920 inch thick, top selvage knuckle end closed, bottom selvage twisted tight.
G. Tension Wire: 6 gage, 0.1920 inch thick steel, single strand.
H. Brace Band: Galvanized and beveled.
I. Tension Band: Galvanized and beveled.
J. Tension Flat Bar: 3/4 or 5/8 inch width galvanized steel.
K. Tie Wire: Aluminum alloy steel wire.
L. Ground fence in accordance with Section 33 7900.

2.03 **ACCESSORIES/HARDWARE**

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

C. Privacy Slats: Vinyl strips, sized to fit fabric weave.

D. Gates that are part of the accessible route shall meet all the requirements of an accessible door in compliance with **CBC Section 11B-404.**

E. The lever of lever actuated latches or locks for an accessible gate shall be curved with a return to within 1/2" of the (face of) gate to prevent catching on the clothing or persons. **California Referenced Standards code. T-24 part 12, Section 12-10-202, Item (F).**

F. Swing doors and gate surfaces within 10" of the finish floor or ground shall have a smooth surface on the push side extending the full width of th door or gate. Parts creating horizontal or vertical joints in these surfaces shall be within 1/16" of the same plane as the other and be free of sharp or abrasive edges. Cavities created by added kick plates shall be capped. **CBC Section 11B-404.2.10**

G. The clear opening width for a door shall be 32" minimum. For a swinging doors it shall be measured between the face of the door and the stop, with the door open 90 degrees. There shall be no projections into it below 34" and 4" maximum projections into it between 34" and 80" above the finish floor or ground. Door closers and stops shall be permitted to be 78" minimum above the finish floor or ground. **CBC Section 11B-404.2.3**

H. Handles pulls, latches, locks, and other operable parts on accesisible doors shall comply with **CBC Section 11B-309.4** and shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. Operable parts of such hardware shall be 34" minimum and 44" maximum above finish floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usalbe from both sides. **CBC Section 11B-404.2.7**

I. The force for pushing or pulling open a door shall be as follows: **CBC Section 11B-404.2.9**
   1. Interior hinged doors, sliding or folding doors: **5 pounds(22.2N)** maxiumum. Required fire doors: the minimum opening force allowable by the DSA authority, not to exceed **15 pounds (67N)**. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position.
   2. The force required for activating any operable parts, such as lever hardware, or disengaging other devices shall be 5 pounds(22.2 N)maximum to comply with CBC Section 11B-309.4

J. Door closing speed shall be as follows: **CBC Section 11B-404.2.8**
   1. Closer shall be adjusted so that the required time to move a door from an open position of 90 degrees to a position of 12 degrees from the latch is **5** seconds min.
   2. Spring hinges shall be adjusted so that the required time to move a door from an open position of 70 degrees to the closed position is **1.5** seconds minimum.

K. Thresholds shall comply with **CBC Section 11B-404.2.5**

L. Floor stops shall not be located in the path of travel and 4" maximum from walls. **DSA Policy 99-08**.

M. Hardware (including panic hardware) shall not be provided with "Night Latch" (NL) function for any accessible doors or gates unless the following conditions are met per **DSA Interpretation 10-08 DSA/AC (External), revised 4/28/09.** Such conditions must be clearly demonstrated and indicated in the specifications:
   1. Such hardware has a 'dogging' feature.
   2. It is dogged during the time the facility is open.
   3. Such 'dogging' operation is performed only by employees as their job function(non-public use).

N. Pair of doors: limit swing of one leaf to 90 degrees so that a clear floor space is provided beyond the arc of the swing for the wall-mounted tactile sign. **CBC Section 11B-703.4.2.1**

2.04 FINISHES

A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 ounces per square foot.
B. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.
C. Accessories: Same finish as framing.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.
B. Place fabric on outside of posts and rails.
C. Set intermediate posts plumb , in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
D. Line Post Footing Depth Below Finish Grade: ASTM F 567.
E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F 567.
F. Brace each gate and corner post to adjacent line post with horizontal center brace rail _____. Install brace rail one bay from end and gate posts.
G. Provide top rail through line post tops and splice with 6 inch long rail sleeves.
H. Install center brace rail on corner gate leaves.
I. Do not stretch fabric until concrete foundation has cured 28 days.
J. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.
K. Position bottom of fabric 2 inches above finished grade.
L. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.
M. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
N. Install bottom tension wire stretched taut between terminal posts.
O. Do not attach the hinged side of gate to building wall; provide gate posts.
P. Install hardware and gate with fabric to match fence.
Q. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

3.02 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.
B. Maximum Offset From True Position: 1 inch.
C. Do not infringe on adjacent property lines.

END OF SECTION

SECTION 32 3300
SITE FURNISHINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pergolas.
B. Tables.
C. Waste receptacles.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Bollard infill and underground encasement.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
E. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
G. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
H. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2012.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, and maintenance information.
C. Shop Drawings: Indicate plans for each unit or groups of units, elevations with model number, overall dimensions; construction, and anchorage details.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide manufacturer’s warranty against defects in materials or workmanship for ductile iron castings for a period of 10 years from Date of Substantial Completion.

C. Provide manufacturer's Lifetime Warranty against defects in materials or workmanship for wood benches manufactured from solid teak.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Furnishings:
   1. Landscape Forms.

B. Precast Furnishings:
   1. Quick Crete Products Corp; _____: www.quickcrete.com/#sle.

2.02 METAL FURNISHINGS

A. Tables: Steel
   1. Configuration: Table and seating.
   2. Seating: Compliant with ADA Standards.
   3. Mounting: Surface, using concealed anchor rods.
   4. Products:
      a. Landscape Forms - Carousel Table.

2.03 PRECAST CONCRETE FURNISHINGS

A. Precast Concrete Furnishings, General:
   1. Precast Concrete Components: Mixture of cement, aggregates, water, and mineral colors; molded to shape, and reinforced with steel bars.
      a. Finish:
         1) Horizontal Surfaces: Smooth for seats and table tops.
         2) Vertical Surfaces: Smooth for supports and sides.
      b. Color: As indicated on drawings.
      c. Clear Sealers: Anti-graffiti.
   2. Hardware: Stainless steel.

B. Waste Receptacles: Precast concrete waste receptacle with removable lid.
   1. Capacity: 36 gallons.
   2. Lids:
      a. Material: Steel.
      b. Type: Flat.
   3. Mounting: Surface, using concealed anchor rods.
   4. Products:
      a. Quick Crete Products Corp; ____: www.quickcrete.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that mounting surfaces, preinstalled anchor bolts, or other mounting devices are properly installed; and ready to receive site furnishing items.

B. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

A. Install site furnishings in accordance with approved shop drawings, and manufacturer's installation instructions.

B. Provide level mounting surfaces for site furnishing items.

END OF SECTION

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SECTION 32 3313
SITE BICYCLE RACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior bicycle racks.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Mounting surface for bicycle racks.

B. Section 32 1313 - Concrete Paving: Mounting surface for bicycle racks.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

C. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.

D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.

F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

G. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

H. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Indicate size, shape, and dimensions, including clearances from adjacent walls, doors, and obstructions.

D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Handle racks with sufficient care to prevent scratches and other damage to the finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Exterior Bicycle Racks:
   1. American Bicycle Security Company; _____: www.ameribike.com/#sle.
   2. Belson Outdoors.

2.02 BICYCLE RACKS

A. Exterior Bicycle Racks: Device allows user-provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
   1. Style: Round loop.
   2. Capacity: Nine bicycles.
   3. Mounting, Ground: In-ground anchor.
   4. Finish: Powder coat, maintenance-free and weather-resistant.
   5. Color: As indicated on drawings..
   6. Accessories: In-ground grout cover.

B. Materials:
   1. Pipe: Stainless steel, ASTM A312/A312M, Type 304, Schedule 40S.
   2. Tube: Stainless steel, ASTM A269/A269M, Grade TP304, seamless.
   3. Bar Round and Flat, Stainless Steel: ASTM A666, Type 304.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive bicycle racks.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.

C. Do not begin installation until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Ensure surfaces to receive bicycle racks are clean, flat, and level.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install level, plumb, square, and correctly located as indicated on drawings.

C. In-Ground Anchor Installation:
   1. Prepare holes in size according to manufacturer’s instructions.
   2. Place anchoring bolts through the holes in pipe.
   3. Lower rack into holes, ensuring the bottom of lower bends are at least 1-1/2 inch from the ground.
   4. Place concrete.
   5. Level rack before concrete sets.

6. Support until dry.

3.04 CLEANING

A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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SECTION 32 3314
SITE BICYCLE LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior bicycle lockers.

1.02 RELATED REQUIREMENTS

A. Section 32 1313 - Concrete Paving: Mounting surface for bicycle lockers.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

D. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Exterior Bicycle Lockers:
   1. Dura Bike.

2.02 BICYCLE LOCKERS

A. Exterior Steel Bicycle Lockers: Secure storage enclosure fabricated of steel panels with factory applied finish and factory installed hardware.
   1. Style: DL2.
   2. Capacity: Two bicycles per unit.
   3. Interior Partition: Exterior grade OSB with factory applied sealer.
   4. Finish: Powder coat, factory applied over primer.
   5. Color: As indicated on drawings.

B. Materials:
   1. Bar, Round and Flat, Carbon Steel: ASTM A36/A36M.

2. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive bicycle lockers.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Do not begin installation until unsatisfactory substrates have been properly repaired.

3.02 PREPARATION

A. Ensure surfaces to receive bicycle lockers are clean, flat, and level.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install bicycle lockers level, plumb, square, and correctly located as indicated on drawings.

C. Post-Installed Anchors: Comply with ICC-ES AC308.

D. Surface Flange Installation: Anchor bicycle lockers securely in place with 1/2 inch by 4 inch anchor bolts through flange holes.

E. Freestanding Installation: Place in location indicated on drawings.

3.04 CLEANING

A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 32 3353
ARCHITECTURAL SITE CONCRETE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Concrete site walls.
B. Concrete retaining walls.(48" or less in height)
C. Concrete cheek walls for exterior concrete stairs.
D. Light pole bases.
E. Other architectural site concrete as indicated.

1.02 RELATED REQUIREMENTS

A. Division 00 Section - 003100 Available Project Information(Geotechnical Report)
B. Division 07 Section - Joint Sealants
C. Division 09 Section - Permanent Non-Sacrificial Anti-Graffiti
D. Division 32 Section - Concrete Paving
E. Division 32 Section - Concrete Paving Joint Sealants

1.03 DEFINITIONS

A. Cast-in-Place Architectural Site Concrete: Non-building formed concrete that is exposed to view in completed exterior work and that requires concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: Fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural site concrete.
D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

1.04 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at project site.
    1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place architectural site concrete to attend, including the following:
        a. Contractor's superintendent.
        b. Independent testing agency responsible for concrete design mixtures.
        c. District's Representative(s).
        d. Architect's Representative(s)
        e. Cast-in-place architectural site concrete subcontractor.

f. Inspector of Record (IOR).
g. Subcontractor for any adjacent work

2. Review testing and inspection procedures, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural site concrete.
3. Contractor to provide meeting minutes for pre-installation conference.

1.05 SUBMITTALS

A. Product Data: For each type of product.
1. Proprietary admixtures, pigments, curing compounds, hardeners, sealers, form-release agents, all accessory material, etc.: Indicate compatibility with other materials used.

B. LEED Submittals:
1. Product Data for Credit MR 4.1 [and Credit MR 4.2]: For products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
2. Design Mixtures for Credit ID 1.1: For each concrete mixture containing at least 40% fly ash as a replacement for Portland cement or other Portland cement replacements and for equivalent concrete mixtures that do not contain Portland cement replacements.

C. Design Mixtures: Submit proposed mix designs and test data for each class, color, application, and strength of concrete and for each method of placement.
1. Prepare mix designs on the basis of field experience (preferred) and/or trial mixes, in compliance with California Building Code (CBC), Section 1905A.3.
2. Prepare mix designs on the basis of field experience (preferred) and/or trial mixes, in compliance with California Building Code (CBC), Section 1905.3.
3. Mix designs shall be prepared and signed by a structural or civil engineer registered in the State of California.
a. Mix designs shall be reviewed by the Architect and Structural Engineer of Record (SEOR).
4. Identify for each mix design submitted the method by which proportions have been selected.
a. For mix designs based on field experience, include individual strength test results, standard deviation, and required average compressive strength calculations.
b. For mix designs based on trial mixtures, include trial mix proportions, test results, graphical analysis and show required average compressive strength face results. Provide gross weight and yield per cubic yard of trial mixes.
c. Indicate quantity of each ingredient per cubic yard of concrete.
d. Indicate type and quantity of admixtures proposed or required.
e. Indicate water to cement ratio by weight.
f. Measured slump.
g. Measured air content.
h. Provide shrinkage test results.
i. Provide maximum [5%] fly ash; ground granulated blast-furnace slag, and/or silica fume content as Portland cement replacement in all concrete.
5. Submit proposed alternate design mixtures for review by the Architect and SEOR(Strutural Engineer of Record) when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
6. Mix designs for each application must be from a single source for the duration of the project. Multiple venders or courses will not be permitted.

7. All mix designs must be wet stamped by a licensed Engineer.

D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
   1. Coordinate with and identify the details of the Contract Drawings on the shop drawings.
   2. Comply with ACI 315, part B and CRSI requirements.

E. Formwork Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural site concrete.
   1. Engineering Responsibility: Formwork shop drawings shall be prepared by or under the supervision of a licensed professional engineer detailing fabrication, assembly, and support of formwork.
   2. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
   3. Location of form ties and patterns are subject to approval of the Landscape Architect. For walls less than 18” high, ties to be located above and below wall face, whenever possible.
   4. Align all form joints with reveal locations indicated on plans. Provide custom size and cut form boards as required.

F. Construction Joint Layout: Indicate proposed construction joints required to construct the structure. Submit dimensioned drawing indicating layout of construction joints, contraction (control) joints, dowelled joints, decorative scoring and placement sequence of concrete.
   1. Location of construction joints are subject to approval of the Architect.
   2. Construction joints locations should align with reveal locations as located per drawings.
   3. Provide custom form boards as required for joint alignment noted per drawings.
   4. Align all form joints with reveal locations indicated on plans. Provide custom size and cut form boards as required.

G. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.

H. Samples: For each of the following materials:
   1. Form-facing panel.
   2. Form ties.
   3. Form liners.
   4. Coarse- and fine-aggregate gradations.
   5. Chamfers and rustications.
   6. Reveals
   7. One quart sample of sand and fine aggregate
   8. On quart sample of coarse aggregate

I. Qualification Data: For manufacturer (batch plant).

J. Welding Certificates: Submit certifications signed by AWS Certified Welding Inspector of prequalified welding procedures, qualifications of welding procedures unless prequalified, qualifications of welding operators and qualifications of welders.

K. Material Certificates: For each of the following:
   1. Cementations materials.
   2. Aggregates and sand.
   3. Admixtures.
   4. Form materials and form-release agents.

5. Steel reinforcement and accessories.
    a. Provide mill test certificates for all reinforcing steel, showing physical and chemical analyses. For steel that will be welded, include in the chemical analysis the percentages of carbon, manganese, copper, nickel, chromium, phosphorus and sulfur, and optionally, the percentages of molybdenum and vanadium.
6. Curing compounds.
7. Surface treatments.
8. Bonding agents.
9. Adhesives.
10. Semi rigid joint filler.
11. Joint-filler strips.
12. Repair materials.

L. Material Test Reports: For the following, by a qualified testing agency:
1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

M. Field Quality-control Reports. Submit reports of all compressive strength, slump, shrinkage and air content tests required by the authorities having jurisdiction and as indicated.
1. Submit copies of delivery tickets complying with ASTM C 94 for each load of concrete delivered to the site. Tickets shall include all information required by the referenced standard.

N. Minutes of pre-installation conference.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with CBC Chapter 19A.
1. Chemical products field-applied to concrete shall comply with the air quality requirements of authorities having jurisdiction.

B. Industry Standards: Comply with the following unless modified by requirements in the Contract Documents.
1. ACI 301, "Specifications for Structural Concrete".
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials".
3. ACI 302.1R, "Guide for Concrete Floor and Slab Construction".
4. ACI 303.1 "Specifications for Cast-in-Place Architectural Concrete".
5. ACI 304R, "Guide for Measuring, Mixing, Transporting, and Placing Concrete".
6. ACI 305R, "Hot Weather Concreting".
7. ACI 306.1, "Standard Specification for Cold Weather Concreting".
8. ACI 318, "Building Code Requirements for Structural Concrete".
9. ACI 347, "Guide to Formwork for Concrete".
10. ACI 318, "Building Code Requirements for Structural Concrete."
11. ACI SP-66, "ACI Detailing Manual".
12. CRSI, "Manual of Standard Practice".
13. CRSI, "Placing Reinforcing Bars".

C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "NRMCA Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities."
2. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

3. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
4. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations for Cast-in-Place Architectural Site Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide cast-in-place architectural site concrete of consistent quality in appearance and physical properties for the duration of the project.

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete,"[Sections 1 through 5.] [Sections 1 through 5 and Section 6, "Architectural Concrete."]
2. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

G. Source Limitations for Concrete Paving: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties. Secure all material required for the duration of the project as needed to ensure consistent quality in appearance

H. Welding Qualifications: Comply with CBC Chapter 17A.
1. Qualify welding procedures and welding personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel" prior to performing any welding.
2. Qualify welding inspection personnel according to AWS QC1, "Standard for AWS Certification of Welding Inspectors."

I. Welding Qualifications: Comply with CBC Chapter 17.
1. Qualify welding procedures and welding personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel" prior to performing any welding.
2. Qualify welding inspection personnel according to AWS QC1, "Standard for AWS Certification of Welding Inspectors."

J. Mockups: Before casting architectural site concrete, build mockups to verify selections made under Sample submittals and to fully demonstrate typical joints, surface finish, texture, tolerances, reveals edges, bulkhead or cold joints, standard of workmanship and completed product. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Build mockups full-size, matching architectural site concrete components indicated on the Drawings. Mock-ups shall be complete in every detail, including joints, reveals, chamfers, etc. Include complex joinery conditions where necessary to integrate to other Project components as indicated.
3. Maintain accurate records of variables associated with each mockup to facilitate the matching of accepted mockups during actual construction.
4. Demonstrate curing, cleaning, and protecting of cast-in-place architectural site concrete, finishes, and contraction and expansion joints, as applicable.
5. Required Mock-up Types:
a. Walls: Construct at least 6 linear feet by 4 foot height of finished concrete site walls for each color, finish, and mix design. Thickness of walls as noted on plans.

b. As-Cast Retarder Finishes: Mockups shall clearly demonstrate a consistent depth-of-cut for retarder finishes for Architect's review.

6. Mock-up Acceptance: Obtain Architect's approval of mockups before casting architectural site concrete.
   a. The mock-up acceptence shall be judged between a distance of 5 feet to 10 feet, at the Architects discretion.
   b. The Architect may reject mockups that, in the Architect's sole judgment, do not demonstrate an acceptable completed product, including, but not limited to, color, joint work, surface finish, texture, tolerances, and standard of workmanship
   c. The Architect may require modifications to mockups to obtain acceptable results.
   d. The Architect may require modifications to mockup repairs to obtain acceptable results.
   e. The Architect may require removal and reconstruction of mockups to obtain acceptable results. Multiple mock ups may be required.
   f. Contractor shall provide additional mockups as required to obtain results acceptable to the Architect at no additional cost to the Owner.
7. Mockup Disposition: Accepted mockups shall not become part of the completed Project. Maintain mock-up on-site for the duration of construction and until all work has been accepted. Remove and legally dispose mockups after acceptance of final installed work. If sufficient permanent architectural site work has been completed, Contractor may submit a written request to Architect to transfer quality control for architectural site concrete from the accepted mockups to one or more designated portions of the permanent work.

1.07 PROJECT CONDITIONS:

A. Traffic Control: Maintain access for Owner's operations and for vehicular and pedestrian control required for construction activities.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
   1. Label bundles with durable identification tags. Maintain reinforcement identification after bundles are broken.
   2. Store reinforcement to avoid excessive rusting or fouling with grease, oil, dirt or other bond-weakening contaminants.
   3. Avoid damaging applied coatings, if any, on steel reinforcement.

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS

A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for formwork and other form-facing material requirements.

B. Form-Facing Panels for As-Cast or Exposed-Aggregate Finishes: Steel, glass-fiber-reinforced plastic, or other approved no absorptive panel materials that will provide continuous, true, and smooth architectural site concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

C. Form-Facing Panels for all exposed As-Cast and Exposed-Aggregate Concrete Finishes: Provide steel, glass-fiber-reinforced plastic, or overlain exterior-grade plywood panels, no absorptive, that will provide continuous, true, and smooth architectural site concrete surfaces, with no wood grain, honeycombing or patch transfer.
   1. Faced plywood panels shall comply with, or be equivalent to, DOC PS 1, Structural I. Provide minimum 7-ply plywood and provide balance sheets for panels coated one-side only. Furnish in largest practicable sizes to minimize number of joints.
      a. Retarder As-Cast Finish: Medium-Density Overlay (MDO), with mill-applied release agent and edge sealant. Provide one of the following panels, or comparable substituted product:
         1) Olympic Panel Products, "B-Matte 333 MDO Concrete Form." Overlay Color: Brown.
         2) Pacific Laminate Products, "ProFace MDO." Overlay Color: Black.
         3) Sylvan Products, LLC, "Armor Ply MDO" Overlay Color: Brown.
   2. Curved Work: Kerf back of plywood form-facing panels, or use accepted flexible or curved forms for curved work with a radius of 100 feet or less to match finish provided by form material noted in items 1 and 2 above.

D. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will provide surfaces without gradual or abrupt irregularities that exceed specified formwork surface class.
   1. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
   2. Finished work is to be free of seams or form markings.

E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

F. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.

G. Rustication Strips or Reveals: Wood, metal or rigid plastic, with sides beveled and back kerfed; nonstaining; in longest practicable lengths. Align reveals as shown on plans and with form seams.

H. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum 1/4 inch (6 mm) thick.

I. Form Joint Sealant: Urethane or silicone elastomeric sealant complying with ASTM C 920, Type M or Type S, Grade NS that adheres to form joint substrates. Form joint sealant shall be compatible with form-facing panels.

J. Form Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood. Form sealer shall be compatible with form-facing panels. All seams and joints are to be sealed.

K. Form-Release Agent: Commercially formulated, colorless form-release agent that will not bond with, stain, or adversely affect architectural site concrete surfaces and will not impair subsequent treatments of those surfaces. Form-release agent shall be compatible with form-facing panels.
   1. Obtain written acceptance of form release agent from integral colored concrete pigment manufacturer.
   2. Form-release agents shall be non-staining.
   3. Formulate form-release agent with rust inhibitor for steel form-facing materials.

L. Surface Retarder (Top Surface): Chemical liquid set retarder, for application on top surface of formed applications to match finish at formed faces, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.
   1. Provide W. R. Grace "Top-Cast" or accepted comparable substitute.

M. Form Ties: Factory-fabricated, stainless steel or fiberglass color keyed to wall color snap ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish ties with tapered plastic tie cone spreaders that, when removed, will leave holes 3/4 inch in diameter on concrete surface.
   2. Furnish internally disconnecting ties that will leave no metal closer than 1-1/2 inches (38 mm) after exposing aggregate, from the architectural site concrete surface.
   3. Furnish glass-fiber-reinforced plastic ties, not less than 1/2 inch (13 mm) in diameter, of color selected by Architect from manufacturer's full range.
   4. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

N. Provide new forms specifically purchased for this project. Reuse of forms from past projects or contractors stock will not be accepted.

O. Provide custom form boards as required to align seams with reveals indicted on plans.

2.02 STEEL REINFORCEMENT AND ACCESSORIES

A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 60 percent.

C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed, unless otherwise indicated.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufacture according to CRSI's "Manual of Standard Practice."
   1. Where legs of wire bar supports contact forms, use CRSI Class 2, stainless-steel bar supports.

E. Tie Wire: Minimum 16 ga. annealed wire, black, galvanized or coated finish to match rebar.

2.03 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type II, or Type IV, gray, unless white cement is required to achieve colors indicated. Supplement with the following:
      a. Fly Ash: ASTM C 618, Class F.

B. Normal-Weight Aggregates: ASTM C 33, Class 1N coarse aggregate or better, graded. Provide aggregates from single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials].

C. Normal-Weight Aggregates: ASTM C 33, complying with building code. Provide aggregates from a single source. All aggregates shall be free of materials with deleterious reactivity to alkali in cement when tested in accordance with ASTM C 289.
   1. Comply with CBC section 1903A.3.
   2. Comply with CBC section 1903.3.

a. Service Class, based on CBC Figure 1904A.2.2, "Weathering Probability Map":
b. Severe and Moderate: Class 5S.
c. Negligible: Class 2N.

3. Maximum Coarse-Aggregate Size: 1/2 inch nominal. Maximum size shall also not be larger than 1/4 of the narrowest dimension between forms, 1/3 the depth of slab nor more than 3/4 of the minimum clear spacing between individual reinforcing bars.
   a. Gradation: Uniformly graded.

D. Normal-Weight Fine Aggregate: ASTM C 33 or ASTM C 144, manufactured or natural sand, from same source for Project, free of materials with deleterious reactivity to alkali in cement and free of materials which may cause staining and light in color
   1. Color to be white to light with no dark material.

E. Water: Potable, complying with ASTM C 94/C 94M except free of wash water from mixer washout operations.

2.04 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Shrinkage-Reducing Admixture: Commercially formulated, shrinkage inhibitor capable of reducing initial shrinkage by 80% and long-term shrinkage by 50%. Provide product suitable for use with either air-entrained or non-air-entrained concrete as appropriate to structural member and project location.
   1. Products: Subject to compliance with requirements, provide one of the following(as required):
      a. Euclid Chemical Company (The), an RPM company; EUCON SRA, SRA+.
      b. Grace Construction Products, W. R. Grace & Co.; Eclipse Floor, Eclipse Plus.
      c. Sika Corporation; Control 40.

2.05 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz. /sq. yd. when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Clear, Waterborne (Non-Colored Concrete): Provide products complying with ASTM C 309, Type 1, Class B, 18 to 25 percent solids, certified by curing compound manufacturer to not interfere with bonding of sealers, with no glossy finish and compatible with specified sealer. Provide products with not more than 100g/L volatile organic content.
   1. Products: Subject to compliance with requirements.

D. Clear, Waterborne (Colored Concrete): Provide products that are acceptable to concrete color pigment manufacturer complying with ASTM C 309, Type 1, Class B, 18 to 25 percent solids, certified by curing compound manufacturer to not interfere with bonding of sealers with no glossy finish and compatible with specified sealer. Provide products with not more than 100g/L volatile organic content.

1. Products: Subject to compliance with requirements.

E. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
   1. For integrally colored concrete, curing compound shall be approved by color pigment manufacturer.
   2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

2.06 SEALERS AND WATER REPELLENTS

A. Penetrating Liquid Floor and Horizontal Surface Treatment (Sealer): Clear, chemically reactive, water-based lithium quartz water-based lithium materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. Materials shall be compatible with concrete admixtures and shall be recommended by manufacturer for intended use. Provide products with 0g/L volatile organic content.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Sinak Corporation; Concrete Sealer HLQ 125.

B. Penetrating Liquid Wall and Vertical Surface Treatment (Repellent): Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. Materials shall be compatible with concrete admixtures and shall be recommended by manufacturer for intended use. Provide products with less than 100g/L volatile organic content.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Rainguard International; Microseal(For use with VandlGuardTEN Anti-graffiti coating)

2.07 **ANTI-GRAFFITI COATING**

A. Refer to Section 099620 Permanent Non-Sacrificial Anti-Graffiti Coating for product and specific sealer.
   1. Compatible sealer to be applied prior to use of Anti-graffiti coating.

2.08 JOINT DEVICES, FILLER MATERIALS AND OTHER ACCESSORY PRODUCTS

A. Joint Filler at Exterior Sealed Joints: ASTM D 1751
   1. Lightweight, nonstaining, polyethylene closed cell expansion joint filler
      a. Deck-O-Foam as manufactured by W.R.Meadows, Hampshire, Ill.
   2. Exterior Expansion- and Isolation-Joint-Filler Strips: See Division 32 Section "Concrete Paving Joint Sealants" for sealants for exterior joints at concrete pavements.

2.09 REPAIR MATERIALS

A. General: Provide cementitious materials, coarse aggregates, fine aggregates, water, bonding agents and admixtures as required to prepare repair grouts that will match as-cast and site finished architectural site concrete.
   1. Maintain accurate records of repair materials and mixtures used on accepted mockups.

B. Bonding Agent: ASTM C 1059, Type II, non-re-emulsifiable. Provide proprietary products composed of latex polymers.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. W.R. Meadows, Inc.; Acry-Lok.
      b. Grace Construction Products, W. R. Grace & Co.; "Daraweld C".
      c. Larsen Products Corp., "Weld-Crete".

2. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.
3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete and for anchoring dowels to hardened concrete.

2.10 SKATEBOARD DETERRENTS

A. General: Provide the following skateboard deterrents, unless otherwise indicated.
   1. Basis of Design Product: Subject to compliance with the requirements, provide the following, or comparable substituted product:
      a. Intellicept, Inc., "Skatestoppers FA-FR series," extruded T-6061 aluminum alloy, mill finish, model as required to match formed edge.
         1) [Model FA 135, to match 3/4" chamfered edge.]

2.11 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of cast-in-place architectural site concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.
   2. Proportioning:
      a. The proportioning of ingredients shall be such that the concrete can be readily worked into forms and around reinforcement under the conditions of placement to be used, without segregation or excessive bleeding.
      b. When proportioning by weight of loose, dry material, 94 pounds of cement shall be considered 1 cubic foot.
      c. Fine aggregate volume shall be at least 35 percent, with a maximum of 50 percent, of the sum of the separate fine and coarse aggregate volumes.
      d. Total water content shall not exceed 35 gallons per cubic yard of concrete.
      e. Weighing equipment shall be accurate within 1 pound and shall be adjustable for varying aggregate moisture content.
      f. A beam auxiliary shall register any part of the last 100 pounds of each aggregate. The aggregate hopper shall have a volume adjustment.
   3. Prepare compressive strength data for both 7-day and 28-day strengths.
      a. The 7-day compressive strength shall be at least 60 percent of the required 28- day strength.
      b. The 28-day compressive strength shall be as indicated.
   4. Provide drying shrinkage test data at 28 days, from not less than 3 test specimens.

B. Cementitious Materials-General: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not more than 5 percent. Per ACI 301 limits for concrete exposed to de-icing chemicals, limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
   1. Cementitious Materials-LEED Supplemental: For LEED-NC Credit ID 1.1: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 40 percent. Per ACI 301 limits for concrete exposed to de-icing chemicals, limit percentage, by weight, of cementitious materials other than Portland cement in concrete as indicated above.
   2. Fly Ash: 0-5 percent.

C. Proportion concrete mixtures as follows:
   1. Minimum Compressive Strength (28 Days): 3000 psi.
   2. Maximum Water-Cementitious Materials Ratio: 0.50-0.60.
   3. Slump Limit: 4 inches, plus or minus 1 inch, unless indicated otherwise.

D. Air Content, Exterior Exposed Concrete: Provide the following air entrainment for all exposed concrete with a weathering probability of severe or moderate per CBC figure 1904.2.2/1904A.2.2.
   1. Provide air entrainment of 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size, unless indicated otherwise.
   2. Provide air entrainment of 6.0 percent, plus or minus 1.5 percent at point of delivery for 1-inch and 3/4-inchnominal maximum aggregate size, unless indicated otherwise.

E. Slump Limit: 4 inches (100 mm], plus or minus 1 inch (25 mm), unless otherwise indicated.

F. Cementitious Materials: For cast-in-place architectural site concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 requirements.[Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.]
   1. Limit water-soluble, chloride-ion content in hardened concrete to [0.06] [0.15] [0.30] [1.00] percent by weight of cement.

G. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement. Limit total chloride-ion content in hardened concrete to 0.10 percent by weight of concrete when tested per AASHTO T 260 potentiometric titration.
   2. Limit "drying shrinkage" after 28 days of curing hardened concrete to 0.045 percent of the original concrete volume.
   3. Admixtures: Admixtures may only be used if they are incorporated into the accepted concrete mix designs. Use admixtures according to manufacturer's written instructions.
      a. Use [water-reducing] [high-range water-reducing] [or] [plasticizing] admixture in concrete, as required, for placement and workability.
      b. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
      c. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
      d. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

H. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with accepted mockup.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."
   1. Splices: Do not splice bars, unless indicated on the Drawings.
   2. Staggered Splices: Stagger splices such that not more than one-half of the reinforcing bars are spliced at any location.

2.13 CONCRETE MIXING

A. Ready-Mixed Architectural Site Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M [and ASTM C 1116/1116M] and furnish batch ticket information.

1. Clean equipment used to mix and deliver cast-in-place architectural site concrete to prevent contamination from other concrete.
2. When air temperature is between 85 and 90 deg. F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg. F, reduce mixing and delivery time to 60 minutes.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

B. Integral Colored Concrete Mixes: Add pigments at the concrete batch plant. Minimum batch size shall be three (3) yards. The same brand of cement, source of sand, and water/cement ratio shall be maintained for each load of the same color for the duration of the project.
1. Batching Procedure: Before adding color-conditioning admixture, the mixing drum shall be thoroughly cleaned and wetted with approximately 40 gallons of the mix water and/or a portion of the aggregates. After cleaning and wetting of the drum, add the specified quantity of admixture correctly packaged for the mix design and batch quantity. Proceed with normal batching of balance of ingredients. After loading is complete, mix at mixing speed for a minimum of 15 minutes. Do not add water after a portion of the load has been discharged.

PART 3 - EXECUTION

3.01 FORMWORK

A. General: Comply with the following, unless otherwise indicated:
1. Conform to ACI 318, ACI 347 and CBC Section 1906.
2. Conform to ACI 318, ACI 347 and CBC Section 1906A.

B. Structural Loads: Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

C. Geometry: Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117. Provide for necessary openings, inserts, anchorages, and other features indicated or required. Properly locate all elements.
1. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
a. Class A, 1/16 or 1/8 inch for smooth-formed finished surfaces.
b. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.

D. Form Joints: Minimize form joints and make forms watertight to prevent leakage of concrete mortar. Locate form joints at exposed concrete symmetrically about center of panel and aligned with reveals, unless otherwise indicated. Align joints symmetrically at exposed conditions.
1. Seal penetrations at form ties with form joint sealant to prevent cement paste leakage.
2. Provide custom form boards as required to align with reveals.

E. Removal: Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where dismantling or stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Chamfers: Chamfered edges are not allowed.

G. Chamfers: Provide chamfered edges and corners at all exposed locations, and at all locations scheduled to receive waterproofing, unless otherwise indicated.

3.02 EARTH FORMS

A. General: Unless indicated, placement of concrete directly against soil or earth (casting "neat") shall not be permitted only with the prior approval of the Structural Engineer of Record. Concrete placed directly against earth shall require a minimum increase in concrete thickness of 1" at vertical faces. For example, footings shall be 2" wider than indicated if both vertical faces are cast against earth.

B. Trimming and Cleaning: Hand trim sides and bottoms of soil forms and trenches. Remove loose soil, exposing undisturbed native soil, and prior to placing concrete.

3.03 CONSTRUCTED FORMWORK

A. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

B. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

C. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

D. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

E. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

F. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

G. Provide bracing and shores to ensure stability of formwork and accommodate all loads. Use form ties of sufficient strength and in sufficient quantities to prevent formwork spreading. Maintain principal shores to support concrete until required strength is achieved.

3.04 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install embedded accessories level, true-to-line and plumb in accordance with manufacturer's instructions.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
3. Provide reveals around embedded items such as light fixtures as shown on Drawings.

3.05 OPENINGS, DEPRESSIONS, RECESSES AND CHASES

A. Size and locate formed openings, depressions, recesses and chases to accommodate products to be applied to, built-into and/or pass-through concrete Work. Coordinate size, location and placement of inserts, embedded products, openings and recesses with Work of other sections. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.06 FORM RELEASE AGENTS

A. General: Provide either form materials with factory-applied non-absorptive liner or field-applied form coating. Field-applied coating shall be non-staining.
   1. Non-absorptive Liner: Rust on steel form surfaces is not acceptable.
   2. Field Applied Coating: Comply with manufacturer's written instructions. Obtain written acceptance of form release agent from integral colored concrete pigment manufacturer.
      a. Reapply coating to thoroughly cleaned and reconditioned formwork before each use.
      b. Verify compatibility of release agents with integrally-colored concrete and all subsequently applied curing compounds, coatings, applied finishes, etc. Do not apply release agent if items are non-compatible.
      c. Do not apply release agent where decorative wood graining is intended for concrete surface. Leave form face dry.

3.07 CONCRETE SURFACE RETARDERS

A. Coat contact surfaces of forms with surface retarder, according to manufacturer's written instructions, before placing reinforcement.

3.08 FORM LINERS

A. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

3.09 REMOVING AND REUSING FORMS

A. General: Formwork for sides of walls, steps, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg. F for 72 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
   1. Schedule form removal to maintain surface appearance that matches accepted mockups.
   2. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength, but not less than 21 days after pour.
   3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
   4. All formwork is to be new specifically purchased for this project.

B. Clean and repair surfaces of forms to be reused in the Work in non-exposed areas. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.10 STEEL REINFORCEMENT

A. General: Place and secure reinforcement as indicated. Comply with CRSI publications "Manual of Standard Practice" and "Placing Reinforcing Bars".
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
   2. Do not bend bars more than once.
   3. Do not bend or straighten reinforcement in a manner injurious to the material, such as heating.
   4. Do not use bars with kinks or bends not indicated.
   5. Do not use bars with reduced cross-section due to corrosion or other cause.
   6. Remove and replace all defective bars.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Space reinforcement as indicated. If not indicated, maintain clear spacing of not less than the bar diameter, 1-inch, or 1-1/3 times the maximum aggregate size, whichever is greater. Where parallel reinforcing is placed in more than one horizontal layer, place as many bars as possible in the outboard layer, maintaining the required lateral clearances and spacing's. Place bars in the inboard layer in direct vertical alignment with the bars of the outboard layer. Maintain not less than 1-inch or the maximum bar diameter in the inboard/outboard layers, whichever is greater, clear space between vertically stacked bars.

D. Accurately position, support, and secure reinforcement against displacement.
   1. Maintain reinforcing steel positions during placement operations. Properly reset any reinforcement that is displaced by runways, workmen and other causes.

E. Locate and support reinforcement with bar supports to maintain minimum concrete cover as indicated or as required by ACI 318.

F. Do not tack weld crossing reinforcing bars.
   1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

G. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

H. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.11 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction or Cold Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
   2. Locate horizontal joints in walls and columns as indicated.

3. Space vertical joints in walls as indicated and as may be directed by the Architect. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
6. Align joints with reveals indicated. Provide custom cut form boards as required.
7. Do not place expansion material at cold joints.

C. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, walls and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.12 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, form-release agent, surface retarders, reinforcement, and embedded items is complete and that required inspections have been performed.
1. Provide protective coatings, coverings and masking’s to protect adjacent Work.
2. Provide temporary runways and other appropriate equipment as necessary to access Work area and to avoid soiling or damage to existing Work.
3. Prevent run-off of concrete hydration water and water polluted by agents and chemicals from soiling existing surfaces or contaminating landscape areas.

B. Do not add water to concrete during delivery, at Project site, or during placement.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
2. If indicated in mix design accepted by the Architect, water added to concrete shall be observed by the Project Inspector, and shall be recorded on the delivery ticket.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. No visible cold joints or lift lines are acceptable in the completed work.
3. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.

4. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
5. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
6. Maintain reinforcement in position on chairs during concrete placement.
7. Screed slab surfaces with a straightedge and strike off to correct elevations.
8. Slope surfaces uniformly to drains where required.
9. Begin initial floating using bull floats or derbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg. F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
4. Do not use chemical accelerators unless otherwise specified and accepted in design mixtures.

F. Hot-Weather Placement: Comply with ACI 305R and as follows:
1. Maintain concrete temperature below 90 deg. F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.13 FINISHES, GENERAL

A. Architectural Site Concrete Finishes: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.

B. Architectural Site Concrete Finishes: Match accepted mockups to satisfaction of Architect.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.
1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

D. Maintain uniformity of special finishes over construction joints unless otherwise indicated.

3.14 EXPOSED-AGGREGATE FINISHES

A. Retarder Finish: Remove formwork without damaging edges or reveals.
1. Ensure finish is even and no honeycombing or discoloration is apparent
2. Edges shall net be chipped or spalled

3.15 SKATEBOARD DETERRENTS

A. General: Install skateboard deterrents in epoxy adhesive supplied by manufacturer, in accordance with manufacturer's instructions.
   1. Install as shown. If not shown, install in symmetrical fashion on all formed edges within 4 feet (1.22 m) of adjacent grade, at intervals not to exceed 3 feet (1.1 m) O.C.

3.16 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 305R for hot-weather protection during curing.

B. Begin curing cast-in-place architectural site concrete immediately after removing forms from concrete or after applying as-cast formed finishes to concrete, consistent with mockup preparation. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:
   1. Moisture Curing: Keep exposed surfaces of cast-in-place architectural site concrete continuously moist for no fewer than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for no fewer than seven days. Immediately repair any holes or tears during curing period; use cover material and waterproof tape.
   3. Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports in accordance with the CBC and ACI 301.
   1. Comply with the requirements of Division 01 Section "Quality Control".
   2. Comply with the requirements of Division 01 Section "Quality Control-DSA".

B. Inspections:
   1. Steel reinforcement placement.
   2. Steel reinforcement welding.
   3. Headed bolts and studs.
   4. Verification of use of required design mixture.
   5. Structural concrete placement, including conveying and depositing.
   6. Curing procedures and maintenance of curing temperature.
   7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg. F and below and when 90 deg. F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.
    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    a. Test one set of two field-cured specimens at 7 days and reserve one set of two specimens for testing at 56 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.18 DEFECTIVE CONCRETE

A. The following list includes, but is not limited to; concrete that will be deemed to be defective and non-conforming. All such concrete shall be removed and replaced with Work complying with the requirements of the Contract:
   1. Concrete not formed as indicated, not true to alignment indicated, not plumb where intended, not level where intended, not true to level or elevation intended.
   2. Concrete voided or honeycombed, including voids and honeycombs that have been cut, resurfaced or filled without prior approval of the Architect.
   3. Concrete with exposed reinforcement.
   4. Concrete with inadequate cover over reinforcement.
   5. Concrete with embedded foreign objects and debris, including sawdust, wood or metal shavings, nails, cans, trash, etc.
   6. Concrete that does not visually match the accepted mockups [or the designated design reference sample].
   7. Other non-conforming work.

B. All concrete deemed to be defective by the Architect or in non-conformance with the contract documents is to be removed and replaced from expansion joint or cold joint to expansion joint or cold joint at no cost to the owner. Repair defective concrete as directed by the Architect, at no cost to the Owner.

3.19 SEALERS AND REPELLENTS

A. General: Uniformly apply a continuous sealing coat of sealers or repellents to all exposed surfaces of architectural site concrete by power spray or roller according to manufacturer's written instructions.
   1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
   2. Do not apply to concrete that is less than 28 days old.

B. Penetrating Liquid Floor and Horizontal Surface Treatment (Sealer): Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
   1. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

C. Penetrating Liquid Wall and Vertical Surface Treatment (Sealer/Repellent): Prepare, apply, and finish penetrating liquid repellent treatment according to manufacturer's written instructions.

3.20 **ANTI-GRAFFITI COATING**

A. Refer to Section 099620 Permanante Non-Sacrificial Anti-Graffiti Coating.

B. Apply to all exposed architectual site concrete.

C. Apply compatilble sealer to exposed architectural site concrete prior to installation of Anti-Graffiti coating.

3.21 REPAIRS, PROTECTION, AND CLEANING

A. Patching or sacking of damaged or defective concrete as a determined by the Architect is not permitted. Remove and replace all damaged or defective concrete from joint to joint. Remove/Repair and cure damaged or defective finished surfaces of cast-in-place architectural site concrete when accepted by Architect. Match repairs to color, texture, and for any replaced work/uniformity of surrounding surfaces and to repairs on approved mockups.

B. Remove and replace cast-in-place architectural site concrete that does not match mockups accepted by Architect.

C. Protect corners, edges, and surfaces of cast-in-place architectural site concrete from damage; use guards and barricades.

D. Protect cast-in-place architectural site concrete from staining, laitance, and contamination during remainder of construction period.

E. Clean cast-in-place architectural site concrete surfaces after finish treatment to remove stains, markings, dust, and debris.

F. Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other Work from staining or damage due to cleaning operations.
   1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural site concrete finishes.

END OF SECTION

SECTION 32 3363
SHADE FABRIC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire-retardant shade fabric.

1.02 REFERENCE STANDARDS

A. ASTM D2261 - Standard Test Method for Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant-Rate-of-Extension Tensile Testing Machine); 2013, with Editorial Revision (2017).

B. ASTM D3786/D3786M - Standard Test Method for Bursting Strength of Textile Fabrics--Diaphragm Bursting Strength Tester Method; 2018 (Reapproved 2023).

C. ASTM D3787 - Standard Test Method for Bursting Strength of Textiles - Constant-Rate-of-Traverse (CRT) Ball Burst Test; 2016.

D. ASTM D5034 - Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test); 2021.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

F. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.

G. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal requirements.

B. Product Data: For each item to be installed.

C. Sustainable Product Data: See Section 01 6000 - Product Requirements and Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
   1. VOC content restrictions data.
   2. CAL (CDPH SM) compliance data.
   3. Life cycle data.

D. Shop Drawings: For each shade fabric system.

E. Samples: Minimum 6 by 6 inches.

F. Test reports.

G. Manufacturer's installation instructions.

H. Warranty.

1.04 QUALITY ASSURANCE

A. Preinstallation Meetings: See Section 01 3000 - Administrative Requirements.
   1. Convene minimum 2 weeks before starting work of this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 6000 - Product Requirements.

B. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing.

C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

D. See Section 01 7419 - Construction Waste Management and Disposal, for packaging waste requirements.

1.06 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions by field measurement before fabrication. Show recorded measurements on shop drawings.

1.07 WARRANTY

A. See Section 01 6000 - Product Requirements and Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's 10 year limited warranty.

PART 2 PRODUCTS

2.01 SUSTAINABLE PRODUCT REQUIREMENTS

A. See Section 01 6000 - Product Requirements.

B. VOC Content Restrictions: Products in this section to not exceed VOC content limits specified in Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. CDPH: Products to comply with CAL (CDPH SM) .

D. Life Cycle: Products in this section to have LCA as specified in Section 01 6000.

2.02 PERFORMANCE REQUIREMENTS

A. Shade fabric system to withstand all anticipated loads of Project site.

B. Breaking Force (ASTM D5034): 268 lbs warp, 340 lbs weft.

C. Elongation at Break (ASTM D5034): 110 percent warp, 75 percent weft.

D. Tear Strength (ASTM D2261): 31 lbs warp, 34 lbs weft.

E. Mullen Burst (ASTM D3786/D3786M): 548 lbs/in.

F. Ball Burst (ASTM D3787): 418 lbf.

G. Fire-Retardant Shade Fabric:
   1. NFPA 701: Pass.
   2. ASTM E84: Class A rating.

2.03 REGULATORY REQUIREMENTS

A. California:

1. California State Fire Marshall Flame Resistance Title 19, Section 1237.1: Pass.

2.04 MANUFACTURERS

A. Manufacturers:
   1. Gale Pacific Commercial.
   2. Polyfab USA.
   3. Sunbrella.
   4. Twitchell.
   5. Substitutions: Section 01 2500 - Substitution Procedures.

B. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

1.02 SHADE FABRIC

A. Fire-Retardant Shade Fabric: Woven high-density fire-retardant polyethylene, with UV stablizers and color additives.
   1. Basis of Design Product:
      a. Gale Pacific Commercial; Commercial NinetyFive 340FR.
      b. Substitutions: See Section 01 2500 - Substitution Procedures.
   2. Color: As selected by Architect from manufacturer's full range.

1.02 ACCESSORIES

A. Fasteners: Manufacturer's standard; corrosion-resistant; hot-dip galvanized or zinc-plated steel and iron, or stainless steel; and theft resistant.

PART 3 EXECUTION

2.01 INSTALLATION

A. Install in accordance with manufacturer's written instructions and approved shop drawings.

2.02 ADJUSTING

A. Confirm tension at each connection is within range of tolerance as shown on approved shop drawings and as approved by manufacturer.

2.03 PROTECTION

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements.

B. Provide barrier or other delineation to prevent damage to installed Work from subsequent construction activities.

END OF SECTION

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SECTION 32 9119
LANDSCAPE GRADING

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Weeding.
B. Finish grading for lawns
C. Finish grading for planting areas.

1.02 RELATED REQUIREMENTS

A. Division 31 Section Site Clearing
B. Division 31 Section Grading
C. Division 32 Section Decomposed Granite Surfacing
D. Division 32 Section: Landscape Work

1.03 DEFINITIONS

A. Finish Grading: finish grading shall consist of adjusting and finishing soil surfaces with site or imported topsoil, raking grades to a smooth, even, uniform plane. Remove and legally dispose of all extraneous matter off site. Facilitate natural run-off water and establish grades and drainage indicated as part of the contract work.
B. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 3/4-inches (19 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
C. Finish Grading: Finish grading shall consist of finishing surfaces by raking smoothly and evenly to facilitate natural run-off water, and by removing and disposing of extraneous matter.
D. Sub-grade: The surfaces upon which additional specified materials are to be placed, prepared, or constructed.
E. Rough Grade: The establishment of grades to required tolerances.
F. Finish Grade: Spot elevations (grades) are indicated based on the best available data. Contract Civil Drawings are referenced to provide additional site grading information. It is intended that constant slopes are maintained between spot elevations.
G. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.04 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.05 EXISTING UTILITIES

A. Stake and mark the location of existing utilities before commencing work.

B. Retain and protect in operating condition all active utilities traversing the site designated to remain.

1.06 QUALITY ASSURANCE

A. Finish grade shall conform to contours, grades, lines, and shapes, as indicated on Contract Drawings, with uniform slopes between finish grades or between finish grades and existing grades.

B. Establish finish landscape grades in a continuous, uniform line, resulting in a uniform surface with no ridges or water pockets.

C. Finish landscape grade tolerance shall be 0.04-feet plus-or-minus from finish elevations indicated on site drawings.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS:

A. Topsoil: A natural, fertile, friable soil, free from stones, roots, clods larger than 1" in diameter, noxious seeds, weeds, subsoil, undesirable insects, plant disease or any other natural objects detrimental to normal plant growth.
   1. Silt plus clay content of the import soil shall not exceed 20% by weight with a minimum 95% passing 2.0-millimeter sieve.
   2. Total pore space content on a volume/volume basis shall be at least 15 percent at field capacity.
   3. Permeability rate shall be not less than one inch per hour or more than 20 inches per hour.
   4. The sodium absorption ratio (SAR) shall not exceed 6 and the electrical conductivity (ECE) shall not exceed 2.0 milliohms per centimeter at 25 degrees centigrade.
   5. Soluble boron shall be no greater than 1.0 part per million (mg/l).
   6. Soil pH range shall be 6.0 - 7.9.
   7. Maximum concentration of soluble chloride shall be 150 parts per million.
   8. Maximum concentration of heavy metals shall not exceed the following when the pH is between 6 and 7:
      a. Arsenic: 1 ppm
      b. Cadmium: 1 ppm
      c. Chromium: 5 ppm
      d. Cobalt: 1 ppm
      e. Lead: 15 ppm
      f. Mercury: 0.5 ppm
      g. Nickel: 2.5 ppm
      h. Selenium: 1.5 ppm
      i. Silver: 0.25 ppm
      j. Vanadium: 1.5 ppm
   9. Petroleum hydrocarbons shall not exceed 100 mg/kg dry soil.
   10. Aromatic volatile organic hydrocarbons shall not exceed 2 mg/kg dry soil.

B. Obtain imported topsoil from approved local sources.

C. All topsoil to be used for planting, regardless of whether import or on-site in origin, shall be tested as described in Part 3 of Section 329300.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Verification of conditions: Prior to commencing the finish grading, review the installed work of other trades and verify that their work is complete.
   1. Rough Grading: Grading in planting areas (except raised planter areas) shall be established to within plus or minus 0.10 foot prior to beginning of finish grading.

B. Import topsoil only when necessary to supplement site soil to achieve grades shown on Drawings, or if site soil is unsuitable for planting.

3.02 PREPARATION:

A. Weeding: Before finish grading, weeds and grasses shall be dug out by the root or sprayed with an herbicide and disposed of off-site. This procedure is outlined in Section 329300-Landscape Work.

B. Remove debris, roots, branches, weeds, stones, in excess of 1/2-inch (13 mm) in size and clumps of earth that do not break up. Before and during finish grading, remove weeds and grasses, including roots, and dispose off-site.

C. Remove soil contaminated with petroleum products and legally dispose off-site.

3.03 INSTALLATION:

A. General: When rough grading and weeding have been completed, and the soil has dried sufficiently to be readily worked, lawn and planting areas shall be graded to the elevations indicated on the Drawings.
   1. Grades indicated on Drawing are grades that will result after thorough settlement and compaction of the soil.
   2. Grades not otherwise indicated shall be uniform finish grades and, if required, shall be made at the direction of the Architect.
   3. Finish grades shall be smooth, even, and a uniform plane with no abrupt change of surfaces.
   4. Soil areas adjacent to buildings shall slope away from the building to allow a natural run-off of water, and surface drainage shall be directed as indicated on the drawings by remodeling surfaces to facilitate the runoff water at 2% minimum grade.
   5. Low spots and pockets shall be graded to drain properly.

B. Drainage: Finish grade with proper slope to drains.
   1. Flow lines, designated or not, shall be graded and maintained to allow free flow of surface water.
   2. If any drainage problems arise during construction period due to Contractor's work (such as, but not limited to, low spots, slides, gullies and general erosion), the Contractor shall be responsible for repairing these areas to a condition equal to their original condition, and in so doing shall prevent further drainage problems from occurring.

C. Prior to placing backfill, remove rock, aggregate base, concrete, and deleterious materials to a depth of 18 inches below soil grade in planter areas. Cross-rip subsoil of friable soil to a depth of 12-inches.
   1. Place a minimum of [15-inches] of topsoil backfill in planters.
   2. Refer to Section 329300 “Landscape Work” for soil materials.

D. Toe of slope: To prevent soil creep or erosion across pavement, where pavement (walk, curb, etc.) is at the toe of a slope, finish grade is to level out or swale slightly at least 12-inches before reaching pavement.

E. Moisture Content: The soil shall not be worked when the moisture content is so great that excessive compaction occurs, nor when it is so dry that dust may form in the air or that clods do not break readily. Water may be applied, if necessary, to provide moisture content for tilling and planting operations. It is the Contractor’s responsibility to control dust that is spread as a result of grading operations.

F. Grades: The finish grade in areas to be planted with turf shall be 1-inch below grade of adjacent pavement, walks, curbs, or headers. Finish grade in shrub areas shall be 2 1/2-inches below adjacent surfaces. Exceptions may be made when drainage conditions require flush grades, as directed by the Architect.

G. Compaction: Soils in planted areas shall be loose and friable, yet firm enough that no settling occurs from normal foot traffic or irrigation.

3.04 FIELD OBSERVATION:

A. It is the Contractor's responsibility to contact the Architect 48 hours or two working days in advance of each agreed observation or conference.

B. Schedule for On-Site Reviews: at completion of finish grading and prior to any planting operations.
   1. See “Site Observation” in Part 3 of Section 329300-Landscape Work to coordinate inspections and review of work.

END OF SECTION

SECTION 32 9300
LANDSCAPE WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Soil Prep and Fertilization.
B. Planting Operation.
C. Planting Materials.
D. Topsoil and Planter Mix.
E. Agronomic Testing.
F. Drainage Materials.
G. Jute Mesh and Erosion Control.
H. Mulching.
I. Sod
J. Pruning
K. Tree stabilization.
L. Edgings.

1.02 RELATED REQUIREMENTS

A. Division 01 Temporary Tree and Plant Protection
B. Division 12 Section Site Furnishings.
C. Division 31 Section Site Clearing
D. Division 32 Section Landscape Grading
E. Division 32 Section Landscape Irrigation
F. Division 32 Section Landscape Maintenance
G. Division 33 Section Storm Drainage Utilities

1.03 REFERENCE STANDARDS

A. American Association of Nurserymen, Inc. (AAN)
    1. American Standard for Nursery Stock, latest edition (ANSI).

1.04 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
B. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of exterior plant required.
C. Finish Grade: Elevation of finished surface of planting soil.

D. Sub-grade Elevations: Excavation, filling and grading required to establish elevations is shown on drawings. Coordinate all work with grading contractor in order to arrive at rough grades that will allow tolerance for topsoil in planting areas, soil amendments and ornamental mulch as required in other sections of this specification. Contractor to assume tolerance of rough grades established at ± 0.09 feet (less than 1 tenths of a foot)

E. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

F. "Diameter at breast height" (DBH) is measurement for tree trunk caliper.

G. Multi-Stem: Where three or more main stems arise from the ground from a single root crown or at a point right above the root crown.

H. Planting Soil: Native or imported topsoil; mixed with soil amendments.

I. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

J. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

K. Pruning: As designated on contract drawings. Items not specifically indicated or specified, but normally required to conform with such work, are considered part of the work.

1.05 SUBMITTALS

A. WITHIN 30 DAYS OF START OF THE ROUGH GRADING OPERATIONS:
   1. Submit documentation that all plant material has been ordered in accordance with Article 1.06 of this section.

B. CERTIFICATION: Submit the following:
   1. Certificates of inspection as required by governmental authorities when transporting materials into the state.
   2. Bulk Materials: Submit a certificate of delivery for all material in containers or bulk.

C. TEST REPORTS: Submit the following:
   1. Agronomic Soils Laboratory Test Report(s) including required amendments and maintenance recommendations.

D. PRODUCT DATA: Submit the following:
   1. In accordance with Division 1 Section "Submittal Procedures", submit complete manufacturer descriptive literature and specifications for proprietary materials and any additional items required by the Architect. Prior to start of construction and submittals; furnish to the Architect the list of items to be submitted and reviewed.
      a. Soil Amendments (as identified in Agronomic Soils Report).
      b. Fertilizer (as identified in Agronomic Soils Report).
      c. Plant Tablets.
      d. Mulch.
      e. Filter Fabric.
      f. Drainage Materials.
      g. Other soil additives per Agronomic Soils Report.
      h. Submit other data substantiating that materials comply with specified requirements. Such certificates may be tags, labels, and/or manufacturers literature. All submittals shall be reviewed and accepted by the Architect before contractor begins work.
      i. Substitution Request
         1) If any plant specified is not obtainable, submit a written substitution request to the Architect during the bidding period.

2) Substitutions of plant material will not be permitted unless accepted in advance in accordance with the provisions of Division 1 Section "Product Requirements."
3) The Contractor is responsible for contract growing all required plant material for to project to ensure availability in the size and requirements of the project.
4) All substitution requests for any material must be made during the bid process. No substitution requests will be permitted after the bid process or during.

j. With submittal of Bid Documents, submit complete list of plant materials to be provided, including unit prices for plants and for installation. Include:
1) Quantity.
2) Size.
3) Botanical Name.
4) Plant Unit Price.
5) Installation Unit Price.

2. PLANTING SCHEDULE: Submit proposed planting schedule at least two months prior to planting any materials, indicating dates for each type of landscape work coinciding with normal seasons for such work. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. If dates need to be revised after acceptance of planting schedule, document reasons for delays and submit for acceptance.
3. Submit photos from nursery yard of each Shrub and groundcover to be used on the project to the architect for review. Photos are to be of the actual material tagged, or secured and that will used for the project at the sourced nursery. No plants may be delivered or planted prior to approval by Architect.

1.06 QUALITY ASSURANCE

A. QUALIFICATIONS
1. Nursery Qualifications: Regularly engaged, for the preceding ten years, in the production of planting materials equivalent in species and size to those required.
a. Stocked, and having a demonstrated ability to provide plant materials required within the constraints of the accepted construction schedule.
b. Landscaper's Qualifications: Regularly engaged and specializing, for the preceding ten years, in the installation and maintenance of planting materials equivalent in species and size to those required.
1) Capable of furnishing a verifiable list of not less than five projects of equivalent type successfully completed within the preceding two years.
2) Subcontracts: Landscape work to a single firm specializing in landscape installation.
2. Pre-Installation Conference: Schedule in advance of beginning work of this section. Arrange for attendance by Owner, Architect, and landscaping subcontractor. Review intent of Contract Documents and resolve conflicts. Prepare minutes of conference and distribute to attendees within five (5) days.
3. Source Quality Control
a. General: Comply with regulations applicable to shipping of landscape materials.
b. Analysis and Standards: All materials shall be of standard, approved and first-grade quality and shall be in prime condition when installed and accepted. Any commercially processed or packaged material shall be delivered to the site in the original unopened container bearing the manufacture's guaranteed analysis. The Contractor shall supply the Architect with a sample of all materials accompanied by analytical data from an approved laboratory source illustrating compliance of bearing the manufactures guaranteed analysis.

4. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
5. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
    a. Report suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
6. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 3/4-inches (19 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
    a. Obtain topsoil only from naturally, well drained sites where topsoil occurs in a depth of not less than 4"; do not obtain from bogs or marshes. All topsoil is to be tested and analyzed by an independent laboratory before delivery to site, as indicated in Article 3.03.
7. Contractor shall provide the Architect with location of soil, crops previously planted on such soil within the last two years, and the USGS soil survey classification and name.
8. Shrubs and Plants: Provide tshrubs and plants of quantity, size, genus, species and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1-1980 "American Standard for Nursery Stock". Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free from disease, insects, insect eggs, larvae and defects such as knots, sun-scald, injuries, abrasions, overlapping surface roots, or disfigurement. Central leaders of all trees shall be intact, undamaged, with evenly spaced lateral branches.
    a. Shrub Measurements: Measure main body of shrub for height and spread; do not measure branches or roots tip-to-tip.
9. Label all shrubs with securely attached waterproof tag bearing legible designation of botanical and common name. Where formal arrangements and consecutive order of trees is shown, select stock for uniform height/spread, and label with number to assure symmetry in planting.

1.07 DELIVERY, STORAGE AND HANDLING

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.
    1. Protect plants from sun or drying winds. Protect and maintain plants that cannot be planted immediately upon delivery.
    2. Do not drop plant material.
    3. Do not pick up container planter material by stems or trunks.
    4. Protect from wind.
    5. Water as required.
    6. Do not prune trees and shrubs before delivery except as approved by Architect. Do not bend or bind trees or shrubs in such manner as to damage bark, break branches or destroy natural shape. Provide protective covering during delivery, and provide protection on site from traffic, pedestrians, and deleterious effects of climate while planting operations are in progress. Dropped or damaged stock will not be accepted.

7. Deliver trees and shrubs after preparations for planting have been completed and plant immediately after approval of plant materials locations. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture. Do not remove container grown stock from containers until planting time.
    a. Do not pick up plants by stems or truck. Handle planting stock by root ball.
    b. Do not remove container - Grown stock from containers before time of planting.
    c. Water root systems of exterior plants stored onsite with a fine-mist spray.
    d. Water as often as necessary to maintain root systems in a moist condition.
8. Plant material shall not be stored on the jobsite for more than 48 hours before planting. Contractor shall schedule nursery deliveries in sub-groups as necessary to comply with this requirement.
9. Deliver accessory materials in manufacturer's original, unopened packaging with identifying labels affixed and legible in accordance with state law. Deliver plants with identifying tags affixed. Contractor shall notify Architect 72 hours in advance of plant material delivery for observation. Review plants with Landscape Architect to confirm that they are the plants which had previously been tagged and supplied. The Architect reserves the right to reject the following:
    a. Plant materials not identifiable as previously selected.
    b. Materials not accompanied by required certificates.
    c. Plant materials where damage to rootball, trunks, or desiccation of leaves has been caused by inadequate protection during delivery.
    d. Plant material not matching the form, shape, or growth habit required for the design intent of the Project.
    e. Horticultural or visual defects in material.
    f. Plant material pruned prior to delivery.
    g. Plant material with detrimental pests.

1.08 PROJECT CONDITIONS

A. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.
    1. Planting Restrictions: Coordinate planting periods with maintenance periods to provide required maintenance from date of substantial completion.
        a. Plant or install materials during normal planting seasons for each type of landscape work required.
    2. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed without having detrimental effects on the plant material, or finished product.
    3. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns unless otherwise acceptable to Architect.
        a. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.
    4. Contractor shall verify locations of all existing utilities, whether shown on plans or not. The Contractor shall notify members of Underground Service Alert (DigAlert) two (2) working days in advance of performing any excavation work by calling the toll-free number 1-800-227-2600 or 811.
    5. After determining location of underground utilities, perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

6. When conditions detrimental to plant growth are encountered, such as rubble fill, hardpan condition, adverse drainage conditions, or obstructions, notify the Architect before planting. Remove all material deemed unsuitable for plant growth as directed by the Architect.
7. No landscape materials may be planted before an irrigation operation and coverage test is completed by the Architect.
8. No landscape materials may be planted before finish grade is reviewed by the Architect.
9. Existing Trees:
    a. Prior to the beginning of any clearing, grubbing, trenching, or excavation on site, the general contractor, grading contractor, project arborist, landscape contractor, and the Architect shall meet in a pre-construction conference to discuss grading near existing trees.
    b. The contractor shall protect all existing trees and shrubs scheduled to remain against injury or damage, including cutting, breaking or skinning of roots, trunks or branches. No blasting of rock shall occur in any area adjacent to existing trees without prior written consent of the Architect.
    c. No trees or shrubs are to be removed, trimmed, or cut without prior approval of the Architect.
    d. Prior to the beginning of the clearing and grading phase of the project, a continuous, temporary, six foot (6') high chain link fence shall be erected around the drip line of all trees scheduled to remain, unless otherwise specified by the Architect. The temporary fencing shall be erected prior to commencing any other work on the project. No construction activity shall be allowed within the limits of this fencing unless directed by the Architect. The temporary fencing shall remain in place during the entire construction period and shall not be removed until directed by the Architect.
    e. Grading beneath trees to be saved shall be given special attention. Every effort shall be made to avoid creating conditions adverse to the tree’s health. The natural ground within the drip lines of trees to be preserved shall remain as undisturbed as possible. Grading within the protected root zone of trees to be preserved will not be permitted unless specifically approved by the Architect prior to beginning of proposed grading.
    f. If during construction or grading (grading, excavation, etc.) tree roots of 2" in diameter or greater are encountered, work shall stop immediately and a Certified Arborist, approved in advance by the Architect, shall be contracted for a root inspection. Root cutting of any roots over 2" in diameter must have prior approval from the Architect. All cuts are to be made with appropriate equipment, as to not affect the plant material.
    g. Major roots one inch (1") or greater in diameter encountered within the drip line of the tree in the course of excavation or trenching shall not be cut and shall be kept moist and covered with earth as soon as possible. Shredding of roots or damaged caused by trenching or grading equipment is not permitted.
    h. Roots one half inch (1/2") to one inch (1") in diameter which are severed shall be trimmed cleanly and covered with earth as soon as possible.
    i. All trenching beneath the drip line of trees to remain shall be done with hand tools only. No mechanical trenching or excavation is allowed within the drip line of existing trees at any time, or where roots are encountered outside the dripline of the tree.
    j. Branches interfering with construction but not designated for removal may be removed only as directed by the Architect.
    k. Any pruning, cutting, or trimming of any trees will be performed by an International Society of Arboriculture Certified Arborist or certified tree worker or in accordance with the National Arborist Association and/or International Society of Arboriculture pruning standards. Cutting of 2" diameter limbs or greater or major dead wooding shall require approval of the Architect.

l. Trees or shrubs scheduled to remain and damaged by construction operations shall be repaired by the contractor in a manner acceptable to the Architect. Damaged trees and shrubs shall be repaired promptly to prevent progressive deterioration. Repair or replacement of trees and shrubs shall be at the contractor's expense as determined by the Architect. Contractor shall be held fully liable for damage caused to trees and shall be assessed fees based on the International Society of Arboriculture "Guide for Plant Appraisal", as determined by the project Arborist; fees will be assessed for: 1) any injury to the trunk, limbs, or root system, and (2) for the value of any tree requiring removal subsequent to injury or treatment that varies from these Specifications.
m. A permit from the City Arborist may be required prior to pruning or removing any trees, as required by applicable codes or ordinances.
n. Parking of vehicles, equipment or storage of materials under the drip line of existing trees shall not occur at any time.
o. Wash all existing and new trees weekly to remove dust and debris during construction.

1.09 SCHEDULING

A. Within 30 days after the commencement of initial grading, furnish documentation to the Architect that all plant material has been secured for the project and is available. Contractor shall be responsible for payments and deposits required by the grower or plant consultant to secure, maintain, and grow plant material indicated on the Contract Drawings.

1.10 WARRANTY

A. Special Warranty: Warrant all plant material in writing where installer agrees to repair or replace plantings and accessories that fail in materials, workmanship or growth within specified warranty period.
1. Failures include, but not limited to, the following:
a. Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by owner.
b. Structural failures including plantings falling or blowing over including during high wind events.
c. Faulty operation of tree stabilization edgings tree grates.
d. Deterioration of metals, metal finishes and other materials beyond normal weathering.
e. Material not thriving.
f. Warranty periods begin from date of final completion:
1) Trees, vines, shrubs: One year.
2) Ground cover and turf: One year.
2. Warrant plant material, installed, or relocated under the contract, in writing, for a period of one year (after beginning of maintenance period) against defects including death, and unsatisfactory growth, except for defects resulting from neglect, abuse or damage by others.
3. Remove and replace trees, shrubs or other plants found to be dead, yellowing, defoliating, or in unhealthy condition, or other defective materials during warranty period at no additional cost to the Owner. Replace trees and shrubs, which in the opinion of the Architect, are in unhealthy condition at end of warranty period. The Architect shall be the sole judge as to the condition of the material. All replacement materials and installation shall comply with the drawings and specifications. Another inspection may be conducted at end of warranty period to determine acceptance or rejection.

4. Upon receipt of written notice from Owner of the loss of any warranted plant materials during the warranty period, the subject plant materials shall be promptly replaced with the same species originally planted, and of a size closely approximating the size of the plant, if normal growth had occurred since the original planting. Replacements shall be subject to the requirements of this specification.
5. When plants are replaced, advise the Owner, in writing, of the new establishment maintenance period equal to the one year.
6. Plant material must be replaced within ten (10) days of written notification, and shall be installed in accordance with these specifications.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Design is based on the use of products manufactured by the following.

B. California (Southern)
1. Conwed Designscape, Ladyscape, MI, 714-532-5548/800-833-4798.
2. Mirafi, Inc., Charlotte, NC 800-438-1855, represented by James Heidt & Associates, Montrose, CA, 818-248-9677/800-233-0512.
3. NDS Drainage Products, 800-726-1998.
4. Pacific Sod, Camarillo, CA, 800-762-3027.
5. Permaloc Corporation, Holland, MI, 616-399-9600.
6. Soil and Plant Laboratory, Inc., Orange, CA, 714-282-8777.
7. Southern California Organic Fertilizer Company, El Monte, CA, 714-750-3830.
8. Southland Sod Farms, Port Hueneme, CA, 805-488-3585.
9. West Coast Turf, Las Vegas, NV, 800-649-8873.
10. Whitecap, Inc., Santa Ana, CA, 714-258-3300.
11. Whittier Fertilizer, Pico Rivera, CA, 310-699-3461.
12. EPIC Plastics, Cerritos, CA, 562-403-3848.
13. Wallace Labs, El Segundo, CA, 310-615-0116.
14. Materials shall be the products of one manufacturer and shall be either the ones upon which the design is based, or the products of manufacturer accepted in advance. No substitutions will be permitted.

2.02 SOIL

A. TOPSOIL: Site to be rough graded to elevations shown on Civil Drawings. Topsoil will be required behind curb areas and in planting area. Provide on-site, import, or non-processed topsoil in planting areas as needed to complete rough grading which is fertile, friable, and natural loam in accordance with Article 2.3. Topsoil shall be from agricultural sources, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 3/4-inch in any dimension, and other extraneous or toxic matter harmful to plant growth.

B. All topsoil to be used for planting, regardless of whether import or on-site in origin, shall be tested as described in Part 3 of this Section.

2.03 SOIL AMENDMENTS

A. The initial application of fertilizers and amendments to be tilled into the soil during soil preparation operations shall be established after soil testing has been conducted by Contractor. An estimated quantity is indicated below for bid purposes only. This estimated quantity does not include mulching, fertilizer tablets, additional topsoil necessary to meet specified grades and fertilizer applications for after planting. After soils analysis recommendations are made to the Architect quantifying the actual amount of amendments required and recommendations have been accepted by the Architect, the Contractor shall, without delay, determine any cost impacts whether credit, no change, or addition, to the Contract Amount. As an integral part of the bid for Landscape Work, provide a Lump Sum bid amount for fertilizers and amendments as described below.

B. Application Rates (FOR BID PURPOSES ONLY):
   1. Sixty (60) lbs. of Tri-C Humate per 1,000 square feet.
   2. Nineteen (19) lbs. of 6-20-20 fertilizer per 1,000 square feet.
   3. Six (6) cubic yards of Aguiñaga GPS2, nitrogen stabilized compost per 1,000 square feet.
   4. 50-lbs Agricultural Gypsum, per 1,000 square feet.

C. Pot or Raised Planter Soil Mix: Prepare and backfill pots with a mix of the following per cubic yard:
   1. Jardinier Capillary Soil
   2. 12-12-12 Commercial Fertilizer
   3. Organic Amendment - 1/3 cubic yard
   4. Fine Sand - 1/3 cubic yard
   5. 12-12-12 Commercial Fertilizer - 1 pound
   6. Iron Sulfate - 2 pounds

D. Actual amendment rates and type shall be per soil test recommendations.

E. Imported Topsoil
   1. Provide natural, fertile, friable soil free from stones, noxious weeds, seeds, roots, subsoil or other material detrimental to normal plant growth. Topsoil acidity range (pH) shall be between 6.5 and 7.5 containing a minimum of 4 percent and a maximum of 25 percent organic matter.
   2. Reuse surface soil stockpiled onsite. Verify suitability of stockpiled surface soil to produce top soil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
      a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain top soil displaced from naturally well drained sites where topsoil occurs at least 4 inches deep; do not obtain from [agricultural land], bogs or marshes. Obtain soil from local sources acceptable to the Architect.
      b. Silt plus clay content of soil shall not exceed 15 percent by weight with a minimum 95 percent passing a 2 millimeter sieve.
   3. Obtain imported topsoil from local sources acceptable to the Architect.
   4. Silt plus clay content of soil shall not exceed 15 percent by weight with a minimum 95 percent passing a 2-millimeter sieve.

F. Organic soil amendment:
   1. "Nitrified Redwood Compost": 0.56 to 0.84% N based on dry weight, treated with relative form of nitrogen (NH3).
      a. Particle Size
      b. 95% - 100% passing 6.35 mm standard sieve.
      c. 80% - 100% passing 2.33mm standard sieve.

d. Salinity: The saturation extract conductivity shall not exceed 3.5 millimhos/centimeter at 25 degrees (25N) centigrade as determined by saturation extract method.
e. Iron Content: Minimum 0.08% dilute acid soluble Fe on dry weight basis.
f. Ash: 0 - 6.0% (dry weight)
g. Acidity range (ph) shall be between 5.5 and 7.5.
h. Actual organic content shall be a minimum 280 pounds (lbs.) per cubic yard.
i. As available from: Redi-Grow Corporation, 909 Elder Creek Road, Sacramento, CA 95828

2. Organic soil amendment shall be Aguinaga GPS2.
3. Particle Size:
   a. 90-100 percent passing 6.35 mm standard sieve.
   b. 80-100 percent passing 4.75 mm standard sieve.
4. Salinity: The saturation extract conductivity shall not exceed 6.5 milliohms/centimeter at 25 degrees Centigrade as determined by saturation extract method.
5. Iron Content: Minimum 0.08 percent dilute acid soluble iron on dry weight basis.
6. Actual organic content shall be a minimum of 280 pounds (lbs.) per cubic yard.

G. Fertilizers
1. Tri-C Humate. Provide per manufacturers specification.
2. Fertilizer Tablets: Fertilizer Tablets: The following is to be used in the planting of container grown material. Follow manufacturer's application rates.
   a. Best-Paks "20-10-5" fertilizer packets. Packets to be made up of a minimum of 20% Nitrogen, 10% Phosphorus, 5% Potash. Use 1 Pak per 1-gallon container, (G.C.), 3 Paks per 5 G.C., 9 Paks per 15 G.C. and 12 Paks per boxed specimen. Evenly distribute as shown in details.
3. Commercial Fertilizer: First Quality Commercial Fertilizer, as specified in Agronomic Soils Report.

H. Related Materials:
1. Pre-Planting Herbicide: Phydura, or equal.
2. Pre-Emergent Weed Control: Ronstar-G, Treflan, Eptam, Vegitex, or equal.
3. Peat Moss: Sphagnum peat moss, Canadian or European variety, free from alkali.
4. Soil Sulfur: First quality commercial grade.
5. Ferrous Iron Sulfate: Chelated first quality commercial grade.
6. Agricultural Gypsum: First quality commercial grade.
7. Best "Ammonium Phosphate" 16-20-0 with net less than 16% total nitrogen, 20% available phosphoric acid and 0% soluble potash.
8. Good Humus.
9. Root Hormone: Super Thrive.

2.04 PLANT MATERIALS

A. Quality: Provide trees, shrubs, and other plants of size, form, genus, species and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock".

B. Shrubs: Provide shrubs of the size shown and with not less than the minimum number of canes required by ANSI Z60.1 for type of shrub required. Provide container grown stock.
1. Ground Cover: Provide plants established and well-rooted in removable containers, in flats, or integral peat pots and with not less than minimum number and length of runners required by ANSI Z60.1 for the size shown or listed.

2.05 SOD

A. Lawn Sod:
   1. Nursery-grown sod shall have the following characteristics:
      a. Sod for planting areas shall be dense, healthy, field-grown on sand fumigated soil with the grass having been mowed at 1-inch height before lifting from field.
      b. Sod for grass pave areas shall be dense and healthy, grown on a sand bed thin cut and washed.
      c. Sod shall be dark green in color, relatively free of thatch, free from disease, weeds and harmful insects.
      d. Sod shall be reasonably free of objectionable grassy and broadleaf weeds. Sod shall be considered weed free if no more than 2 such weeds are found per 100 square feet of sod.
      e. Sod shall be rejected if found to contain the following weeds: common Bermuda grass, quack grass, Johnson grass, nimble weed, thistle, bindweed, bentgrass, perennial sorrel, and bromegrass.
      f. Sod variety shall be:
         1) Turf Grass: Tiffway II, Bullseye, Bandera, GN1, Medallion Plus 90% Tall Fescue/10% Bluegrass Blend, as produced by West Coast Turf / Pacific Sod.
         2) Molate Fescue: No Mow Fine Fescue Blend, as produced by Pacific Sod.

2.06 MISCELLANEOUS LANDSCAPE MATERIALS:

A. Headers and Edging
   1. Concrete edger: Dimension as specified on plans, poured in place concrete edger, color per plan.

B. Mulch
   1. Bark Mulch:
      a. Mulch shall be shredded bark mulch, as manufactured by Whittier Fertilizer, Pico Rivera, CA.
         1) Mulch shall consist of shredded bark mulch with a particle range of 2-3/4-inch to 1-inch in size.
   2. Weed Control Fabric: Place Mirafi Mirascape landscape fabric below rock mulch or as shown on drawings. Overlap all seams 12" minimum and pin down every 36" typical. Mirascape fabric available from: Towns & Associates, 800-222-6036

C. Drainage Materials
   1. Gravel in raised planters on structural slab and in pots shall be clean, coarse 3/8-inch to 3/4-inch diameter.
   2. Gravel for tree drainage shall be 3/4" diameter coarse clean gravel.
   3. Synthetic filter membrane cover over drainage course shall be woven synthetic fabrics.
      a. Model 140N, as manufactured by Mirafi.
   4. Drain Pipe at trees: 4-inch diameter PVC perforated(within gravel), and non-perforated PVC drain pipe(stand pipe) with PVC adaptor connected to 4-inch ABS female reciever with 4-inch black ABS cleanout plug.

D. Weed Control: Phydura, or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected, and Architect has reviewed and accepted materials as defined within the section.

3.02 SITE OBSERVATION SCHEDULE

A. General: Notify Landscape Architect at least 3 days in advance when requesting on-site reviews.

B. Prior to commencement of site visits, items noted in previous observation reports shall have been either completed or remedied, unless such compliance has been waived. Failure to complete prior tasks or failure to prepare adequately for scheduled observations shall obligate Contractor to reimburse Architect for additional hourly services, plus transportation costs

C. Schedule For On-Site Reviews by the Landscape Architect:
   1. Pre-construction conference with general contractor, grading contractor, landscape contractor, project arborist and landscape architect to discuss grading and protective measures to be followed in the vicinity of existing trees, or existing structures.
   2. At completion of finish grading, and roto-tilling
   3. Review of irrigation coverage prior to installation of any planting material.
   4. At completion of fine grading and at delivery of plant materials, together with plant layout; prior to excavating pits.
   5. Review of drainage system, standpipes, and plant material locations.
   6. After planting pits have been excavated, but prior to backfilling. Provide one sample plant pit mock up for review.
   7. After initial planting operations (One tree with each type of specified staking shall be approved prior to planting of trees).
   8. See "Final Review and Acceptance" at the end of Part 3 in this Section for final site observations and acceptance of work.

3.03 TESTING

A. Planting Soil: Agronomic Soil Testing
   1. Test shall be paid for by the Contractor. (SoCal)Testing lab shall be:
      a. Wallace Labs, El Segundo, CA
      b. Waypoint Analytical, Anaheim, CA
   2. Agronomic Soils Testing
      a. Take 2 samples of site soil at a depth of 6 to 12 inches, within proposed planting areas, after completion of final grading and prior to weed control and soil preparation.
      b. Take samples to agronomic soils testing laboratory indicated above for soil evaluation.
      c. Request testing for fertility and suitability analysis with written recommendations for soil amendment, fertilizer and chemical conditioners, application rates for soil preparation, planting backfill mix, pot-soil mix, hydro-spray, and post-maintenance fertilization programs.

d. Soils report recommendations shall take precedence over the amendment and fertilizer application rates specified in this section.
e. Submit testing laboratory's interpretation, recommendations, and comments to Architect within 14 days after the completion of rough grading.
f. Furnish a soils analysis of import soil, and organic soil amendment prior to backfill.
    1) Submit soil testing laboratory's findings to Architect within 5 days prior to backfilling.
g. Take six additional soil samples after completion of planting in the soil preparation and backfill mix areas, to be determine effectiveness to amendments prior and during planting. Submit to the testing laboratory the original amendment specification with previously issued bulletins for soil amendments and installation procedures. Re-apply necessary amendments based on recommendation of new soils test.

3.04 PREPARATION

A. Final Grades
1. Finished grading shall insure proper drainage of the site. Conform to Division 31 Section "Earthwork" and Division 32 Section "Landscape Grading."
2. The following areas shall be graded so that the final grades shall be established below adjacent paved areas, sidewalks, valve boxes, headers, clean outs, drains, manholes, etc. before placement of mulch as follows:
    a. Shrub/Groundcover Areas: 2-1/2 inches.
    b. Turf areas: 1-inch.
    c. Surface drainage shall be away from all building foundations, 2% minimum.
    d. Dispose of excess or unacceptable soil from the site at no expense to the Owner.
    e. Verify that final grades have been established prior to beginning planting operations.
3. Parking Lot Planters and areas adjacent to hardscape.
    a. All aggregate base rock, lime-treated soil, soil sterilents, and other non-organic materials shall be removed from all parking lot planter areas down to the level of native soil. Scarify native soil to a depth of 12 inches and backfill planters to specified finish grade with native or approved topsoil and amend as specified.
    b. Remove all concrete overpours or any material that may prohibit the placement of plant material, irrigation, grates, root barriers, or any other conflicting material.
4. Lightweight soil mix shall be sampled after mixing and delivery to the site, but prior to filling planters. Submit the original lightweight soil specification to the testing laboratory with previous bulletins for lightweight soil mix. Provide 1-quart of lightweight soil mix for every 65 cubic yards for organic and fertility analyses. Fertility analysis, recommendations and interpretations shall be furnished by the testing laboratory to ensure all specified amendments have been provided. Lightweight soil is to be used only in locations indicated on the Contract Drawings and as approved by the Architect.
5. Protect planting areas from compaction by foot, trucks and heavy equipment.

3.05 PLANTING BED ESTABLISHMENT

A. Preparation Of Planting Area
1. Cross-rip on-grade planting areas to a minimum depth of 12 inches minimum 2 perpendicular directions. Remove stones over ½ inch (13mm) in any dimension and sticks, roots, rubbish and other deleterious matter per Division 32 "Landscape Grading".
2. Where additional soil is needed, place the top 15” with topsoil. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil.
3. Leach soil prior to amending.

4. After approximate finished grades have been established and soil has been leached, soil shall be conditioned and fertilized in the following manner: Soil condition shall, at the rate specified in the approved soils test recommendations, be uniformly spread and cultivated thoroughly by means of mechanical tiller into the top (8) eight inches of soil.
5. Broadcast soil amendments uniformly over surface of the area to be treated. Roto-till the top (8) eight inches of planting areas to evenly distribute the amendments and conditioners into the soil.
6. Retest as required to verify leaching was successful. All soil areas shall be compacted and settled by application of irrigation to a minimum depth of six (6) inches prior to any plant materials being installed.
7. At time of planting, the top 12 inches of all areas to be planted shall be free of stones, stumps, or other deleterious matter one 1/2 inch in diameter or larger, and shall be free from all debris, or similar objects that would be a hindrance to planting and maintenance.
8. Weed Eradication:
    a. Manually remove all existing vegetation in planting areas and dispose of it offsite.
    b. Fertilize planting areas with urea 30-0-0 commercial fertilizer at the rate of 0.5 pounds per 1000 square feet.
    c. Water planting areas thoroughly and continuously(by irrigation system, hand/hose, water truck, or other) for a period of 3 consecutive weeks, or until the weed seed have germinated. If accepted in advance by the Landscape Architect, employ a specific watering duration and frequency program designed to germinate residual weed seeds.
    d. Discontinue watering process for 2 days. Then apply a non-selective broad spectrum systemic herbicide for perennial weeds.(2 applications minimum) The type of herbicide to be used shall be determined by a licensed pest control applicator. If annual weeds are present, use straight contact herbicide in accordance with pest control applicator's recommendations.
        1) Do not use a pre-emergent herbicide.
    e. Allow sufficient period of time to ensure that weeds are dead. Follow herbicide manufacturer’s directions.
    f. Water planting areas thoroughly and continuously (by irrigation system, hand/hose, water truck or other)for a period of 3 weeks. A shorter watering period may be permissible at the discretion of the Landscape Architect. Discontinue watering process for 1 day prior to the second application of the herbicide spraying.(2 applications minimum) Re-apply the spraying operation with straight contact weed killer in accordance with pest control adviser's recommendations.
        1) Do not use a pre-emergent herbicide.
        2) Avoid irrigation for a minimum of 4 days for effective final weed kill.
    g. Clear desiccated weeds from the area.
    h. Water Planting areas thoroughly and continuously for 3 consecutive days to saturate upper layers of soil prior to planting operations.
    i. Allow planting area soil surface to dry out for I day only prior to the planting application. Exercise care to not allow the soil surface to be either super-saturated with water or bone dry prior to the planting installation. Ensure moderate residual moisture within the top 1/4 inch of the soil surface.
    j. The hydraulic equipment used for pesticide applications shall consist of an ISO-gallon minimum capacity fiberglass tank with complete mechanical agitation. The pump capacity shall be 10 gallons per minute while operating at a pressure of 100 pounds. Per square inch.

k. Distribution lines shall be large enough to carry the volume of water necessary for even, chemical distribution. The spray nozzle must cover a IS-foot swath, with a minimum output of 5 gallons per minute at 80 pounds per square inch.

9. Pre-emergent Weed Control: Immediately after planting, apply pre-emergent weed control to planted areas which will not be seeded.
10. Excavation For Trees And Shrubs
    a. Excavate pits, beds, and trenches as shown in details on the drawings.

B. Preparation for Lawn Areas: Limit preparation to areas which will be planted promptly after preparation.
1. Prepare planting area as described in 3.05 A.
2. Fine grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll, rake and drag lawn areas, remove ridges and fill depressions, as required to meet finish grades. Establish smooth uniform surface. Limit fine grading to areas which can be planted immediately after grading.
3. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
4. Restore lawn areas to specified conditions if eroded or otherwise disturbed after fine grading and prior to planting.

3.06 SOD

A. Sod shall be laid with closely fitted joints on a smooth, level surface which has been prepared as previously specified. Ends of strips shall be staggered. On irregular areas, sod shall be laid in both directions from the longest straight line that can be drawn through the area.

B. After a light initial watering immediately after installation, the sod shall be rolled to eliminate all irregularities.

C. After compaction, the sodded area shall be wetted to a soil depth of at least 8 inches.

D. Sod shall be as specified on the Contract Drawings

E. Protect sod from pedestrian traffic for 21 days and from sports activity for 6 weeks.

F. Sod is to be rolled minimum two times or as often as required in two directions with a water ballast roller to remove variations in grade. Sand infill all depresses. Sand to comply with turf manufacturer recommendations.

G. Sod is to be machine placed from “Big Rolls”.

3.07 PLANTING

A. General
1. Actual planting shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted practice, as approved by the Architect.
2. Only as many plants as can be planted and watered on that same day shall be distributed in a planting area.
3. Container shall be opened and plants shall be removed in such a manner that the ball of earth surrounding the roots is not broken and they shall be planted and watered as herein specified immediately after removal from the containers. Containers shall not be opened prior to placing the plants in the planting area.

B. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure acceptance by the Architect before start of planting work. Make minor adjustments as may be requested.

C. Excavation for Shrubs:
   1. Excavate pits, beds and trenches as shown in details on the Drawings.
   2. Roughen and score edges of planting pit to eliminate any glazing of the sides of the pit.
   3. Field Samples: Prior to planting, prepare one plant pit with standpipe, gravel, filter fabric, and root barriers for each tree size to be reviewed by the Architect.
   4. Do not cover standpipes.
   5. Excavation for planting shall include the stripping and stockpiling of all acceptable topsoil encountered within the areas to be excavated for trenches, tree pits, plant pits, and planting beds.

D. Container Removal
   1. Cut containers on two sides with an acceptable cutter. Do not cut containers with spade or ax. Do not injure the rootball.
   2. Carefully remove plants from containers without injury or damage to rootball.
   3. After removing plants, superficially cut edge roots with knife on three sides.
   4. For plants with sensitive roots, place container intact in flat pit 1½ times the size of a standard plant pit. Insert blades of sharp, needle-nose shears into a drain hole and cut the container bottom away. Remove bottom from pit. Follow with a cut down one side of the container from top to bottom. Repeat cut on opposite side. Fill plant pit with prepared plant pit mixture. Carefully remove the detached pieces.

E. Planting Shrubs: Set container-grown stock, plumb and in center of pit or trench. Set top of rootball 2-inches above finish grade at trees, 1-inch above finish grade at shrubs, or as indicated on Contract Drawings. Do not use plant, if root system has severely kinked or circling roots, or if rootball is cracked, disturbed or broken. If root system is healthy, loosen spiraling roots and set in plant pit.

F. Planting pit shall be backfilled with the following soil conditioner and organic amendment, per cubic yard:
   1. Application Rates, (FOR BID PURPOSES ONLY)as determined by contractor's soils tests:
      a. Potassium Sulfate - 0-0-50, ¼-pound
      b. Single Superphosphate - 0-20-0, ¼-pound
      c. Ammonium Sulfate - 21-0-0, ¼-pound
      d. Compost - 15% by volume
      e. Agricultural Gypsum - 1.5 pounds
      f. Good Humus - 15% by volume
   2. Final amendments and rates are to be determined by Agronomic Soils Test.

G. When set, place additional fill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 1/2-full, place appropriate number of fertilizer tablets and complete backfill operations.

H. After backfilling, an earthen basin shall be constructed around each plant. Each basin shall be as indicated on the Contract Drawings. Basin shall be of a size suitable for the individual plant. In no case shall the basin for fifteen (15) gallon plant be less than four (4) feet in diameter; a five (5) gallon plant less than three (3) feet in diameter. The basins shall be constructed of amended backfill materials, and shall not be constructed for trees in turf areas.

I. Repeat watering until no more is absorbed.

J. Apply pre-emergent herbicide as per manufacturer's recommendations to all shrub and ground cover planting areas after planting.

K. Mulch all planted areas that do not receive jute netting, other than lawn areas, at not less than 3" thickness of mulch.
   1. Areas with 30% slope and greater shall be protected with jute mesh.

L. Equally space and align trees and shrubs in both directions where designated on Contract Drawings.

M. Pull bark mulch three (3) inches away from the rootballs of all plants to insure proper air circulation.

N. Prune, thin out and shape shrubs in accordance with standard horticultural practices. Prune trees and other plantings only if required. Pruning shall be limited to remove injured wigs and branches, and to compensate for loss of roots during transplanting, but never exceed 1/3 of the branch structure. Never prune without prior review with Architect.

O. Prune shrubs to retain natural character. Unless directed by the Architect, do not prune leaders or apices of any plant material. Do not prune into balled or boxed forms without prior written approval of the Architect.

P. Remove and replace excessively pruned or malformed stock resulting from improper pruning.

Q. Planting Ground Cover
   1. Space plants as shown or scheduled.
   2. Dig holes large enough to allow for spreading of roots and compact area around plant. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover crowns of plants with wet soils.
   3. Mulch areas between ground cover plants with not less than three (3) inch deep mulch.

R. Miscellaneous Landscape Work: Install headers and edgings where shown. See appropriate details.

S. Planting Vines: Plant in accordance with details. Attach vine to vertical elements with vine ties as per manufacturer's recommendations.

T. Hardpan Conditions
   1. Where hardpan exists, whether it is in the form of caliche, rock or other impervious matter, and it is within the top 2½ feet of soil, or within the plant pit, use powered equipment to break through completely at each plant location to allow drainage and root growth. Remove hardpan at least 1½ feet greater than the rootball diameter of plant. Backfill with soil mix as specified.
   2. Where hardpan is within the first 12-inches of soil, it shall be completely penetrated for all trees and shrubs.

3.08 CLEANUP AND PROTECTION:

A. During landscape work, keep pavements clean and work area in an orderly condition. Haul away and remove all debris from landscape areas, and do not leave any clippings, and or other material from landscape planting and/or maintenance period.

B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and/or other trades. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.

C. Powerwash all pavement and flatwork as necessary to remove all staining and tire marks and provide a clean surface.

3.09 REVIEW & FINAL ACCEPTANCE

A. General: Notify Landscape Architect at least 5 days in advance when requesting on-site reviews.

B. Site Observation requirements:
   1. Punch list at completion of landscape/irrigation work.

a. Review of grading, irrigation and planting.
b. Upon completion of punch list items the Maintenance Period begins.
1) The maintenance period will not begin until all punchlist items are resolved and acceptance is provided by the Landcape Architect in writing.

2. Final acceptance of project (at end of Maintenance Period).
a. Review of grading, irrigation and planting.
b. Upon completion of punch list items to the Client and Landscape Architect's satisfaction, the work is deemed completed.
3. Refer to Division 32 Section "Landscape Maintenance."
4. Replace non-compliant and/or rejected work prior to final observation.
5. Prior to the date of final observation, Conractor sahll provide the Landdscape Architect with all Record Drawings in accordance with the Plans and Specifications.

3.10 REPLACEMENT

A. All plant material and other materials installed under the Contract shall be waranteed against any and all poor, inadequate or inferior materials and/or workmanship or improper maintenance, as determined by the Landscape Architect, and shall be replaced by the Contractor at his expense. Warranty periods are noted in Part of this Specification.
1. Trees, vines, and shrubs: One Year
2. Groundcover and Turf: One Year
3. Replacement: Any materials found to be dead, missing, or not in a satisfactory or healthy condition during the maintenance period shall be replaced immediately. The Landscape Architect shall be sole judge as to the condition of material. Material to be replaced within the guarantee period shall be replaced by the Contractor within five (5) days of written notification by the Landscape Architect. All replacement materials and installations shall comply with the Plans and Specifications.
a. As soon as weather condtions permit, replace work that does not comply with the Plans and Specifications, without cost to the Owner. Remove rejected and non-compliant work and mateirals immediately from the project. Continue specified maintenance period until reinspected by the Landscape Architect and dtermeined to be acceptable.
b. Any plant missing due to suspected theft shall be replaced by the Contractor. If the Contractor suspects that theft may be a problem, the Contractor shall provide written documentation to the Landscape Architect that security on this site needs to be intensified.
4. Contractor to schedule replacement work with the Owner's representative, and arrange for proper staging and access.
a. Contractor to include re-inspaection dats as part of replacment work scheduling.
5. The Contractor may relieve himself of theft responsibility if after the security notice, with no result, a written notice to the Landscape Architect shall be given that plant material will not be replaced for theft or vandalism due to lack of site security being maintained. This procedure may take place only during the Landscape Maintenance Period.

END OF SECTION