

Mammoth Arts & Cultural Center - Phase 2

100 College Pkwy., Mammoth Lakes, CA 93546

2375009-100

Mammoth Lakes Foundation

100 College Pkwy., Mammoth Lakes, CA 9354



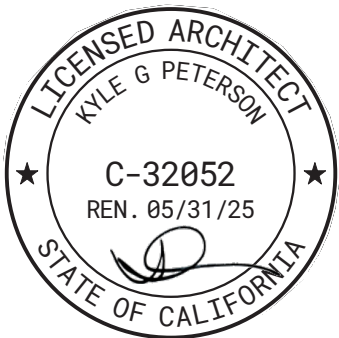
HMC Architects

MAY 12, 2025

MAMMOTH ARTS & CULTURAL CENTER - PHASE 2
Mammoth Lakes Foundation
Mammoth Lakes, California

MAY 12, 2025

HMC # 2375009-100



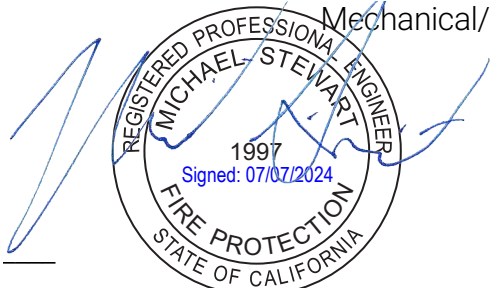
HMC ARCHITECTS
Architect



MHP Structural Engineers
Structural Engineer



Design West Engineering
Mechanical/Plumbing Engineers



Design West Engineering
Fire Protection

MAMMOTH ARTS & CULTURAL CENTER - PHASE 2
Mammoth Lakes Foundation
Mammoth Lakes, California

MAY 12, 2025

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Design West Engineering
Electrical Engineer



Triad/Holmes Associates
Civil Engineer

Salas O'Brien
Theater/Acoustics & Audio Visual

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NOT APPLICABLE

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SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Owner-furnished/Contractor-installed (OFI) products.
 2. Contractor's use of site and premises.
 3. Coordination with occupants.
 4. Work restrictions.
 5. Specification and Drawing conventions.

1.02 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFI) PRODUCTS

- A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:
1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
 2. Provide for delivery of Owner-furnished products to Project site.
 3. Upon delivery, inspect, with Contractor present, delivered items.
 - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
 4. Obtain manufacturer's inspections, service, and warranties.
 5. Inform Contractor of earliest available delivery date for Owner-furnished products.
- B. Contractor's Responsibilities: The Work includes the following, as applicable:
1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
 2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
 3. Receive, unload, handle, store, protect, and install Owner-furnished products.
 4. Make building services connections for Owner-furnished products.
 5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
 6. Repair or replace Owner-furnished products damaged following receipt.

1.03 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

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1.04 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.

1.05 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 - 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 - 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.

1.02 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.03 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.

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SUBSTITUTION PROCEDURES
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- i. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.04 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.05 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.06 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.

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- b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 35 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.
- 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.
 - j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SUBSTITUTION PROCEDURES
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SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.02 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.03 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

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CONTRACT MODIFICATION
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2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form provided by Owner. Sample copy is included in Project Manual.

1.04 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor..

1.05 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive directing Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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CONTRACT MODIFICATION
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SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.02 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Arrange schedule of values consistent with format of AIA Document G703.
 - 2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 - 3. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 - 4. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
 - 5. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.03 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

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- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use form designated by Architect as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien in accordance with Owner's requirements and as follows:
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit conditional final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 - 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of values.
 - 3. Contractor's construction schedule (preliminary if not final).
 - 4. Products list (preliminary if not final).
 - 5. Sustainable design action plans, including preliminary project materials cost data.
 - 6. Schedule of unit prices.
 - 7. Submittal schedule (preliminary if not final).

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8. List of Contractor's staff assignments.
 9. List of Contractor's principal consultants.
 10. Copies of building permits.
 11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 12. Initial progress report.
 13. Report of preconstruction conference.
 14. Certificates of insurance and insurance policies.
 15. Performance and payment bonds.
 16. Data needed to acquire Owner's insurance.
- H. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 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. AIA Document G706.
 5. AIA Document G706A.
 6. AIA Document G707.
 7. Evidence that claims have been settled.
 8. 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.
 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Project meetings.

1.02 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.

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1.03 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

1.04 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Owner name.
 2. Owner's Project number.
 3. Name of Architect.
 4. Architect's Project number.
 5. Date.
 6. Name of Contractor.
 7. RFI number, numbered sequentially.
 8. RFI subject.
 9. Specification Section number and title and related paragraphs, as appropriate.
 10. Drawing number and detail references, as appropriate.
 11. Field dimensions and conditions, as appropriate.
 12. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 13. Contractor's signature.

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14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
 - D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within five days of receipt of the RFI response.
 - E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.
- 1.05 PROJECT MEETINGS
- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 - B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 1. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

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2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Critical work sequencing and long lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Sustainable design requirements.
 - l. Preparation of Record Documents.
 - m. Use of the premises.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Procedures for disruptions and shutdowns.
 - t. Construction waste management and recycling.
 - u. Parking availability.
 - v. Office, work, and storage areas.
 - w. Equipment deliveries and priorities.
 - x. First aid.
 - y. Security.
 - z. Progress cleaning.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

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5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at regular intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of sustainable design documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site use.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of RFIs.
 - 16) Status of Proposal Requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

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- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.

1.02 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file.
 - 2. PDF file.
- B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- C. Construction Schedule Updating Reports: Submit with Applications for Payment.

1.03 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.04 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 - 2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.

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- b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.
 - 3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 - 5. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- C. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- D. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
- 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate Final Completion percentage for each activity.
- E. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
- 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.
- 1.05 GANTT-CHART SCHEDULE REQUIREMENTS
- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for commencement of the Work.

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1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Submittal schedule requirements.
 2. Administrative and procedural requirements for submittals.

1.02 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.03 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1.04 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Architect.
 4. Name of Contractor.
 5. Name of firm or entity that prepared submittal.
 6. Names of subcontractor, manufacturer, and supplier.
 7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
 8. Category and type of submittal.
 9. Submittal purpose and description.
 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.

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11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.05 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
- B. Coordination: 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.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

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1.06 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

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- a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
- a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
- a. Number of Samples: Submit full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
- a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample set; remainder will be returned. Retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

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- E. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- F. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- G. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
 4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

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5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.07 DELEGATED-DESIGN SERVICES

- 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, 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.

1.08 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

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1.09 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review or discard submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned or discarded by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.02 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Laboratory Mockups: Full-size physical assemblies constructed and tested at testing facility to verify performance characteristics.

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2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall have the same meaning as testing agency.
- I. 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.
- J. 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.
- 1.03 DELEGATED-DESIGN SERVICES
- 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 not sufficient to perform services or certification required, submit a written request for additional information to Architect.

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- B. Delegated-Design Services Statement: Submit a statement, 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, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.04 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.05 ACTION SUBMITTALS

- A. Mockup Shop Drawings: For laboratory mockups.
 - 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.

1.06 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

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- C. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.07 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, telephone number, and email address of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Statement on condition of substrates and their acceptability for installation of product.
 2. Statement that products at Project site comply with requirements.
 3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 5. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Statement that equipment complies with requirements.
 2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 3. Other required items indicated in individual Specification Sections.

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1.08 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. 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.
- I. 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:

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1. Contractor responsibilities include the following:
 - 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. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - d. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

1.09 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.

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2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Contractor-Engaged Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."

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- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 6. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.10 SPECIAL TESTS AND INSPECTIONS

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

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1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

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SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.01 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. "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.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "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.

1.02 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.

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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.

1.03 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall 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."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.02 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.

1.03 INFORMATIONAL SUBMITTALS

- A. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- C. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
 - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
 - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 - 3. Indicate methods to be used to avoid trapping water in finished work.
- D. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.

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4. Waste-handling procedures.
5. Other dust-control measures.

- E. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:
1. Methods used to meet the goals and requirements of the Owner.
 2. Concrete cutting method(s) to be used.
 3. Location of construction devices on the site.
 4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
 5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.

1.04 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and the California Building Code.

1.05 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

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- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.02 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- C. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- D. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.03 SUPPORT FACILITIES INSTALLATION

- A. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- B. Parking: Provide temporary offsite or use designated areas of Owner's existing parking areas, if authorized, for construction personnel.
- C. Storage and Staging: Provide temporary offsite area or use designated areas of Project site for storage and staging needs.
- D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.

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- E. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touch up signs, so they are legible at all times.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations.

3.04 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

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- F. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- G. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- H. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- I. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 - 1. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 - 2. Insulate partitions to control noise transmission to occupied areas.
 - 3. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 - 4. Protect air-handling equipment.
 - 5. Provide walk-off mats at each entrance through temporary partition.
- J. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.05 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work.

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- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard and replace stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.06 OPERATION, TERMINATION, AND REMOVAL

- A. Maintenance: Maintain facilities in good operating condition until removal.

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1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- B. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

END OF SECTION

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SECTION 01 57 13 – TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, and Sections 10 and 13 of the 2023 edition of the Caltrans Standard Specifications apply to this Section.

1.2 SUMMARY

- A. This Section includes erosion and dust control and related work as shown and specified.
- B. Erosion and Sediment Control shall conform to Section 13 of the CSS, these Special Provisions and TOML.
- C. Dust Control shall conform to Section 10 “Watering” of the CSS.
- D. Contractor will be responsible to maintain erosion and sediment control BMPs in place and add BMPs as needed.

1.3 SUBMITTALS

- A. General: In addition to submitting documents to regulatory agencies as described below, submit 2 copies of each submittal listed to Architect. One copy will be forwarded to the Owner for Owner’s use. Submittals are for record keeping purposes and will not be reviewed nor returned to the Contractor.

1.4 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. California Stormwater Quality Association: Stormwater Best Management Practice Handbook for Construction (BMP Handbook).

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Use materials of a class, grade and type needed to meet the performance described in the BMP Handbook and Section 13-5 and 13-6 of the CSS.

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PART 3 - EXECUTION

3.1 FUGITIVE DUST PREVENTION PLAN IMPLEMENTATION

- A. Dust control shall be implemented in conformance with Section 10 "Watering" of the CSS.

3.2 PERFORMANCE:

- A. General: Contain on-site water at the jobsite. Do not drain water directly into the storm drain. Anchor and brace all erosion control measures to resist the most severe storms consistent with a 100-year event. Use the BMP Handbook for minimum standards.
- B. LIMITED DISTURBANCE – It is the intention that the contractor shall limit his disturbance to the areas that have permanent surfacing. Contractor shall be responsible for restoration of disturbed areas to be stabilized such that they will not be a source of sediments or pollutants.
- C. HYDROSEEDING –Areas disturbed during construction that will not be landscaped shall be hydroseeded and covered with an erosion control blanket as directed by Town. Areas to receive hydroseeding include but are not limited to the graded slopes on the west and north sides of the site, the graded berm and graded areas on the north side of the building.
1. Seed: Contractor shall furnish the Town with seed supplier's certificate which shall conform to the mixes shown on the Plans, or within these Special Provisions.
 2. Cellulose Fiber: Fiber shall be colored with a non-toxic, water-soluble green dye to provide the proper visual gauge for metering of material over ground surfaces and shall be produced from natural or recycled (pulp) fiber, such as wood chips, similar wood materials, or newsprint, chip board, corrugated cardboard, or a combination of these processed materials.
 3. Fiber shall be of such character that upon addition and agitation in slurry tanks with fertilizer, seed, water and other additives, fibers become uniformly suspended to form a homogeneous slurry.
 4. When hydraulically sprayed on the ground, fiber shall form a blotter-like ground cover impregnated uniformly with seed which allows absorption of moisture and rainfall percolation into underlying soil.
 5. Materials that inhibit germination or growth shall not be present in the mixture.
 6. Organic Stabilizer: Stabilizer shall be a biodegradable tackifier, non-toxic to plant or animal life, such as Sentinel or M-Binder.
 7. General Requirements: Hydroseeding shall be performed during a windless period using approved equipment and materials. The contractor shall verify that hydroseed areas are adequately graded for seed application and free of deleterious material and weeds at the time of planting. Soil shall be left serrated or rough and broken so it can hold seed and retard run-off.
 8. Equipment: Shall have a built-in agitation system and operating capacity sufficient to agitate, suspend and homogeneously mix a slurry of water, fertilizer, fiber, seed and other additives.
 9. Slurry distribution lines shall be large enough to prevent clogging and shall be equipped with a set of hydraulic spray nozzles which provide a continuous nonfluctuating discharge and uniform delivery of slurry in prescribed quantities without misses, waste or erosion.

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10. Slurry tank shall have a minimum capacity of 300 gallons and shall be mounted on a traveling unit which may be drawn by a separate or self-propelled unit in order to properly place the slurry tank and spray nozzle for uniform distribution.
11. Slurry Preparation: With agitation system operating at half speed, water shall be added to the tank, and good circulation established. The seed shall be added first, then fiber. The mixture shall be agitated at full speed when the tank is half full.
12. Fiber shall not be added until the tank is at least one-third filled with water. Fertilizer and seed mix shall be added at the last practical moment. Total time from the addition of seed to seed discharge shall be less than one hour; if more than one hour, the remainder of the load shall be recharged with seed.
13. Application: The operator shall spray the areas with a uniform, visible coat using the green color of the wood pulp as a guide. The slurry shall be applied in a sweeping motion, so as to allow the fibers to build on each other until a good coat is achieved and the material is spread at the required rate per acre.
14. Application Rates: The materials shall be mixed and applied in the approximate proportions:

| | |
|-----------------------------|---------------------------|
| a. Fiber | 1800 lbs/acre |
| b. Seed mix | 55 lbs/acre |
| c. Fertilizer 16-20-0(N-PK) | 350 lbs/acre |
| d. Organic Stabilizer | 80 lbs/acre |
| e. Water | as needed for application |
15. The establishment period shall be 30 days. Watering by truck or other method shall be required a minimum of twice daily during this period.

- D. EROSION CONTROL BLANKET - Erosion Control Blanket shall be installed on disturbed areas where final graded slopes exceed 4:1 horizontal to vertical. Install per manufacturer's instructions and securely fasten to ground. Blankets shall be installed on top of newly hydroseeded ground, above the hydroseeding layer. Erosion control blanket shall be North American Green DSG150 or approved equal.
- E. Contractor shall use measures as indicated on the plans and additional measures as necessary to limit erosion and the transport of sediment.
- F. Stormwater shall not be allowed to flow across unstable construction materials.
- G. LANDSCAPE – All areas to be landscaped shall conform to the project landscape plan sheets.
- H. MEASUREMENT AND PAYMENT - Measurement and payment for all erosion control work shall be made per the lump sum prices as follows:
 1. The lump sum price for "Erosion and Sediment Control" shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in erosion control in conformance with these specifications.

END SECTION

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SECTION 01 57 23 - STORMWATER POLLUTION CONTROL MEASURES FOR CONSTRUCTION ACTIVITIES

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. General

1. The Contractor shall exercise every reasonable precaution to protect channels, storm drains, and bodies of water from pollution.
2. Conduct and schedule operations to minimize or avoid muddying and silting channels, drains, and waters.
3. As required, obtain permits for erosion and water pollution control from the appropriate jurisdictional agency before starting Work. All costs for work required for compliance with this Section shall be included within the Bid Prices.
4. Provide any necessary water pollution control devices to prevent, control, and abate water pollution, and implement good housekeeping pollution control measures to reduce the discharge of pollutants from work sites to the maximum extent practicable. These water pollution control devices include drains, gutters, slope protection blankets and retention basins and shall be constructed concurrently with other Work at the earliest practicable time.
5. Exercise care in preserving vegetation and protecting property, to avoid disturbing areas beyond the limits of the Work. Promptly repair any damage caused by Contractor operations.
6. Comply with the specific requirements based on acreage of disturbed soil.
7. Penalties: Failure to comply with this Section may result in significant fines and possible imprisonment. The RWQCB or other prosecuting authority may assess fines of up to \$32,500 per day for each violation. Should the Town be fined or penalized as a result of the Contractor failing to comply with this Section, the Contractor shall reimburse the Town for any and all fines, penalties and related costs.
8. Notification and Report: If pollution occurs in the work area for any reason or when the Contractor becomes aware of any violation of this Section, correct the problem and immediately notify the Qualified SWPPP Practitioner (QSP) assigned to the project. In addition, submit a written report to the Town Engineer within seven (7) calendar days describing the incident and the corrective actions taken. If either the QSP or Town Engineer is first to observe pollution or a violation, the Contractor shall also explain in the written report why the Work was inadequately monitored.
9. The provisions of this Section describe minimum compliance and do not preclude other more stringent stormwater pollution control measures that may be required in the Contract.

B. Definition

1. Construction Activity: Includes clearing, grading, excavation, stockpiling, and reconstruction of existing facilities involving removal and replacement. Construction activity does not include routine maintenance such as, maintenance of original line and grade, hydraulic capacity, or original

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purpose of the facility. If construction activity is part of a larger common plan of development, the amount of disturbed soil is the total land area of disturbed soil that results under the common plan.

C. Projects Having Less Than One Acre of Disturbed Soil

Projects with construction activity that will result in less than one acre of disturbed soil, the Contractor shall comply with the following minimum water quality protection requirements:

1. Retain eroded sediments and other pollutants on-site and do not allow transportation from the site by sheet flow, swales, area drains, natural drainage, or wind. Control slope and channel erosion by implementing an effective combination of best management practices (BMPs). Such BMPs include scheduling grading during non-rainy seasons, planting and maintaining vegetation on slopes and covering erosion-susceptible slopes.
2. Protect stockpiles of earth and other construction-related materials from being transported from the site by wind or water.
3. Properly store and handle fuels, oils, solvents, and other toxic materials to not contaminate the soil or surface waters, enter the groundwater, or be placed where they may enter a live stream, channel, drain, or other water conveyance facility. Protect all approved toxic storage containers from weather. Clean spills immediately and properly dispose of cleanup materials. Spills shall not be washed into live streams, channels, drains, or other water conveyance facilities.
4. Do not wash excess or waste concrete into the public way or any drainage system. Retain concrete wastes on-site until they can be appropriately disposed of or recycled.
5. Deposit trash and construction-related solid wastes in covered receptacles to prevent contamination of rainwater and dispersal by wind.
6. Do not allow sediments and other materials to be tracked from the site by vehicle traffic. Stabilize construction entrance roadways to inhibit sediments from being deposited onto public ways. Immediately sweep up accidental depositions. Do not allow depositions to be washed away by rain or by any other means.
7. Contain non-stormwater runoff from equipment or vehicle washing and any other activity at the work site.
8. At completion of the Work, clear the worksite of debris and restore to a condition at least equal to or better than prior to construction.
9. When construction activity with grading is likely to occur during the rainy season (October 15 through April 15), prepare an Erosion Control Plan (ECP) per TOMLMC Section 12.08.090. The Erosion Control Plan must be submitted to the Engineer for approval within thirty (30) calendar days after Notice to Proceed.
10. When working in live streams, these are additional water pollution control requirements:
 - a. Erect barriers sufficient to prevent muddying or polluting streams.
 - b. Prior to removing materials from a flowing stream, use a stream bypass or other equivalent means to keep the flow in the stream free of the mud or silt from the removal operations.
 - c. Avoid transporting materials across live streams. If not possible, the

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transportation operation must be designed to prevent materials from falling into the stream and cannot muddy the stream.

- d. Equipment may not be operated in a live stream or channel unless the Contractor can demonstrate to the Engineer's satisfaction that no other practical alternatives exist. The equipment must be designed to prevent materials from falling into the stream and cannot muddy the stream.
- e. Do not allow fresh portland cement or fresh portland cement concrete to enter the water flowing in streams, channels or drains. Do not allow material derived from the Work to be deposited in a live stream, channel or drain.

END OF SECTION

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SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling and comparable products.

1.02 DEFINITIONS

- A. 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. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, 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.
- B. 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.

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- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. 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.

1.03 QUALITY ASSURANCE

- A. 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.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

1.05 PRODUCT WARRANTIES

- 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 standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to 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.

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2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.01 PRODUCT SELECTION PROCEDURES

- 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 meeting 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.
 6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.
- B. Product Selection Procedures:
 1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience may be considered at the discretion of the Architect.

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- a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
 4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
 - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
 5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience may be considered at the discretion of the Architect.
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
 6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
 7. Basis-of-Design Product: 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. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 25 00 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "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 25 00 "Substitution Procedures" for proposal of product.

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- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a 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.
- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.
 - 1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.02 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: 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 the following requirements:
 - 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 - 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 33 00 "Submittal Procedures."
 - 1. Form of Approval of Submittal: As specified in Section 01 33 00 "Submittal Procedures."
 - 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

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- D. 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.

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Installation of the Work.
 - 2. Progress cleaning.
 - 3. Starting and adjusting.
 - 4. Protection of installed construction.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

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- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

3.03 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.
- B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

3.04 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb, and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

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- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
 - D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
 - E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
 - F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
 - G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
 - H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
 - I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.
 - J. Repair or remove and replace damaged, defective, or nonconforming Work.
- 3.05 PROGRESS CLEANING
- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.

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3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - B. Site: Maintain Project site free of waste materials and debris.
 - C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
 - E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
 - F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
 - G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
 - H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
 - I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
 - J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- 3.06 STARTING AND ADJUSTING
- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
 - B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

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- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.07 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

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SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Cutting and patching.

1.02 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.03 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

PART 3 - EXECUTION

3.01 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

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- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.

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3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

END OF SECTION

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SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.

1.02 ACTION SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.03 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.04 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

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4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
 5. Submit testing, adjusting, and balancing records.
 6. Submit sustainable design submittals not previously submitted.
 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
- 1.05 FINAL COMPLETION PROCEDURES
- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Division 01 Section payment procedures."

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2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.06 LIST OF INCOMPLETE ITEMS

- A. Organization of List: 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.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. PDF Electronic File: Architect will return annotated file.

1.07 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

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PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.01 FINAL CLEANING

- A. Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - c. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - d. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - e. Vacuum and mop concrete.
 - f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - g. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - h. Remove labels that are not permanent.
 - i. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

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- j. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- k. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- l. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
- m. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
- n. Clean strainers.
- o. Leave Project clean and ready for occupancy.

END OF SECTION

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SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Systems and equipment operation manuals.
 - 2. Systems and equipment maintenance manuals.
 - 3. Product maintenance manuals.

1.02 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
- C. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training.

1.03 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

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1.04 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
 - 1. Product name and model number. Use designations for products indicated on Contract Documents.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.
 - 6. Limiting conditions.
 - 7. Performance curves.
 - 8. Engineering data and tests.
 - 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
 - 1. Startup procedures.
 - 2. Equipment or system break-in procedures.
 - 3. Routine and normal operating instructions.
 - 4. Regulation and control procedures.
 - 5. Instructions on stopping.
 - 6. Normal shutdown instructions.

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7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.05 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

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- a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.

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1.06 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 78 36 - WARRANTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for warranties on products and systems.
- B. Related Sections:
 - 1. Section 01 77 00 "Closeout Procedures" for submitting warranties.

1.02 WARRANTIES

- 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, system, and installation warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product or system and issued in the name of the Owner or endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner for a particular product or system and issued in the name of the Owner or endorsed by manufacturer to Owner.
 - a. Installation Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner for a particular product or system and issued in the name of the Owner or endorsed by installer to 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 in the Project Manual, prepare a written document, using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record specifications.

1.02 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up record prints.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

1.03 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.

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- j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
- 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Format: Annotated PDF electronic file.
 - 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.
- 1.04 RECORD SPECIFICATIONS
- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
- 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Note related Change Orders and Record Drawings where applicable.
- B. Format: Submit record specifications as annotated PDF electronic file .
- 1.05 MAINTENANCE OF RECORD DOCUMENTS
- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

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PART 3 - EXECUTION (Not Used)

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SECTION 01 81 13.71 - SUSTAINABLE DESIGN REQUIREMENTS - CALGREEN
NON-RESIDENTIAL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: General requirements and procedures for compliance with 24 CCR 11, California Green Building Standards Code (CALGreen).
 - 1. Some CALGreen requirements depend on product selections and may not be specifically identified as CALGreen requirements. Compliance with CALGreen requirements may be used as one criterion to evaluate substitution requests and comparable product requests.
 - 2. Some CALGreen requirements depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
 - 3. Additional CALGreen requirements not included in this specification apply to the Project.

1.02 DEFINITIONS

- A. CALGreen: California Green Building Standards Code, including supplements in effect as of date of the Contract Documents unless otherwise indicated.
 - 1. Definitions that are part of CALGreen apply to this Section.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Respond to questions and requests from Architect about CALGreen requirements that depend on product selection or product qualities. Document responses as informational submittals.
- B. When requested by enforcing agency submit substantiating documentation confirming compliance with CALGreen requirements.
- C. Sustainable design submittals shall be identified and submitted separately from other submittals.

1.04 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for Construction and Demolition Waste Management: Submit documentation complying with CALGreen for one of the following:
 - a. Construction Waste Management Plan.
 - b. Waste Management Company.
 - c. Waste Stream Reduction Alternative.

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PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Construction and Demolition Waste Management: Achieve end-of-Project rates for salvage/recycling of not less than 65 percent of total nonhazardous solid waste generated by the Work. Comply with local construction and demolition waste management ordinance when it is more stringent.
- B. Universal Waste: Universal Waste items such as fluorescent lamps and ballast, and mercury containing thermostats, as well as other California prohibited Universal Waste materials shall be disposed of properly and diverted from landfills.
- C. Site-Clearing Waste: 100 percent of trees, stumps, rocks and associated vegetation and soils resulting primarily from land clearing shall be reused or recycled. If contamination by disease or pest infestation is suspected, contact the Country Agricultural Commissioner and follow its direction for recycling or disposal of the material.

2.02 MATERIALS

- A. Provide products and procedures necessary to comply with CALGreen requirements in this Section. Although other Sections may specify some requirements that contribute to referenced CALGreen requirements, determine additional materials and procedures necessary to comply with CALGreen requirements indicated.

2.03 LOW-EMITTING MATERIALS

- A. Adhesives and Sealants:
 - 1. For field applications, adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers, and caulks shall comply with VOC content limits of authorities having jurisdiction, or the following VOC content limits:
 - a. Indoor Carpet Adhesives: 50 g/L.
 - b. Carpet Pad Adhesives: 50 g/L.
 - c. Outdoor Carpet Adhesives: 150 g/L.
 - d. Wood Flooring Adhesive: 100 g/L.
 - e. Rubber Floor Adhesives: 60 g/L.
 - f. Subfloor Adhesives: 50 g/L.
 - g. Ceramic Tile Adhesives: 65 g/L.
 - h. VCT and Asphalt Tile Adhesives: 50 g/L.
 - i. Gypsum Board and Panel Adhesives: 50 g/L.
 - j. Cove Base Adhesives: 50 g/L.
 - k. Multipurpose Construction Adhesives: 70 g/L.
 - l. Structural Glazing Adhesives: 100 g/L.

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- m. Single-Ply Roof Membrane Adhesive: 250 g/L.
- n. Other Adhesive Not Specifically Listed: 50 g/L.
- o. PVC Welding Compounds: 510 g/L.
- p. CPVC Welding Compounds: 490 g/L.
- q. ABS Welding Compounds: 325 g/L.
- r. Plastic Cement Welding Compounds: 250 g/L.
- s. Adhesive Primer for Plastic: 550 g/L.
- t. Contact Adhesive: 80 g/L.
- u. Special-Purpose Contact Adhesive (Contact Adhesive That Is Used to Bond Melamine Covered Board, Metal, Unsupported Vinyl, Rubber, or Wood Veneer 1/16 Inch or Less in Thickness to Any Surface): 250 g/L.
- v. Structural Wood Member Adhesives: 140 g/L.
- w. Top and Trim Adhesive: 250 g/L.
- x. Metal-to-Metal Adhesives: 30 g/L.
- y. Plastic Foam Adhesives: 50 g/L.
- z. Adhesives for Porous Materials (except Wood): 50 g/L.
- aa. Wood Glues: 30 g/L.
- bb. Fiberglass Adhesives: 80 g/L.
- cc. Architectural Sealants: 250 g/L.
- dd. Nonmembrane Roof Sealants: 300 g/L.
- ee. Roadway Sealants: 250 g/L.
- ff. Single-Ply Roof Membrane Sealants: 450 g/L.
- gg. Other Sealants: 420 g/L.
- hh. Sealant Primers for Nonporous Substrates: 250 g/L.
- ii. Sealant Primers for Porous Substrates: 775 g/L.
- jj. Modified Bituminous Sealant Primers: 500 g/L.
- kk. Other Sealant Primers: 750 g/L.
- 2. Prohibited Ingredients: Adhesives and sealants must not contain the following:
 - a. Chloroform.
 - b. Ethylene dichloride.
 - c. Methylene chloride.
 - d. Perchloroethylene.
 - e. Trichloroethylene.
- 3. Additional Requirements: Comply with additional requirements in CALGreen for aerosol adhesives, and small unit sizes of adhesives, and sealant or caulking compounds.

B. Paints and Coatings:

- 1. For field applications, paints and coatings shall comply with VOC limits of California Air Resources Board (CARB) Architectural Coatings Suggested Control Measure (SCM) below, unless more stringent local limits apply. The VOC content limit for coatings that do not meet the definitions for the specialty coatings categories listed shall be determined by classifying the coating as flat, nonflat, or nonflat-high gloss coating, based on its gloss.
 - a. Flat Coatings: 50 g/L.

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- b. Nonflat Coatings: 100 g/L.
- c. Nonflat - High Gloss Coatings: 150 g/L.
- d. Specialty Coatings:
 - 1) Aluminum Roof Coatings: 400 g/L.
 - 2) Basement Special Coatings: 400 g/L.
 - 3) Bituminous Roof Coatings: 50 g/L.
 - 4) Bituminous Roof Primers: 350 g/L.
 - 5) Bond Breakers: 350 g/L.
 - 6) Concrete Curing Compounds: 350 g/L.
 - 7) Concrete/Masonry Sealers: 100 g/L.
 - 8) Driveway Sealers: 50 g/L.
 - 9) Dry-Fog Coatings: 150 g/L.
 - 10) Faux Finishing Coatings: 350 g/L.
 - 11) Fire-Resistive Coatings: 350 g/L.
 - 12) Floor Coatings: 100 g/L.
 - 13) Form-Release Compounds: 250 g/L.
 - 14) Graphic Arts Coatings (Sign Paints): 500 g/L.
 - 15) High-Temperature Coatings: 420 g/L.
 - 16) Industrial Maintenance Coatings: 250 g/L.
 - 17) Low Solids Coatings: 120 g/L.
 - 18) Magnesite Cement Coatings: 450 g/L.
 - 19) Mastic Texture Coatings: 100 g/L.
 - 20) Metallic Pigmented Coatings: 500 g/L.
 - 21) Multi-Color Coatings: 250 g/L.
 - 22) Pretreatment Wash Primers: 420 g/L.
 - 23) Primers, Sealers, and Undercoaters: 100 g/L.
 - 24) Reactive Penetrating Sealers: 350 g/L.
 - 25) Recycled Coatings: 250 g/L.
 - 26) Roof Coatings: 50 g/L.
 - 27) Rust-Preventive Coatings: 250 g/L.
 - 28) Shellacs, Clear: 730 g/L.
 - 29) Shellacs, Opaque: 550 g/L.
 - 30) Specialty Primers, Sealers and Undercoaters: 100 g/L.
 - 31) Stains: 250 g/L.
 - 32) Stone Consolidants: 450 g/L.
 - 33) Swimming Pool Coatings: 340 g/L.
 - 34) Traffic Marking Coatings: 100 g/L.
 - 35) Tub and Tile Refinish Coatings: 420 g/L.
 - 36) Waterproof Membranes: 250 g/L.
 - 37) Wood Coatings: 275 g/L.
 - 38) Wood Preservatives: 350 g/L.
 - 39) Zinc-Rich Primers: 340 g/L.
- 2. Additional Requirements: Comply with additional requirements in CALGreen for aerosol paints and coatings.

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- C. Carpet Systems: All interior carpet materials, including cushion, shall comply with at least one of the following:
 - 1. Carpet and Rug Institute's Green Label Plus program.
 - 2. VOC-emission limits and testing 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," Version 1.2 (CDPH Standard Method v1.2).
- D. Composite Wood Products: Composite wood products used on the interior or exterior of the building shall have formaldehyde emission rates not greater than the following specified by the California Air Resources Board (CARB), Air Toxics Control Measure (ATCM) for Composite Wood, as tested in accordance with ASTM E1333:
 - 1. Hardwood Plywood (Veneer Core and Composite Core): 0.05 ppm.
 - 2. Particleboard: 0.09 ppm.
 - 3. Medium-Density Fiberboard More Than 5/16 Inch Thick: 0.11 ppm.
 - 4. Medium-Density Fiberboard 5/16 Inch or Less in Thickness: 0.13 ppm.
- E. Resilient Flooring Systems: Where resilient flooring is installed, at least 80 percent of floor area receiving resilient flooring shall meet the requirements comply with the following:
 - 1. VOC-emission limits and testing 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," Version 1.2 (CDPH Standard Method v1.2).
- F. Thermal Insulation: Thermal insulation products shall comply with VOC-emission limits and testing 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," Version 1.2 (CDPH Standard Method v1.2).
- G. Acoustical Ceilings and Wall Panels: Acoustical ceilings and wall panels shall comply with VOC-emission limits and testing 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," Version 1.2 (CDPH Standard Method v1.2).

PART 3 - EXECUTION

3.01 CONSTRUCTION WASTE MANAGEMENT

- A. Construction and Demolition Waste Management: Achieve specified rates for waste management by one of the following:

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1. Construction Waste Management Plan: Where a local jurisdiction does not have a construction and demolition waste management ordinance that is more stringent, submit a construction waste management plan that includes the following:
 - a. Identification of construction and demolition waste materials to be diverted from disposal by efficient usage, recycling, reuse on the Project or salvage for future use or sale.
 - b. Determination of construction and demolition waste materials will be sorted on-site (source separated) or bulk mixed (single stream).
 - c. Identification of diversion facilities where construction and demolition waste material collected will be taken.
 - d. Specification of the amount of construction and demolition waste materials diverted shall be taken by weight or volume, but not by both.
2. Waste Management Company: Utilize a waste management company that can provide verifiable documentation that the percentage of construction and demolition waste material diverted from the landfill complies with CALGreen.
3. Waste Stream Reduction Alternative: The combined weight of new construction disposal that does not exceed two pounds per square foot of building area shall be deemed to meet the 65 percent minimum requirement as approved by the enforcing agency.

3.02 CONSTRUCTION IAQ MANAGEMENT

- A. Cover or close openings in ducts and other related air-distribution component openings with tape, plastic, sheet metal, or other approved method before beginning dust-producing operations and maintain until dust-producing operations are complete.
- B. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period, install MERV 8 filter media according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
 1. Replace all air filters immediately prior to occupancy.

END OF SECTION

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SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.

1.02 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- C. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.03 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.04 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.05 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:

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1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

- C. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.06 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.07 FIELD CONDITIONS

- A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
1. Maintain fire-protection facilities in service during selective demolition operations.

1.08 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

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1.09 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- B. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.02 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

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- b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
- c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.03 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.04 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

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2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

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3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

3.06 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

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SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.
- B. Openings for other work.
- C. Form stripping.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- B. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).
- C. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- D. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- E. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2022.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design formwork under direct supervision of a Professional Structural Engineer experienced in design of concrete formwork and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.
- C. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.
- D. Comply with relevant portions of ACI CODE-318, ACI PRC-347, and ACI SPEC-301.

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PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI SPEC-301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Obtain approval before framing openings in structural members that are not indicated on drawings.
- E. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.
- F. Coordinate this section with other sections of work that require attachment of components to formwork.
- G. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

3.03 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.04 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.

3.05 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI SPEC-117, unless otherwise indicated.
- B. Construct and align formwork for elevator hoistway in accordance with ASME A17.1.

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3.06 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

3.07 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

END OF SECTION

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SECTION 03 15 00 - CONCRETE ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Waterstops.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 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 (19 by 25 mm).
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.
 - b. CETCO; Volclay Waterstop-RX.
 - c. Concrete Sealants Inc.; Conseal CS-231.
 - d. Greenstreak; Swellstop.
 - e. Henry Company, Sealants Division; Hydro-Flex.
 - f. JP Specialties, Inc.; Earth Shield Type 20.
 - 2. Locations: For 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. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic rubber, for adhesive bonding to concrete.
 - 1. Product: Adeka; KBA-1510FP.
 - 2. Locations: For 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.

PART 3 - EXECUTION

3.01 WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

HMC Architects
2375009100

CONCRETE ACCESSORIES
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END OF SECTION

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CONCRETE ACCESSORIES
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SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Floors and slabs on grade.
- B. Grade beams and footings.
- C. Concrete shear walls, elevator shaft walls, and foundation walls.
- D. Concrete reinforcement.
- E. Joint devices associated with concrete work.
- F. Miscellaneous concrete elements, including equipment pads, equipment pits, light pole bases, flagpole bases, thrust blocks, and manholes.
- G. Concrete curing.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories: Forms and accessories for formwork.

1.03 REFERENCE STANDARDS

- A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- B. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
- C. ACI PRC-302.1 - Guide to Concrete Floor and Slab Construction; 2015.
- D. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- E. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.
- F. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.
- G. ACI PRC-308 - Guide to External Curing of Concrete; 2016.
- H. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- I. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- J. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
- K. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2017.
- L. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
- M. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2023.
- N. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.
- O. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- P. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

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- Q. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2020.
- R. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.
- S. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2023.
- T. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).
- U. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2023, with Editorial Revision.
- V. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.
- W. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2021.
- X. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.
- Y. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers; 2020.
- Z. ASTM E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers (Metric); 2014.
- AA. 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.
- BB. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
- C. Mix Design: Submit proposed concrete mix design.
 - 1. Indicate proposed mix design complies with requirements of ACI 318, Chapter 26.
- D. Samples: Submit samples of underslab vapor retarder to be used.
- E. Test Reports: Submit report for each test or series of tests specified.
- F. Sustainable Design Submittal: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.
- G. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

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1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.
- B. Follow recommendations of ACI PRC-305 when concreting during hot weather.
- C. Follow recommendations of ACI PRC-306 when concreting during cold weather.
- D. For slabs required to include moisture vapor reducing admixture (MVRA), do not proceed with placement unless manufacturer's representative is present for every day of placement.

PART 2 PRODUCTS

2.01 REINFORCEMENT MATERIALS

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 - 1. Type: Deformed billet-steel bars.
 - 2. Finish: Unfinished, unless otherwise indicated.
- B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.
- C. Reinforcement Accessories:
 - 1. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 - 2. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.02 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type II - Moderate Portland type.
 - 1. Acquire cement for entire project from same source.
- B. Fine and Coarse Aggregates: ASTM C33/C33M.
 - 1. Acquire aggregates for entire project from same source.
- C. Lightweight Aggregate: ASTM C330/C330M.
- D. Fly Ash: ASTM C618, Class C or F.
- E. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.03 ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
- C. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

2.04 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder:
 - 1. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
- B. Non-Shrink Cementitious Grout: Premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.

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2.05 BONDING AND JOINTING PRODUCTS

- A. Epoxy Bonding System:
 - 1. Complying with ASTM C881/C881M and of Type required for specific application.
- B. Slab Isolation Joint Filler: 1/2-inch thick, height equal to slab thickness, with removable top section forming 1/2-inch deep sealant pocket after removal.
- C. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.

2.06 CURING MATERIALS

- A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
- B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
- C. Curing Agent, Water-Cure Equivalent Type: Clear, water-based, non-film-forming, liquid-water cure replacement agent.
 - 1. Comply with ASTM C309 standards for water retention.
 - 2. Compressive Strength of Treated Concrete: Equal to or greater than strength after 14-day water cure when tested in accordance with ASTM C39/C39M.
 - 3. VOC Content: Zero.
- D. Moisture-Retaining Sheet: ASTM C171.
 - 1. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.
- E. Water: Potable, not detrimental to concrete.

2.07 CONCRETE MIX DESIGN

- A. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
 - 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- B. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended or required by manufacturer.
- C. Normal Weight Concrete:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
 - 2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
 - 3. Water-Cement Ratio: Maximum as indicated on drawings percent by weight.
 - 4. Maximum Slump: as indicated on drawings inches.
 - 5. Maximum Aggregate Size: as indicated on drawings inch.
- D. Structural Lightweight Concrete:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
 - 2. Water-Cement Ratio: Maximum as indicated on drawings percent by weight.
 - 3. Maximum Slump: as indicated on drawings inches.
 - 4. Maximum Aggregate Size: as indicated on drawings inch.

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5. Maximum dry unit weight: 113 lb per cubic foot.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

- A. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- B. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
 2. Use latex bonding agent only for non-load-bearing applications.
- C. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Comply with requirements of ACI SPEC-301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.
- C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE

- A. Place concrete in accordance with ACI PRC-304.
- B. Place concrete for floor slabs in accordance with ACI PRC-302.1.
- C. Notify Architect not less than 48 hours prior to commencement of placement operations.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting. See drawings for additional joint preparations as required.

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- G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 SLAB JOINTING

- A. Locate joints as indicated on drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values for on-grade slabs and elevated slabs before removal of shoring:
 - 1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15, before removal of shoring.
 - 2. Under Thick-Bed Tile: F(F) of 20; F(L) of 15, before removal of shoring.
 - 3. Under Carpeting: F(F) of 25; F(L) of 20, before removal of shoring.
 - 4. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, before removal of shoring.
- B. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.
- C. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.
- D. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.07 CURING AND PROTECTION

- A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Surfaces Not in Contact with Forms:
 - 1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
 - 2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water-fog spray or saturated burlap.
 - a. Spraying: Spray water over floor slab areas and maintain wet.
 - b. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
 - 3. Final Curing: Begin after initial curing but before surface is dry.

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- a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.
- b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.08 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.09 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

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SECTION 03 35 03 - CONCRETE SLAB FINISHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Concrete finish requirements for unformed horizontal concrete surfaces. This section supplements requirements of Division 03 Section "Cast-In-Place Concrete."
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for sealers, indicating VOC content.
- B. Product Test Reports:
 - 1. Slip-resistance test reports from qualified independent testing agency.

1.04 QUALITY ASSURANCE

- A. Standards: Comply with the following documents, except where requirements of the contract documents are more stringent:
 - 1. ACI 301.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Sealers:
 - a. VOC content limits for field applications.

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2.02 PERFORMANCE REQUIREMENTS

- A. Slip Resistance, Coefficient of Friction: For sealers on walking surfaces, provide products with the following values as determined by testing identical products in accordance with the following:
 - 1. Level Surfaces, Dry and Wet: DCOF of not less than 0.42 in accordance with ANSI A326.3.

2.03 CONCRETE SLAB SEALER

- A. Concrete Slab Sealer: Liquid chemical hardener; enhanced silicate or silicate type.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Curecrete Chemical; Ashford Formula.
 - b. Dayton Superior; Sure Hard Densifier J17.
 - c. Laticrete; L&M Lion Hard.

2.04 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified product that can be applied in thicknesses from a feathered edge to 1/2 inch to match adjacent floor elevations.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ardex; Feather Finish.
 - b. Dayton Superior; Sure Finish.
 - c. Laticrete; Supercap.
 - 2. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 3. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 4. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 - 5. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ardex.
 - b. Dayton Superior.
 - c. Laticrete.
 - 2. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.

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3. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
4. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
5. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.05 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Contraction Joint Filler:
 1. Sealant: As specified in Section 07 92 00.
- B. Concrete Cleaner: Liquid concentrate, biodegradable, heavy-duty cleaner-degreaser compound.

PART 3 - EXECUTION

3.01 FINISHING SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, 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 in 1 direction.
 1. Apply scratch finish to surfaces as follows:
 - a. To receive concrete floor toppings.
 - b. To receive mortar setting beds for bonded cementitious floor finishes.
 - c. Other surfaces indicated.
- 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 restraighening until surface is left with a uniform, smooth, granular texture.
 1. Apply float finish to surfaces as follows:
 - a. To receive trowel finish.
 - b. To be covered with fluid-applied or sheet waterproofing.
 - c. Other surfaces indicated.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen 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 trowel finish to surfaces as follows:
 - a. Exposed to view.
 - b. To receive concrete sealer.

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- c. To be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage/waterproofing/crack-isolation membrane, paint, or another thin-film-finish coating system.
 - d. Other surfaces as indicated.
 - 2. Finish surfaces to the following Specified Overall Value (SOV) and Minimum Local Value (MLV) tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Carpeted Floors: Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 - b. Other Floors at Slabs on Grade: 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.
 - c. Other Floors at Suspended Slabs: Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
 - 3. F(L) tolerances do not apply to randomly trafficked floor surfaces that are inclined or cambered.
 - 4. F(L) tolerances do not apply to shored, elevated construction after shoring has been removed.
 - E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Apply trowel and fine broom finish to surfaces as follows:
 - a. To receive ceramic or quarry tile installed by either thickset or thin-set method.
 - b. Exposed interior stair treads/landings, steps, and ramps.
 - c. Other surfaces indicated.
 - 2. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
 - F. Broom Finish: Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
 - 1. Apply broom finish to surfaces as follows:
 - a. Exterior concrete platforms, steps, and ramps.
 - b. Other surfaces indicated.
- 3.02 REPAIRING SLAB SURFACES
- A. Repairing Unformed Surfaces:
 - 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

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2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 3. After concrete has cured at least 14 days, correct high areas by grinding.
 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
 5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
 6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
 8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- B. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- C. Repair materials and installation not specified above may be used, subject to Architect's approval.

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3.03 SEALED CONCRETE FLOORS

- A. Concrete Slab Sealer:
1. Apply sealer/finish following manufacturer's printed application instructions; apply single saturation coat.
 2. Remove surplus sealer/hardener and rinse according to manufacturer's instructions.
 3. Burnishing: Prior to substantial completion, apply light second coat of chemical sealer-hardener material and polish using mild abrasives or brushes in accordance with sealer/hardener manufacturer's recommendations. Buff to even satin sheen.
 4. Location: At all interior, exposed slabs subject to pedestrian traffic, unless indicated otherwise.

3.04 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
1. Coordinate floor and slab flatness and levelness testing with Owner's testing agency according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION

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SECTION 03 35 07 - FORMED CONCRETE FINISHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Formed concrete surfaces of completed structure or building, exposed to view, that require special finishing to obtain specified architectural appearance. This section supplements requirements of Division 03 Section "Cast-In-Place Concrete."

1.02 QUALITY ASSURANCE

- A. 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 and Section 6, "Architectural Concrete."
 - 2. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Form Tie Plugs: Polymer modified mortar plug designed to patch tie holes created by form tie cones.
 - 1. Basis-of-Design Product: A54 Snaplug Concrete Plug by Dayton Superior.
 - 2. Adhesive: Manufacturer's recommended adhesive approved for intended purpose.

PART 3 - EXECUTION

3.01 FINISHES, GENERAL

- A. 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.
- B. Maintain uniformity of special finishes over construction joints unless otherwise indicated.

3.02 AS-CAST FORMED FINISHES

- A. Produce as-cast formed finishes in accordance with ACI 301 and as follows:
 - 1. Surface Finish 1.0 (SF-1):

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- a. Patch voids larger than 1-1/2 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1 inch.
 - c. Tie holes to remain unpatched.
 - d. Provide surface tolerance Class D in accordance with ACI 117.
 - e. Apply to concrete surfaces not exposed to public view.
2. Surface Finish 2.0 (SF-2):
- a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/4 inch.
 - c. Patch tie holes.
 - d. Provide surface tolerance Class B in accordance with ACI 117.
 - e. Apply to concrete surfaces exposed to public view.

3.03 FORMED 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 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. Limit cut depth to 3/4 inch. 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 before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. 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.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance.

3.04 FORM TIE HOLE PLUG INSTALLATION

- A. Installation: Plug form tie holes with form tie hole plugs using adhesive, in accordance with manufacturer's instructions.
 1. Install form tie hole plug flush with adjacent concrete surface, unless otherwise indicated.

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3.05 FIELD QUALITY CONTROL

- A. General: Comply with field quality-control requirements in Division 03 Section "Cast-in-Place Concrete."

3.06 PROTECTION, AND CLEANING

- A. Protect corners, edges, and surfaces from damage; use guards and barricades.
- B. Protect concrete from staining, laitance, and contamination during remainder of construction period.
- C. Clean concrete surfaces after finish treatment to remove stains, markings, dust, and debris.

END OF SECTION

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SECTION 04 20 00 - UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete block.
- B. Mortar and grout.
- C. Reinforcement and anchorage.
- D. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

- A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- B. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2023.
- C. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.
- D. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2023a.
- E. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- F. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- G. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- I. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.
- J. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- K. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for masonry units, mortar, and masonry accessories.
- C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

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1.06 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 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 nominal depth of 8 inches.
 - 2. Special Shapes: Provide nonstandard blocks configured for corners.
 - 3. Load-Bearing Units: ASTM C90, medium weight.

2.02 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M, Type N.
- B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Mortar Aggregate: ASTM C144.
- E. Grout Aggregate: ASTM C404.
- F. Water: Clean and potable.

2.03 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; galvanized.

2.04 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
 - 1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com/#sle.
- B. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.05 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
 - 1. Masonry below grade and in contact with earth: Type S.
 - 2. Loadbearing masonry: Type S.
- 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.

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.

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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.

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

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. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.06 GROUTED COMPONENTS

- A. Lap splices minimum 48 bar diameters, unless noted otherwise.
- B. Support and secure reinforcing bars and other embedded items from displacement. Maintain position within 1/2 inch of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.

3.07 CONTROL AND EXPANSION JOINTS

- A. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- B. Form expansion joint as detailed on drawings.

3.08 BUILT-IN WORK

- A. As work progresses, install built-in fabricated metal frames, anchor bolts, and plates 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.

3.09 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

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- C. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- D. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

3.10 CUTTING AND FITTING

- A. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.11 PARGING

- A. Dampen masonry walls prior to parging.
- B. Scarify each parging coat to ensure full bond to subsequent coat.
- C. Parge masonry walls in two uniform coats of mortar to a total thickness of 3/4 inch.
- D. Steel trowel surface smooth and flat with a maximum surface variation of 1/8 inch per foot.
- E. Strike top edge of parging at 45 degrees.

3.12 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.

3.13 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Clean soiled surfaces with cleaning solution.

3.14 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

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SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural steel framing members, support members and struts.
- B. Structural steel support members, suspension cables, sag rods, and struts.
- C. Base plates, and shear stud connectors and expansion joint plates.
- D. Grouting under base plates.

1.02 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual; 2023.
- B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2022.
- 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 A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.
- F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- G. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- I. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use; 2014 (Reapproved 2020).
- J. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- K. ASTM A514/A514M - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding; 2022.
- L. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.
- M. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.
- N. 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.
- O. 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.
- P. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

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- Q. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film; 2017.
- R. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2019.
- S. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry; 2023.
- T. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.
- U. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.
- V. ASTM F959/F959M - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series; 2017a.
- W. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.
- X. 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.
- Y. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- Z. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- AA. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
- BB. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2020.
- CC. SSPC-SP 3 - Power Tool Cleaning; 2018.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
- C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
- D. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
- E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.04 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
- B. Structural steel members designated as architecturally-exposed structural steel (AESS) to also comply with Section 05 12 13.

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- C. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience in similar types of fabrication.
- D. Fabricator Qualifications: A qualified steel fabricator shall have one of the following:
 - 1. Participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD
 - 2. Is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
 - 3. Is approved by the Los Angeles Department of Building and Safety.
- E. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

- A. As indicated on drawings.
- B. Steel Angles and Plates: ASTM A36/A36M.
- C. Steel W Shapes and Tees: ASTM A992/A992M.
- D. Rolled Steel Structural Shapes: ASTM A992/A992M.
- E. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade C.
- F. Steel Sheet: ASTM A1011/A1011M, Designation SS, Grade 30 hot-rolled, or ASTM A1008/A1008M, Designation SS, Grade per drawings cold-rolled.
- G. Pipe: ASTM A53/A53M, Grade B, Finish black.
- H. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.
- I. Suspension Cable: _____ wire rope.
- J. Sag Rods: ASTM A36/A36M.
- K. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563/A563M nuts and ASTM F436/F436M washers.
- L. Tension Control Bolts: Twist-off type; ASTM F3125/F3125M.
- M. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563/A563M nuts and ASTM F436/F436M Type 1 washers.
- N. Headed Anchor Rods: ASTM F1554 Grade 36, plain.
- O. Load Indicator Washers: Provide washers complying with ASTM F959/F959M at connections requiring high-strength bolts.
- P. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- Q. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
 - 2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
- R. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
- S. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

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2.02 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
- C. Develop required camber for members.

2.03 FINISH

- A. Prepare structural component surfaces in accordance with SSPC-SP 3.
- B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.

2.04 SOURCE QUALITY CONTROL

- A. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts," as required by contract documents.
- B. Welded Connections: Visually inspect all shop-welded connections and test at least 75 percent of full penetration welds using one of the following:
 - 1. Radiographic testing performed in accordance with ASTM E94/E94M.
 - 2. Ultrasonic testing performed in accordance with ASTM E164.
 - 3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
 - 4. Magnetic particle inspection performed in accordance with ASTM E709.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

- A. Erect structural steel in compliance with AISC 303.
- B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Field weld components and shear studs indicated on shop drawings.
- D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".
- E. Do not field cut or alter structural members without approval of Architect.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.03 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-

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Strength Bolts", as indicated required by contract documents.

- C. Welded Connections: Visually inspect all field-welded connections and test as required by contract documents using one of the following:
1. Radiographic testing performed in accordance with ASTM E94/E94M.
 2. Ultrasonic testing performed in accordance with ASTM E164.
 3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
 4. Magnetic particle inspection performed in accordance with ASTM E709.

END OF SECTION

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SECTION 05 31 00 - STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof deck.
- B. Composite floor deck.
- C. Bearing plates and angles.
- D. Stud shear connectors.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- 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 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.
- F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- H. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- I. FM (AG) - FM Approval Guide; Current Edition.
- J. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; 2016, with Editorial Revision (2022).
- K. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
- L. ICC-ES AC43 - Acceptance Criteria for Steel Deck Roof and Floor Systems; 2022.
- M. ICC-ES AC70 - Acceptance Criteria for Power-Actuated Fasteners Driven into Concrete, Steel and Masonry Elements; 2019, with Editorial Revision (2021).
- N. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.
- O. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.
- B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.

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C. Certificates: Certify that products furnished meet or exceed specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Cut plastic wrap to encourage ventilation.
- B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Deck:
 - 1. Verco Manufacturing, Inc..
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 STEEL DECK

- A. Roof Deck: Non-composite type, fluted steel sheet:
 - 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
 - 2. Profile, thickness and joints as indicated on drawings.
- B. Composite Floor Deck: Fluted steel sheet embossed to interlock with concrete:
 - 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.

2.03 ACCESSORY MATERIALS

- A. Bearing Plates and Angles: ASTM A36/A36M steel, galvanized per ASTM A123/A123M.
- B. Stud Shear Connectors: Made from ASTM A108 Grade 1015 bars.
- C. Welding Materials: AWS D1.1/D1.1M.
- D. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.
- E. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.
- F. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

2.04 FABRICATED DECK ACCESSORIES

- A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gauge, 0.0299 inch thick sheet steel; of profile and size as indicated; finished same as deck.
- B. Roof Sump Pans: Formed sheet steel, 14 gauge, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.
- C. Floor Drain Pans: Formed sheet steel, 14 gauge, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below floor deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.

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3.02 INSTALLATION

- A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
- B. On steel supports provide minimum 1-1/2 inch bearing.
- C. Fasten deck to steel support members at ends and intermediate supports at 12 inches on center maximum, parallel with the deck flute and at each transverse flute using methods specified.
- D. Clinch lock seam side laps.
- E. Provide attachments to supports as indicated on drawings.
- F. Weld deck in accordance with AWS D1.3/D1.3M.
- G. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete.
- H. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.
- I. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.
- J. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- K. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- L. Weld stud shear connectors through steel deck to structural members below.
- M. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION

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SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formed steel stud exterior wall framing.
- B. Formed steel stud non-load bearing interior wall and non-load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.
- C. Exterior wall sheathing.
- D. Water-resistive barrier over sheathing.

1.02 REFERENCE STANDARDS

- A. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).
- B. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- C. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- D. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
- E. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- F. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- G. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with work of other sections that is to be installed in or adjacent to metal framing systems, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.
- C. Product Data: For lateral-force resisting systems, provide product data sheets on hold-down, showing compliance with requirements.
- D. Manufacturer's Installation Instructions: For lateral-force resisting systems, indicate welding procedure specifications.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Connectors:
 - 1. Same manufacturer as metal framing.
 - 2. Simpson Strong-Tie: www.strongtie.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

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2.02 PERFORMANCE REQUIREMENTS

2.03 MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.

2.04 STRUCTURAL FRAMING COMPONENTS

- A. Wall Studs and Track Sections: AISI S240; c-shaped studs and u-shaped track sections in stud-matching nominal width and compatible height.

2.05 MISCELLANEOUS CONNECTIONS

- A. Welding: Comply with AWS D1.1/D1.1M.

2.06 SHEATHING

2.07 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness as indicated on drawings; finish to match framing components.
- B. Galvanizing Repair: Touch up bare steel with zinc-rich paint in compliance with ASTM A780/A780M.
- C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- E. Water-Resistive Barrier: ICC-ES AC38 Grade D and 60-minute plastic sheet.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION - GENERAL

- A. Install structural members and connections in compliance with ASTM C1007.

3.03 INSTALLATION OF STUDS

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- C. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
- D. Install horizontal bridging in wall studs, spaced vertically in rows indicated in Drawings.
- E. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- F. Touch-up field welds and damaged corrosion protected surfaces with primer.

3.04 INSTALLATION OF WALL SHEATHING

- A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.

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1. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges, and ends.

3.05 TOLERANCES

- A. Maximum Variation from True Position: 1/8" inch.
- B. Maximum Variation of any Member from Plane: 1/8" inch.

END OF SECTION

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SECTION 05 40 00.13 - EXTERIOR METAL STUD FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Exterior non-load-bearing wall framing.
- B. Related Sections:
 - 1. Section 09 22 16 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.02 DEFINITIONS

- A. Gage Thickness Equivalents: Where gage thicknesses are indicated, provide minimum thicknesses of uncoated sheet as follows.
 - 1. 14 gage: 68 mils (0.068 inch).
 - 2. 16 gage: 54 mils (0.054 inch).
 - 3. 18 gage: 43 mils (0.043 inch).
 - 4. 20 gage: 33 mils (0.033 inch).

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product and accessory indicated.
- B. 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.

1.04 INFORMATIONAL SUBMITTALS

- A. Delegated-Design Submittal: For exterior metal stud framing indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Welding certificates.
- C. Product test reports.

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1.05 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code--Sheet Steel."
- C. Fire-Test-Response Characteristics: Where indicated, provide exterior metal stud framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- D. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CEMCO; California Expanded Metal Products Co.
 - 2. ClarkDietrich.
 - 3. SCAFCO Steel Stud Company.

2.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide exterior metal stud framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing:
 - 1) Walls Scheduled for Masonry Veneer: Horizontal deflection of 1/600 of the wall height.
 - 2) All Other Walls: Horizontal deflection of 1/240 of the wall height.
 - 3. Design framing systems to provide for movement of framing members 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.

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4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure.
 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Seismic Performance: Provide cold-formed metal framing capable of withstanding the effects of earthquake motions determined according to ASCE/SEI 7.
- D. Cold-Formed Steel Framing Design Standards: Unless more stringent requirements are indicated, comply with AISI S240.

2.03 STEEL FRAMING, GENERAL

- A. Framing Members: ASTM C 955.
- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
1. Grade: As required by structural performance.
 2. Coating: G90 or equivalent, minimum.

2.04 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: 0.0329 inch .
 2. Flange Width: 1-5/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and same minimum base-metal thickness as steel studs.
- C. Vertical Deflection Clips: Manufacturer's standard 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 and lateral loads.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

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2.05 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members, unless otherwise indicated.
- B. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.06 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.02 INSTALLATION, GENERAL

- A. Install exterior metal stud framing according to ASTM C1007, AISI S200 "North American Standard for Cold-Formed Steel Framing - General Provisions", and manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install exterior metal stud framing and accessories plumb, square, and true to line, and with connections securely fastened.

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- C. Install framing members in one-piece lengths.
- D. Install temporary bracing and supports to secure framing and support loads comparable in intensity 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.
 - 1. Do not bridge building expansion and control joints with exterior metal stud framing. Independently frame both sides of joints.
- E. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- F. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- G. Erection Tolerances: Install exterior metal stud framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.03 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to bottom track, unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated.
- 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 deflection tracks and anchor to building structure.
 - 2. Install double deflection tracks and anchor outer track to building structure.
 - 3. Connect vertical deflection clips to studs and anchor to primary building structure.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain-wall-framing system.

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3.04 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed exterior metal stud framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

END OF SECTION

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SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Miscellaneous metal items indicated and specified, or otherwise necessary for completion of the work. Work of this section includes, but is not limited to, the following:
 - 1. Ferrous and non-ferrous metalwork detailed on the drawings as a component part of other assemblies, but not specified elsewhere.
 - 2. Miscellaneous steel framing and supports including:
 - a. Overhead doors.
 - b. Mechanical and electrical equipment.
 - c. Applications where framing and supports are not specified in other Sections.
 - 3. Reinforcement for low partitions.
 - 4. Slotted channel framing.
 - 5. Metal ladders.
 - 6. Alternating tread devices.
 - 7. Metal bollards.
 - 8. Loose bearing and leveling plates for applications where they are not specified in other Sections.
- B. Related Sections:
 - 1. Section 05 12 00 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.

1.02 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.03 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Fasteners.
 - 2. Shop primers.

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3. Slotted channel framing.
 4. Manufactured metal ladders.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.04 QUALITY ASSURANCE
- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."
- 1.05 COORDINATION
- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- 1.06 FIELD CONDITIONS
- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal fabrications, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
1. Structural Performance, General: Design metal fabrications to withstand the effects of gravity loads within limits and under conditions indicated.
 2. Seismic Performance: Provide metal fabrications capable of withstanding the effects of earthquake motions determined according to ASCE/SEI 7.

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3. Structural Performance of Alternating Tread Devices: Alternating tread devices shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - a. Uniform Load: 100 lbf/sq. ft..
 - b. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - d. Alternating Tread Device Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 - e. Comply with applicable railing loadings in Section 05 52 13 "Pipe and Tube Railings."
4. Structural Performance of Slotted Channel Framing: Slotted Channel Framing shall withstand the effects of loads and stresses applied by equipment being supported.

2.02 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 1. Manufacturers: Subject to compliance with requirements, acceptable manufacturers include, but are not limited to, the following:
 - a. Unistrut
 2. Size of Channels: As indicated.
 3. Material: Galvanized steel, ASTM A653/A653M, commercial steel, Type Bor structural steel, Grade 33, with G90 coating; 0.108-inch nominal thickness.

2.03 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 1. Provide stainless steel fasteners for fastening aluminum or stainless steel .
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

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- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- H. Post-Installed Anchors: Torque-controlled expansion anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.04 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Division 09 "Painting" Sections.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- C. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

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2.05 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

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2.06 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. 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.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Partial Height Partition Reinforcement: Steel reinforcement members designed to support out-of-plane loading in partial height partitions that are unsupported at the top track.
 - 1. Product: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. The Steel Network, Inc.; MidWall.
 - 2. Minimum Yield Strength and Base-Metal Thickness: As required to meet performance requirements indicated.
 - 3. Height:
 - a. For partitions less than 48 inches: 24 inches.
 - b. For partitions equal to or greater than 48 inches: 48 inches.
 - 4. Depth: As indicated on drawings.
- D. Galvanize miscellaneous exterior framing and supports.
- E. Prime miscellaneous framing and supports where indicated.

2.07 METAL LADDERS

- A. General:
 - 1. Comply with ANSI A14.3.
- B. Steel Ladders:
 - 1. Space siderails 18 inches apart unless otherwise indicated.
 - 2. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - 3. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.

2.08 ALTERNATING TREAD DEVICES

- A. Alternating Tread Devices: Fabricate alternating tread devices of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

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1. Basis-of-Design Product: Subject to compliance with requirements, provide Precision Ladders, LLC; Model AT Aluminum Alternating Tread Stairs, or comparable product by one of the following:
 - a. Lapeyre Stair Inc.
 - b. Schmidt Structural Products; a subsidiary of Penco Products, Inc.
2. Tread depth shall be not less than 8-1/2 inches exclusive of nosing or less than 10-1/2 inches including the nosing, tread width shall be not less than 7 inches, and riser height shall be not more than 8 inches.
3. Fabricate from aluminum and assemble by welding or with stainless steel fasteners.
4. Comply with applicable railing requirements in Section 05 52 13 "Pipe and Tube Railings."
 - a. Provide 42-inch handrail extensions.

2.09 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 80 galvanized steel pipe .
 1. Cap bollards with 1/4-inch- thick, galvanized steel plate with flat top unless indicated otherwise.
- B. Fabricate internal sleeves for removable bollards from Schedule 80 galvanized steel pipe or 1/4-inch wall-thickness galvanized steel tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4-inch machine bolt.

2.10 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize bearing and leveling plates.

2.11 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

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2.13 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. 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.
 - 1. Shop prime with primers specified in Section 09 91 00 "Painting" unless zinc-rich primer is indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
 - 4. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

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- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.02 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for overhead doors securely to, and rigidly brace from, building structure.

3.03 INSTALLATION OF METAL BOLLARDS

- A. Anchor internal sleeves for removable bollards in concrete by inserting in pipe sleeves preset into concrete. Fill annular space around internal sleeves solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward internal sleeve.

3.04 INSTALLATION OF BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

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3.05 REPAIRS

- A. Touchup Painting:
 - 1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 00 "Painting."
- B. Galvanized Surfaces: Clean field welds and damaged areas and repair galvanizing to comply with ASTM A 780/A 780M, in accordance with Annex A1 zinc solder or Annex A3 metallizing. Repair method in accordance with Annex A2 galvanizing repair paint not permitted.

END OF SECTION

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SECTION 05 51 13 - METAL PAN STAIRS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Preassembled steel stairs with concrete-filled treads.
- B. Related Sections:
 - 1. Section 05 50 00 "Metal Fabrications" for alternating tread devices.

1.02 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs.
 - 1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
 - 2. Deliver such items to Project site in time for installation.

1.03 ACTION SUBMITTALS

- A. Product Data: For metal pan stairs and the following:
 - 1. Prefilled metal-pan-stair treads.
 - 2. Shop primer products.
 - 3. Grout.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
 - 3. Include plan at each level.
- C. Delegated-Design Submittal: For stairs, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.
 - 1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
 - 2. Protect steel members and packaged materials from corrosion and deterioration.
 - 3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
 - a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Stairs: Metal 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 and guard loads in addition to loads specified above.
 - 5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.
- B. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.02 METALS

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.
- D. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

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2.03 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls.
 - 1. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
- D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.04 MISCELLANEOUS MATERIALS

- A. Welding Electrodes: Comply with AWS requirements.
- B. Shop Primers: Provide primers that comply with Section 09 91 00 "Painting."
- C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.
- D. Prefilled Concrete Treads:
 - 1. Concrete Materials and Properties: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 3000 psi and maximum aggregate size of 1/2 inch unless otherwise indicated.
 - 2. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, steel, 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated on Drawings.
 - 3. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.
 - a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

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- E. Abrasive Inserts for Concrete, Precast Concrete, and Terrazzo Treads: 1/2-inch- wide, silicon carbon/epoxy mixture 1/16 inch thick.
 - 1. Provide one insert, 2 inches wide, located 1 inch from nosing at **[each] [top and bottom]** tread.
 - 2. Provide three inserts, 1/2 inch apart, with first insert located 1 inch from nosing at **[each] [top and bottom]** tread.
 - 3. Color: **[Custom color as directed by Architect] [As selected by Architect from manufacturer's standard color selections]**.

2.05 FABRICATION, GENERAL

- A. Fabricators: Subject to compliance with requirements, available fabricators offering stair and railing assemblies that may be incorporated into the Work include, but are not limited to the following:
 - 1. American Stair.
 - 2. Pacific Stair.
 - 3. Duvinage; Sharon Stair.
- B. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
- C. Assemble stairs in shop to greatest extent possible.
 - 1. Disassemble units only as necessary for shipping and handling limitations.
 - 2. Clearly mark units for reassembly and coordinated installation.
- D. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- E. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- F. Form exposed work with accurate angles and surfaces and straight edges.
- G. Weld connections to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Weld exposed corners and seams continuously unless otherwise indicated.

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5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish # 3 - Partially dressed weld with spatter removed.

- H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
 1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
 2. Locate joints where least conspicuous.
 3. Fabricate joints that will be exposed to weather in a manner to exclude water.
 4. Provide weep holes where water may accumulate internally.

2.06 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Commercial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
 1. Fabricate stringers as indicated on Drawings.
 - a. Stringer Size: As required to comply with "Performance Requirements" Article.
 - b. Provide closures for exposed ends of channel and rectangular tube stringers.
 - c. Finish: Shop primed.
 2. Construct platforms of steel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
 - a. Provide closures for exposed ends of channel and rectangular tube framing.
 - b. Finish: Shop primed.
 3. Weld[**or bolt**] stringers to headers; weld[**or bolt**] framing members to stringers and headers.[**If using bolts, fabricate and join so bolts are not exposed on finished surfaces.**]
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.
 1. Steel Sheet: Uncoated, cold -rolled steel sheet unless otherwise indicated.
 2. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
 3. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

2.07 FINISHES

- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

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- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
 - 1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
 - 1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Fit exposed connections accurately together to form hairline joints.
 - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
 - 2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
 - 3. Comply with requirements for welding in "Fabrication, General" Article.
- D. Place and finish concrete fill for treads and platforms to comply with Section 03 30 00 "Cast-in-Place Concrete."

3.03 REPAIR

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 00 "Painting."

END OF SECTION

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SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Steel railings.
- B. Related Sections:
 - 1. Section 05 51 13 "Metal Pan Stairs" for steel tube railings associated with metal pan stairs.

1.02 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

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1.06 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.

2.02 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.03 STEEL RAILINGS

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M, Type 5.
- C. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
- D. Plates, Shapes, and Bars: ASTM A36/A36M.

2.04 FASTENERS

- A. Fastener Materials:

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1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941, Class Fe/Zn 5 for zinc coating.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
- D. Post-Installed 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 AC193 or ICC-ES AC308.
 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.05 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: [**Cast iron**] [**Cast aluminum,**] [**Cast stainless steel,**] [**Cast nickel-silver,**] center of handrail [2-1/2 inches] [3-1/8 inches] <**Insert dimension**> from [**face of railing**] [**wall**].
- B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
- C. Shop Primers: Provide primers that comply with Section 09 91 00 "Painting".
- D. Intermediate Coats and Topcoats: Provide products that comply with Section 09 91 00 "Painting."

2.06 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 1. Clearly mark units for reassembly and coordinated installation.
 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 2. Remove sharp or rough areas on exposed surfaces.

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- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water.
 - 1. Provide weep holes where water may accumulate.
 - 2. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint
- I. Form changes in direction as follows:
 - 1. As detailed.
 - 2. By bending to smallest radius that will not result in distortion of railing member.
- J. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
 - 1. Fabricate anchorage devices capable of withstanding loads imposed by railings.

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2. Coordinate anchorage devices with supporting structure.

- O. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

2.07 STEEL AND IRON FINISHES

- A. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3.
- C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
1. Shop prime uncoated railings with primers specified in Section 09 91 00 "Painting" unless zinc-rich primer is indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.02 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
1. Fit exposed connections together to form tight, hairline joints.
 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

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- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.03 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches of post.

3.04 ANCHORING POSTS

- A. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For steel railings, weld flanges to post and bolt to metal supporting surfaces.

3.05 ATTACHING RAILINGS

- A. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.
- B. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
 - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
 - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

3.06 REPAIR

- A. Touchup Painting:
 - 1. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 00 "Painting."

END OF SECTION

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SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural dimension lumber framing.
- B. Structural composite lumber framing.
- C. Nonstructural dimension lumber framing.
- D. Rough opening framing for doors, windows, and roof openings.
- E. Sheathing.
- F. Subflooring.
- G. Roof-mounted curbs.
- H. Roofing nailers.
- I. Roofing cant strips.
- J. Preservative treated wood materials.
- K. Miscellaneous framing and sheathing.
- L. Communications and electrical room mounting boards.
- M. Concealed wood blocking, nailers, and supports.
- N. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 30 00 - Cast-in-Place Concrete: Setting anchors in concrete.
- C. Section 05 12 00 - Structural Steel Framing: Prefabricated beams and columns for support of wood framing.
- D. Section 05 50 00 - Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing.
- E. Section 06 18 00 - Glued-Laminated Construction.
- F. Section 07 62 00 - Sheet Metal Flashing and Trim: Sill flashings.
- G. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- 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 E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- D. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024.
- E. AWPA U1 - Use Category System: User Specification for Treated Wood; 2024.
- F. PS 1 - Structural Plywood; 2023.

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- G. PS 2 - Performance Standard for Wood Structural Panels; 2018.
- H. PS 20 - American Softwood Lumber Standard; 2021.
- I. WWPA G-5 - Western Lumber Grading Rules; 2021.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Structural Composite Lumber: Submit manufacturer's published structural data, marked to indicate which sizes and grades are being used; if structural composite lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.
- C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Douglas Fir-Larch, unless otherwise indicated.
 - 2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Stud Framing (2 by 2 through 2 by 6):
 - 1. Species: Douglas Fir-Larch.
 - 2. Grade: as indicated on structural drawings.
- D. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16):
 - 1. Species: Douglas Fir-Larch.
 - 2. Grade: as indicated on structural drawings.
- E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, as indicated on structural drawings.

2.03 TIMBERS FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry (23 percent maximum).
- C. Beams and Posts 5 inches and over in thickness:
 - 1. Species: Douglas Fir-Larch.
 - 2. Grade: as indicated on structural drawings.

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2.04 STRUCTURAL COMPOSITE LUMBER

- A. At Contractor's option, structural composite lumber may be substituted for concealed dimension lumber and timbers.
- B. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.

2.05 CONSTRUCTION PANELS

- A. Roof Sheathing: PS 2 type, rated Structural I Sheathing.
 - 1. Bond Classification: Exterior.
 - 2. Span Rating: 48.
 - 3. Performance Category: 1/2 PERF CAT.
- B. Wall Sheathing: PS 2 type.
 - 1. Bond Classification: Exterior.
 - 2. Grade: Structural I Sheathing.
 - 3. Span Rating: 24.
 - 4. Performance Category: 15/32 PERF CAT.
 - 5. Edge Profile: Square edge.
- C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.06 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
- B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.
 - 1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.
- C. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
 - 1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.
- D. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.

2.07 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

PART 3 EXECUTION

3.01 PREPARATION

- A. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.

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- B. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FRAMING INSTALLATION

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.
- E. Install horizontal spanning members with crown edge up and not less than 1-1/2 inches of bearing at each end.
- F. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- G. Provide bridging at joists in excess of 8 feet span as detailed. Fit solid blocking at ends of members.
- H. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.04 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.
- C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- E. Provide the following specific nonstructural framing and blocking:
 - 1. Cabinets and shelf supports.

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2. Wall brackets.
3. Handrails.
4. Grab bars.
5. Towel and bath accessories.
6. Wall-mounted door stops.
7. Wall paneling and trim.
8. Joints of rigid wall coverings that occur between studs.

3.05 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at each roof opening except where prefabricated curbs are specified and where specifically indicated otherwise; form corners by alternating lapping side members.

3.06 INSTALLATION OF CONSTRUCTION PANELS

- A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
 1. Nail panels to framing; staples are not permitted.
- B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails.
- C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 3. Install adjacent boards without gaps.
 4. Size and Location: As indicated on drawings.

3.07 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.
- C. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.08 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.

3.09 CLEANING

- A. Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.
 1. Comply with applicable regulations.
 2. Do not burn scrap on project site.
 3. Do not burn scraps that have been pressure treated.

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- 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
 - B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
 - C. Prevent sawdust and wood shavings from entering the storm drainage system.
- END OF SECTION

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SECTION 06 16 43 - GYPSUM SHEATHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Exterior wall gypsum sheathing.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 GYPSUM SHEATHING

- A. Gypsum Wall Sheathing: Provide one of the following:
 - 1. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M, Type X, 5/8 inch thick.
 - a. Product: Subject to compliance with requirements, provide one of the following:
 - 1) CertainTeed Corp.; GlasRoc Sheathing.
 - 2) Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
 - 3) USG Corporation; Securock Glass Mat Sheathing.

2.02 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For gypsum sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117.
- B. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
 - 1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C1002.
 - 2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

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PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.02 GYPSUM SHEATHING INSTALLATION

- A. Comply with ASTM C1280 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 - 3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing, in compliance with ASTM C954.
- C. Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

END OF SECTION

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SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Interior standing and running trim.
 - 2. Shop finishing of interior architectural woodwork.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

1.03 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Anchors.
 - 2. Adhesives.
 - 3. Shop finishing materials.
- B. Samples for Verification: For the following:
 - 1. Lumber for Transparent Finish: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.

1.04 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for installation adhesives, indicating VOC content.
 - 2. Documentation for composite wood products, indicating compliance with emissions testing or certification.

1.05 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

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1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Architectural Woodwork Standards, Section 2.
- B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.
- C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
 - 1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

1.07 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.
- B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.

1.08 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Adhesives:
 - a. VOC content limits for field applications.
 - 2. Composite Wood Products:
 - a. Formaldehyde emissions testing or certification.

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2.02 ARCHITECTURAL WOODWORK, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
1. If discrepancies arise between the Contract Documents and the Architectural Woodwork Standards, comply with the more stringent requirement.

identify

2.03 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Architectural Woodwork Standards Grade: Premium.
- B. Hardwood Lumber:
1. Species: [Red oak] [White oak] [White ash] [Hickory] <Insert species>.
 2. Cut: [Plain sliced/plain sawn] [Rift cut/rift sawn] [Quarter cut/quarter sawn].
 3. For trim items other than base wider than available lumber, use veneered construction. Do not glue for width.
 4. For base wider than available lumber, glue for width. Do not use veneered construction.

2.04 COMPOSITE WOOD MATERIALS

- A. Composite Wood Products: Provide materials that comply with requirements of the Architectural Woodwork Standards for each type of interior architectural woodwork and quality grade specified unless otherwise indicated.
1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.

2.05 MISCELLANEOUS MATERIALS

- A. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.
1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
 2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

2.06 FABRICATION

- A. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.
1. Ease edges to radius indicated for the following:

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- a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
- b. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.

2.07 SHOP FINISHING

- A. Finish interior architectural woodwork with transparent finish at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.
- C. Transparent Finish:
 - 1. Architectural Woodwork Standards Grade: Premium .
 - 2. Finish System - 5: Varnish, Conversion.
 - 3. Staining: Match existing as directed by Architect.
 - 4. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter in accordance with ASTM D523.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.
- B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.02 INSTALLATION

- A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.
- B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.
- C. Install interior architectural woodwork level, plumb, true in line, and without distortion.
 - 1. Shim as required with concealed shims.
 - 2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

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- D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.
 - 1. Secure with countersunk, concealed fasteners and blind nailing.
 - 2. Use fine finishing nails for exposed fastening, countersunk and filled flush with interior architectural woodwork.
 - 3. For shop-finished items, use filler matching finish of items being installed.
- F. Standing and Running Trim:
 - 1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
 - 2. Do not use pieces less than 96 inches long, except where shorter single-length pieces are necessary.
 - 3. Scarf running joints and stagger in adjacent and related members.
 - 4. Fill gaps, if any, between top of base and wall with plastic wood filler; sand smooth; and finish same as wood base if finished.
 - 5. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

3.03 REPAIR

- A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.
- B. Where not possible to repair, replace defective woodwork.
- C. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.
 - 1. Fill nail holes with matching filler where exposed.
 - 2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.04 CLEANING

- A. Clean interior architectural woodwork on exposed and semiexposed surfaces.

END OF SECTION

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SECTION 06 42 16 - FLUSH WOOD PANELING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Flush wood paneling (wood-veneer wall surfacing).
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
 - 2. Section 05 70 00 "Decorative Metal" for metal reveals at wood paneling.

1.02 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: For flush wood paneling.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
 - 3. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
- C. Samples: For each exposed product and for each color and finish specified, in manufacturer's or fabricator's standard size.

1.04 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for installation adhesives, indicating VOC content.
 - 2. Documentation for composite wood products, indicating compliance with emissions testing or certification.

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1.05 QUALITY ASSURANCE

- A. Quality Standard: Unless otherwise indicated, comply with WI's North American Architectural Woodwork Standards (NAAWS) for grades indicated for construction, finishes, installation, and other requirements.
 - 1. Where the Contract Documents contain requirements that are more stringent than the referenced quality standard, comply with requirements of the Contract Documents in addition to those of the referenced quality standard.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver paneling until painting and similar operations that might damage paneling have been completed in installation areas. Store paneling in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.07 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Established Dimensions: Where paneling is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Adhesives:
 - a. VOC content limits for field applications.
 - 2. Composite Wood Products:
 - a. Formaldehyde emissions testing or certification.

2.02 FLUSH WOOD PANELING (WOOD-VENEER WALL SURFACING)

- A. Grade: Premium.

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- B. Wood Species and Cut: **[White oak, rift sliced] [Select white ash, plain sliced] [Sycamore, plain sliced] [Cherry, plain sliced] [Butternut, plain sliced] [Avodire, quarter sliced] <Insert species and cut>.**
- C. Veneer Matching Method:
1. Adjacent Veneer Leaves: **[Book] [Slip] [Pleasant (Random)]** match.
 2. Within Panel Face: **[Running] [Balance] [Center-balance]** match.
 3. Adjacent Veneer Leaves and within Panel Face: Slip, center-balance, or book match.
- D. Panel-Matching Method:
1. No matching is required between adjacent panels. Select and arrange panels for similarity of grain pattern and color between adjacent panels.
 2. **[Premanufactured panel sets used full width] [Premanufactured panel sets selectively reduced in width] [Made-to-order, sequence-matched panels] [Made-to-order, blueprint-matched panels and components]** within each separate area.
 - a. See Section 01 10 00 "Summary" for requirements concerning flitches reserved by Architect.
- E. Vertical Panel-Matching Method: **[Continuous end match; veneer leaves of upper panels are continuations of veneer leaves of lower panels] [Architectural end book match; veneer leaves are individually book matched from lower panels to upper panels] [Architectural end slip match; veneer leaves are individually slip matched from lower panels to upper panels] [Panel end book match; panels are book matched from lower panels to upper panels] [Panel end slip match; panels are slip matched from lower panels to upper panels].**
- F. Panel Core Construction: **[Hardwood veneer-core plywood] [Particleboard or MDF] [Fire-retardant particleboard or fire-retardant MDF].**
1. Thickness: **[3/4 inch] [As indicated on Drawings].**
- G. Exposed Panel Edges: **[Inset solid-wood or wood-veneer matching faces] [Legs of metal channels forming reveals] [Applied solid-wood banding 11/16 inch thick by depth of panels] [Applied bronze flat bars 1/16 inch thick by depth of panels] <Insert description>.**
- H. Panel Reveals: **[Matte black plastic laminate] [Bronze sheet] [Stainless steel sheet] [Bronze channels, 1 by 1 by 1/8 inch thick] [Stainless steel channels, 1 by 1 by 1/16 inch thick] <Insert description>.**

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- I. Fire-Retardant-Treated Paneling: Panels shall consist of wood-veneer and fire-retardant particleboard or fire-retardant, medium-density fiberboard (MDF). Panels shall have a flame-spread index of [25] [75] or less and a smoke-developed index of 450 or less per ASTM E84, and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
- J. Assemble panels by gluing and concealed fastening.

2.03 MATERIALS

- A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
 - 1. MDF: ANSI A208.2, Grade 130.
 - 2. Particleboard (Medium Density): ANSI A208.1, Grade M-2.

2.04 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.
- C. Installation Adhesive: Product recommended by panel fabricator for each substrate for secure anchorage.

2.05 FABRICATION

- A. Complete fabrication, including assembly, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- B. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

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2.06 SHOP FINISHING

- A. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.
 - 1. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling.
- C. Transparent Finish:
 - 1. Grade: Same as item to be finished.
 - 2. Finish: System - [1, **nitrocellulose lacquer**] [2, **precatalyzed lacquer**] [3, **postcatalyzed lacquer**] [4, **water-based latex acrylic**] [5, **conversion varnish**] [6, **synthetic penetrating oil**] [7, **catalyzed vinyl**] [8, **water-based crosslinking acrylic**] [9, **UV curable acrylated epoxy, polyester, or urethane**] [10, **water-based UV curable**] [11, **catalyzed polyurethane**] [12, **water-based polyurethane**] [13, **catalyzed polyester**].
 - 3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
 - 4. Staining: [**None required**] [**Match approved sample for color**] [**Match Architect's sample**].
 - 5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
 - 6. Filled Finish for Open-Grain Woods:[**After staining, apply wash-coat sealer and allow to dry.**] Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
 - 7. Sheen: [**Flat, 15-30**] [**Satin, 31-45**] [**Semigloss, 46-60**] [**Gloss, 61-100**] gloss units measured on 60-degree gloss meter per ASTM D523.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Before installation, condition paneling to humidity conditions in installation areas.
- B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.02 INSTALLATION

- A. Grade: Install paneling to comply with quality standard grade of paneling to be installed.

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- B. Install paneling level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.
 - 1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding [1/32 inch] [1/16 inch].
- C. Anchor paneling to supporting substrate with **[concealed panel-hanger clips]** **[splined connection strips]** **[blind nailing]**.
 - 1. Do not use face fastening unless **[covered by trim]** **[otherwise indicated]**.
- D. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed.
 - 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.03 ADJUSTING AND CLEANING

- A. Repair damaged and defective paneling, where possible, to eliminate defects. Where not possible to repair, replace paneling. Adjust for uniform appearance.
- B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

MAMMOTH LAKES FOUNDATION
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SECTION 07 05 43 - CLADDING SUPPORT SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Metal cladding support systems.
- B. Related Sections:
 - 1. Section 07 21 00 "Thermal Insulation" for continuous (exterior) insulation.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of support system and accessory.
- B. Shop Drawings:
 - 1. Include installation layout for each cladding support system, each cladding type supported, and for each backup wall condition.

1.03 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, tests performed by a qualified testing agency.
- B. Energy Performance Test Reports: For each product and system, tests performed by a qualified testing agency.
- C. Delegated-Design Submittal: For cladding support systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 COORDINATION

- A. Coordinate cladding support system installation with cladding systems, continuous (exterior) insulation, air and weather barrier, flashing, trim, and other adjoining work.

1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cladding support systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.

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- b. Deterioration of metals and other materials beyond normal weathering.
- 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design cladding support systems.
- B. Structural Performance: Provide systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Cladding Deflection Limits: For wind loads, space support elements and subframing as required to meet performance requirements indicated for cladding types being supported.
- C. Seismic Performance: Cladding support systems with cladding types supported shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- D. Energy Performance: Cladding support system with cladding types supported shall have clear field U-factor of not more than the following, determined according to 3D thermal modeling in accordance with ASHRAE 1365-RP, or laboratory testing in accordance with ASTM C1363:
 - 1. Thermal Transmittance (U-factor): [**U-0.077**] [**U-0.064**] [**U-0.055**] [**U-0.045**] **<insert value>**.
- E. Fire Propagation Characteristics: Where required by building code for wall assemblies indicated, passes NFPA 285 testing as part of an approved assembly.

2.02 METAL CLADDING SUPPORT SYSTEMS

- A. Thermally Isolated Steel Z-Furring: System consisting of a hollow thermal isolation strip and a galvanized steel z-girt with a punched web .
 - 1. Basis of Design Product: Knight Wall Systems; Thermazee.
 - 2. Material: ASTM A1046, Structural Steel (SS), Grade B, 50ksi yield, coating designation ZM40.
 - 3. Minimum Base-Metal Thickness: As required to meet performance requirements.
 - 4. Z-Girt Depth: As indicated on drawings.
 - 5. Finish: [**Mill**] [**Black PVDF**].

2.03 MISCELLANEOUS MATERIALS

- A. Metal Subframing: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide sections as required for support and alignment of cladding system.

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CLADDING SUPPORT SYSTEMS
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- B. Fasteners: Type and size as recommended by cladding support system manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
 - 1. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required.
 - 2. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Install rails, subframing, and other miscellaneous support members and anchorages according to cladding support manufacturer's written recommendations.

3.03 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align cladding units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

END OF SECTION

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SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Bonded High Density Polyethylene (HDPE) sheet waterproofing at below grade walls and slabs.
 - 2. Molded-sheet drainage panels.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. 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.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Sample Warranties: For special warranties.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

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SELF-ADHERING SHEET
WATERPROOFING
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1.06 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
 - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.07 WARRANTY

- A. Manufacturer's Warranty:
 - 1. Waterproofing 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.
 - a. Warranty Period: Five years from date of Substantial Completion.
- B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations for Waterproofing System: Obtain waterproofing materials from single source from single manufacturer.

2.02 BONDED HPDE SHEET WATERPROOFING

- A. Bonded HDPE Sheet Waterproofing for Vertical Applications: Uniform, flexible, multilayered-composite sheet membrane that forms a permanent bond with fresh concrete placed against it; complete with accessories and preformed shapes for an unbroken waterproofing assembly; with the following physical properties:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Grace Construction Products; Preprufe 160R.
 - b. AVM Industries; Aussie Skin 550G.
 - 2. Physical Properties:
 - a. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D1970/D1970M.
 - b. Peel Adhesion to Concrete: 5 lbf/in. minimum; ASTM D903, modified.
 - c. Lap Adhesion: 5 lbf/in. minimum; ASTM D1876, modified.
 - d. Hydrostatic-Head Resistance: 230 feet; ASTM D5385, modified.
 - e. Puncture Resistance: 100 lbf minimum; ASTM E154/E154M.

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- f. Water Vapor Permeance: 0.1 perm maximum; ASTM E96/E96M, Water Method.
 - g. Ultimate Elongation: 335 percent minimum; ASTM D412, modified.
 - B. Bonded HDPE Sheet Waterproofing for Horizontal Applications: Uniform, flexible, multilayered-composite sheet membrane that forms a permanent bond with fresh concrete placed against it; complete with accessories and preformed shapes for an unbroken waterproofing assembly; with the following physical properties:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Grace Construction Products; Preprufe 300R.
 - b. AVM Industries; Aussie Skin 560G.
 - 2. Physical Properties:
 - a. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D1970/D1970M.
 - b. Peel Adhesion to Concrete: 5 lbf/in. minimum; ASTM D903, modified.
 - c. Lap Adhesion: 5 lbf/in. minimum; ASTM D1876, modified.
 - d. Hydrostatic-Head Resistance: 230 feet; ASTM D5385, modified.
 - e. Puncture Resistance: 200 lbf minimum; ASTM E154/E154M.
 - f. Water Vapor Permeance: 0.1 perm maximum; ASTM E96/E96M, Water Method.
 - g. Ultimate Elongation: 335 percent minimum; ASTM D412, modified.
 - C. Mastic, Adhesives, and Detail Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.
- 2.03 AUXILIARY MATERIALS
- 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 of authorities having jurisdiction.
 - B. Primer: Liquid primer recommended for substrate by sheet waterproofing material manufacturer.
 - C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet waterproofing material manufacturer.
 - D. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch, predrilled at 9-inch centers.

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2.04 MOLDED-SHEET DRAINAGE PANELS

- A. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel without Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding No. 40 sieve, laminated to one side of the core, without a polymeric film bonded to the other side; and with a horizontal flow rate through the core of not less than 2.8 gpm per ft..

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of waterproofing.
 - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 - 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D4263.
 - 3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections.
- E. Fill form tie holes, honeycomb, aggregate pockets, holes, and other voids.
- F. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D4258.
 - 1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.

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- G. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.
 - 1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- H. Corners: Prepare, prime, and treat inside and outside corners in accordance with manufacturer's instructions.
 - 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
- I. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

3.03 INSTALLATION OF MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
- D. Two-Ply Application: Install sheets to form a membrane with lap widths not less than 50 percent of sheet widths, to provide a minimum of two thicknesses of sheet membrane over areas to receive waterproofing.
- E. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.
- F. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- G. Seal edges of sheet waterproofing terminations with mastic.

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- H. Install sheet waterproofing and auxiliary materials to tie into adjacent waterproofing.
- I. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.
- J. Immediately install protection course with butted joints over waterproofing membrane.
 - 1. Molded-sheet drainage panels may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

3.04 INSTALLATION OF BONDED HDPE SHEET WATERPROOFING

- A. Install waterproofing according to manufacturer's written instructions.
- B. Place and secure molded-sheet drainage panels over substrate. Lap edges and ends of geotextile to maintain continuity.
- C. Vertical Applications: Install sheet with face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation. Mechanically fasten to substrate.
 - 1. Securely fasten top termination of membrane with continuous metal termination bar anchored into substrate and cover with detail tape.
- D. Horizontal Applications: Install sheet with face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation.
- E. Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.
- F. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane troweling.
- G. Install sheet waterproofing and auxiliary materials to produce a continuous watertight tie into adjacent waterproofing.
- H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending 6 inches beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.

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3.05 INSTALLATION OF MOLDED-SHEET DRAINAGE PANELS

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.06 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

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SECTION 07 19 00 - WATER REPELLENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes penetrating water-repellent and graffiti-resistant treatments for the following non-traffic, vertical and horizontal exterior surfaces:
 - 1. Decorative concrete masonry units.

1.02 PERFORMANCE REQUIREMENTS

- A. General Performance: Water repellents shall meet performance requirements indicated without failure due to defective manufacture, fabrication, or installation.
 - 1. Water Repellents: Comply with performance requirements specified, as determined by preconstruction testing on manufacturer's standard substrate assemblies representing those indicated for this Project.
- B. Water Absorption: Minimum 80 percent reduction of water absorption after 24 hours in comparison of treated and untreated specimens.
 - 1. Concrete Masonry Units: ASTM C 140.
- C. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, according to ASTM E 514.
- D. Durability: Maximum 5 percent loss of water-repellent properties after 2500 hours of weathering according to ASTM G 154 in comparison to water-repellent-treated specimens before weathering.

1.03 PRECONSTRUCTION TESTING

- A. Preconstruction Testing: Installed water repellents shall comply with performance requirements indicated, as evidenced by reports based on Project-specific preconstruction testing of existing substrate assemblies by a qualified testing agency.
 - 1. Select sizes and configurations of assemblies to adequately demonstrate capability of water repellents to comply with performance requirements.
 - 2. In addition to verifying performance requirements, use test applications to verify manufacturer's written instructions for application procedure and optimum rates of product application to substrate assemblies.
 - 3. Notify Architect seven days in advance of the dates and times when assemblies will be tested.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

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- B. Samples: For each type of water repellent and substrate indicated.

1.05 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Preconstruction Testing Reports: For water-repellent-treated substrates.
- C. Sample Warranty: For special warranty.

1.06 QUALITY ASSURANCE

- A. Mockups: Prepare mockups of each required water repellent and graffiti-resistant treatment on each type of substrate required to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Locate each test application as directed by Architect.
 - 2. Size: 25 sq. ft..
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 FIELD CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
 - 1. Concrete surfaces and mortar have cured for not less than 28 days.
 - 2. Building has been closed in for not less than 30 days before treating wall assemblies.
 - 3. Ambient temperature is above 40 deg F and below 100 deg F and will remain so for 24 hours.
 - 4. Substrate is not frozen and substrate-surface temperature is above 40 deg F and below 100 deg F.
 - 5. Rain or snow is not predicted within 24 hours.
 - 6. Not less than 24 hours have passed since surfaces were last wet.
 - 7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.01 PENETRATING GRAFFITI-RESISTANT TREATMENT

- A. Water Repellent Preparation Treatment:
 - 1. Concrete Masonry Units: Evonik Industries; Protectosil Aqua-Trete Concentrate.
- B. Fluorosilane, Penetrating Graffiti-Resistant Treatment: Clear, containing 10 percent or more solids of fluorosilanes; with water, and with 0 g/L VOCs.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Evonik Industries; Protectosil Antigraffiti.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
 - 1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in representative locations by method recommended by manufacturer.
 - 2. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.
 - 3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
 - 4. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

3.02 PREPARATION

- A. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions.
- B. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- C. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
 - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

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3.03 GRAFFITI-RESISTANT TREATMENT APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
- B. Apply water repellent preparation treatment as preparation for an application of graffiti-resistant treatment in number of coats and application rate recommended by manufacturer.

3.04 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION

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SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Slab and Foundation wall insulation.
 - 2. Insulation in cavities formed by framing members.
 - 3. Exterior continuous insulation.
 - 4. Interior continuous insulation.
 - 5. Miscellaneous rigid and semi-rigid board insulation applications.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
 - 2. Division 07 Sections: For insulation specified as part of roofing and horizontal waterproofing assemblies.
 - 3. Section 09 81 00 "Acoustic Insulation" for sound attenuation insulation.
 - 4. Division 22 and 23 Sections: For pipe and duct insulation.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for insulation, indicating compliance with emissions testing or certification.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.04 QUALITY ASSURANCE

- 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.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:

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1. Insulation:
 - a. VOC emissions testing or certification.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide exterior wall assemblies with foam plastic insulation 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 SLAB AND FOUNDATION WALL INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:
 1. Thermal resistivity of 5.0 deg F x h x sq. ft./Btu x in. at 75 deg F.
 2. Compressive Strength: Type IV, 25 psi.
 3. Locations: Where indicated, and as follows:
 - a. Concrete slabs on grade, below grade walls, and foundations in contact with earth or backfill.

2.04 INSULATION IN CAVITIES FORMED BY FRAMING MEMBERS

- A. Unfaced, Glass-Fiber Blanket Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
 1. Locations: Where indicated, and as follows:
 - a. Cavities formed with steel stud framing members.
- B. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
 1. Locations: Where indicated, and as follows:
 - a. Cavities formed with steel stud framing members.

2.05 EXTERIOR CONTINUOUS INSULATION

- A. Unfaced, Semi-Rigid Mineral-Wool Board Insulation: ASTM C612, Type IVA or IVB; with maximum flame-spread and smoke-developed indexes of 0; and of the following nominal density and thermal resistivity:

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1. Nominal density of 4.5 lb/cu. ft., thermal resistivity of 4.2 deg F x h x sq. ft./Btu x in. at 75 deg F.
2. Locations: Where indicated, and as follows:
 - a. Continuous insulation between exterior cladding and sheathing.
3. Product: Provide one of the following:
 - a. Owens Corning; Thermafiber RainBarrier 45.
 - b. Rockwool; CavityRock.

B. Fasteners:

1. Cavity-Wall Fasteners: Corrosion-resistant fasteners recommended by insulation manufacturer for intended use consisting of 1-3/4 inch diameter plastic cap, and fastener indicated below.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
 - 1) Wind-Lock Corporation; ci-Lock Steel Series Selection.

2.06 INTERIOR CONTINUOUS INSULATION

- A. Foil-Faced, Polyisocyanurate Board Insulation: ASTM C1289, Type I, Class 2, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed on unfaced core in thicknesses up to 4 inches meeting building code requirements for thermal barrier for foam plastic insulation in exposed conditions.
1. Thermal resistivity of 6.5 deg F x h x sq. ft./Btu x in. at 75 deg F.
 2. Locations: Where indicated, and as follows:
 - a. Interior face of concrete and CMU exterior walls.
 3. Product: Dupont; Thermax.
- B. Adhesive: Manufacturer's recommended product with demonstrated capability to bond insulation securely to substrates indicated.

2.07 MISCELLANEOUS RIGID AND SEMI-RIGID BOARD INSULATION

- A. Foil-Faced, Polyisocyanurate Board Insulation: ASTM C1289, Type I, Class 2, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed on unfaced core in thicknesses up to 4 inches meeting building code requirements for thermal barrier for foam plastic insulation in exposed conditions.
1. Thermal resistivity of 6.5 deg F x h x sq. ft./Btu x in. at 75 deg F.
 2. Locations: Where indicated, and as follows:
 - a. In locations exposed to the interior.
 3. Product: Dupont; Thermax.
- B. Fasteners:

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1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. AGM Industries, Inc.
 - b. Gemco.
2. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
 - a. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.
3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
4. Dome Caps: Designed to protect ends of insulation-retaining washers in locations where exposed to view or human contact.

2.08 MISCELLANEOUS ACCESSORIES

- A. Foil-Faced Board Insulation Tape: Pressure-sensitive tape of type recommended by insulation manufacturer and as required performance requirements. Tape joints and ruptures in foil facings and seal each continuous area of insulation to ensure airtight installation.
- B. Closed-Cell Polyurethane Foam Sealant: Board insulation manufacturer's recommended product for use in gaps between rigid insulation joints and edge terminations greater than 1/8 inch.
- C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGM Industries, Inc.; HA 19-Z Insulation Hanger Adhesive.
 - b. Boss Products; 180 Multi Seal Insulation Anchor Adhesive.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

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- 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.

3.02 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
 - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions.
 - 2. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
 - 3. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
 - 4. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
 - 5. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.
- C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.03 INSTALLATION OF EXTERIOR CONTINUOUS INSULATION

- A. Mineral-Wool Board Insulation: Install insulation fasteners 4 inches from each corner of board insulation, at center of board, and as recommended by manufacturer.
 - 1. Fit courses of insulation between obstructions, with edges butted tightly in both directions, and with faces flush.
 - 2. Press units firmly against inside substrates.

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3.04 INSTALLATION OF INTERIOR CONTINUOUS INSULATION

A. Retain this article if masonry insulation is required and is not specified in Division 04 Section "Unit Masonry."

- A. Foam-Plastic Board Insulation: Adhesively bond insulation boards directly to the wall to temporarily secure it until furring is attached, as recommended by manufacturer.
1. Fit courses of insulation between obstructions, with edges butted tightly in both directions, and with faces flush.
 2. Press units firmly against substrates until adhesive has cured.
 3. Fill gaps greater than 1/8 inch between boards and adjacent construction with closed-cell polyurethane foam sealant.
 4. Seal joints between board insulation and adjacent construction with board insulation facing tape to form a continuous air barrier preventing interior air from infiltrating the insulation board.

3.05 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
1. Install blankets according to ASTM C1320.
 2. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 3. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 4. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 5. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced glass fiber blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation.
1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..

3.06 INSTALLATION MISCELLANEOUS RIGID AND SEMI-RIGID BOARD INSULATION

- A. Install insulation on substrates by adhesively attached, spindle-type insulation anchors as follows:

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1. Fasten insulation anchors to substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for substrate type, insulation type, thickness, and application indicated.
2. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
3. Where insulation will be exposed to view or human contact, apply dome caps to tips of spindles.
4. Seal joints between board insulation and adjacent construction with board insulation facing tape to form a continuous air barrier preventing interior air from infiltrating the insulation board.

END OF SECTION

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SECTION 07 25 00 - WEATHER BARRIERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fluid-applied weather barriers.
- B. Related Sections:
 - 1. 076500 - Flexible Flashing: For flexible flashings not part of weather barrier assemblies.

1.02 DEFINITIONS

- A. Weather Barrier: Material within the exterior envelope assembly that performs as a water-resistive and air barrier, primarily to mitigate the consequences of bulk water intrusion through cladding systems and air movement through assemblies.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For weather barrier assemblies.
 - 1. Show locations and extent of weather barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1.04 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports: From manufacturer's technical personnel.
- B. Sample Warranties.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by weather barrier system manufacturer to install manufacturer's product.

1.06 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of weather barriers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General: Weather barrier shall be capable of performing as a continuous barrier to air, water, and perform as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Weather barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Weather Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E2357.
- C. Self-Adhering Flexible Flashing Performance: Self-adhering flexible flashing shall meet minimum performance requirements when tested according to AAMA 711.

2.02 FLUID-APPLIED WEATHER BARRIERS

- A. Fluid-Applied Vapor-Permeable Membrane: Silicone membrane.
 - 1. VOC Content: Complying with VOC content limits of authorities having jurisdiction.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. GE Silicones; Elemax 2600 AWB.
 - b. Dow Corning Corp.; DefendAir 200.
 - 3. Physical and Performance Properties:
 - a. Air Permeance: Maximum 0.004 cfm/ sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
 - b. Vapor Permeance: Minimum 10 perms; ASTM E 96, Procedure B Water Method.
 - c. Ultimate Elongation: Minimum 250 percent; ASTM D 412, Die C.
 - d. Combustibility: Tested in accordance with ASTM E1354, as follows:
 - 1) Peak heat release rate: Less than 150 kW/m².
 - 2) Total heat release rate: Less than 20 MJ/m².
 - 3) Effective heat of combustion: Less than 18 MJ/kg allowable.
 - e. Flame Spread and Smoke Developed: Tested in accordance with ASTM E84, as follows:
 - 1) Flame spread index: Less than 25.
 - 2) Smoke-developed index: Less than 450.

2.03 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by weather barrier manufacturer to produce a complete weather barrier assembly and compatible with weather barrier membrane.

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PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

3.02 SURFACE PREPARATION

- A. Mask off adjoining surfaces not covered by weather barrier to prevent spillage and overspray affecting other construction.
- B. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- C. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- D. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

3.03 FLUID-APPLIED WEATHER BARRIER INSTALLATION

- A. General: Install fluid-applied membrane weather barrier and accessory materials according to weather barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous weather barrier.
- B. Apply primer to substrates when required by weather barrier manufacturer in accordance with manufacturer's instructions.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- C. Wall Openings: Prepare concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors.
 - 1. Continue weather barrier and weather barrier flashing into wall openings and tie to interior air barrier seals for air barrier continuity.
- D. Seal top of through-wall flashings to weather barrier.
- E. Fluid-Applied Membrane Material: Apply a continuous unbroken weather barrier membrane to substrates with total dry film thickness as recommended in writing by manufacturer to meet performance requirements, applied in one or more equal coats. Apply weather barrier membrane in full contact around protrusions such as masonry ties.

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- F. Do not cover weather barrier until it has been inspected by manufacturer's technical personnel.
- G. Correct deficiencies in or remove weather barrier that does not comply with requirements; repair substrates and reapply weather barrier components.

3.04 FIELD QUALITY CONTROL

- A. Inspections: Arrange for weather barrier system manufacturer's technical personnel to inspect weather barrier installation on completion.
- B. Repair or remove and replace components of weather barrier system where inspections indicate that they do not comply with specified requirements.

3.05 CLEANING AND PROTECTION

- A. Protect weather barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
 - 1. Protect weather barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace weather barrier exposed for more than days allowed by manufacturer.
 - 2. Protect weather barrier from contact with incompatible materials and sealants not approved by weather barrier manufacturer.
- B. Remove masking materials after installation.

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SECTION 07 26 00 - VAPOR RETARDERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Underslab vapor retarders.
 - 2. Above grade vapor retarders.
- B. Related Sections:
 - 1. Division 31 Section "Earth Moving" for drainage fill and subbase under slabs-on-grade.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.03 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.01 UNDERSLAB 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, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fortifiber Building Systems Group; Moistop Ultra.
 - b. Insulation Solutions, Inc.; Viper VaporCheck.
 - c. Meadows, W. R., Inc.; Perminator.
 - d. Raven Industries Inc.; Vapor Block.
 - e. Stego Industries, LLC; Stego Wrap.

2.02 ABOVE GRADE VAPOR RETARDERS

- A. Polyamide Vapor Retarders: Formed by blowing a 2-mil thick film of polyamide nylon, with maximum permeance rating of 1.0 perm in accordance with ASTM E 96 and with flame-spread and smoke-developed indexes of not more than 20 and 55, respectively, per ASTM E 84.
 - 1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:

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- a. Certainteed; MemBrain.

2.03 ACCESSORIES

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.
- C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.02 INSTALLATION OF VAPOR RETARDERS OVER FRAMING

- A. Place vapor retarders on side of construction indicated on Drawings.
- B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.
- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.03 INSTALLATION OF UNDERSLAB VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.

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3.04 PROTECTION

- A. Protect vapor retarders from damage until concealed by permanent construction.

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SECTION 07 31 13 - ASPHALT SHINGLES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Glass-fiber-reinforced asphalt shingles.
 - 2. Composite nail base insulated roof sheathing.
 - 3. Underlayment materials.
 - 4. Ridge vents.
 - 5. Metal flashing and trim.

1.02 DEFINITIONS

- A. Roofing Terminology: See ASTM D1079 for definitions of terms related to roofing Work in this Section.

1.03 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Asphalt shingles.
 - 2. Underlayment materials.
 - 3. Ridge vents.
 - 4. Asphalt roofing cement.
 - 5. Elastomeric flashing sealant.
- B. Shop Drawings: For metal flashing and trim.
- C. Samples: For each exposed product and for each color and blend specified, in sizes indicated.
 - 1. Asphalt Shingles: Full size.
 - 2. Ridge and Hip Cap Shingles: Full size.
 - 3. Ridge Vent: 12-inch- long Sample.
 - 4. Exposed Valley Lining: 12 inches square.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each type of asphalt shingle and underlayment product indicated, for tests performed by a qualified testing agency.
- C. Sample Warranty: For manufacturer's materials warranty.

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1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For asphalt shingles to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized installer who is trained and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store roofing materials in a dry, well-ventilated location protected from weather, sunlight, and moisture in accordance with manufacturer's written instructions.
- B. Store underlayment rolls on end, on pallets or other raised surfaces. Do not double-stack rolls.
- C. Protect unused roofing materials from weather, sunlight, and moisture when left overnight or when roofing Work is not in progress.
- D. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.

1.08 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with installation only when existing and forecasted weather conditions permit product installation and related Work to be performed in accordance with manufacturer's written instructions and warranty requirements.
 - 1. Install self-adhering, polymer-modified bitumen sheet underlayment within the range of ambient and substrate temperatures recommended in writing by manufacturer.

1.09 WARRANTY

- A. Materials Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Manufacturing defects.
 - 2. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds for 15 years from date of Substantial Completion.
 - 3. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for 25 years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.01 SOURCE LIMITATIONS

- A. Obtain each type of product from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance in accordance with ASTM E108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
- B. Wind Resistance: Provide asphalt shingles that comply with requirements of ASTM D3161/D3161M, Class F, and with ASTM D7158/D7158M, Class H.
- C. Solar Reflectance Index: Not less than [23] [16] when calculated according to ASTM E1980, based on testing identical products by a qualified testing agency.

2.03 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

- A. Laminated-Strip Asphalt Shingles: ASTM D3462/D3462M, laminated, multi-ply overlay construction; glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide GAF; Timberline HDZ Shingles, or comparable product by one of the following:
 - a. Atlas Molded Products, a division of Atlas Roofing Corporation.
 - b. Building Products of Canada Corp.
 - c. CertainTeed; SAINT-GOBAIN.
 - d. IKO Industries Inc.
 - e. Malarkey Roofing Products.
 - f. Owens Corning.
 - g. PABCO Roofing Products.
 - h. Tamko Building Products LLC.
 - 2. Strip Size: Manufacturer's standard.
 - 3. Algae Resistance: Granules resist algae discoloration.
 - 4. Color and Blends: As selected by Architect from manufacturer's full range.
- B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

2.04 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING

- A. Vented, Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: ASTM C1289, Type II, Class 1, with DOC PS 2, Exposure 1 oriented strand board adhered to spacers on one face.

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1. Basis-of-Design Product: Subject to compliance with requirements, provide GAF Thermacal 1 or a comparable product by one of the following:
 - a. Atlas Molded Products, a division of Atlas Roofing Corporation.
 - b. Hunter Panels; a Carlisle company.
 - c. Johns Manville; a Berkshire Hathaway company.
 - d. Rmax, Inc.
 - e. The Dow Chemical Company.
2. Polyisocyanurate-Foam Thickness: 4 inches.
3. Oriented-Strand-Board Nominal Thickness: 7/16 inch.

2.05 UNDERLAYMENT MATERIALS

- A. Self-Adhering, Polymer-Modified Bitumen Sheet: ASTM D1970/D1970M, minimum 40-mil- thick sheet; glass-fiber-mat-reinforced, polymer-modified asphalt; with slip-resistant top surface and release backing; cold applied.

2.06 RIDGE VENTS

- A. Rigid Ridge Vent: Manufacturer's standard, rigid-section, high-density, UV-stabilized plastic ridge vent for use under ridge shingles.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Air Vent, Inc.; Gibraltar Industries, Inc.
 - b. Benjamin Obdyke Incorporated.
 - c. CertainTeed; SAINT-GOBAIN.
 - d. Cor-A-Vent, Inc.
 - e. GAF.
 - f. Lomanco, Inc.
 - g. Owens Corning.
 - h. Tamko Building Products LLC.
 - i. Tapco International Corporation; Mid-America Components.

2.07 ACCESSORIES

- A. Asphalt Roofing Cement: ASTM D4586/D4586M Type II, asbestos free.
- B. Elastomeric Flashing Sealant: ASTM C920, Type S, Grade NS, one-part, non-sag, elastomeric polymer sealant; of class and use classifications required to seal joints and remain watertight; recommended in writing by manufacturer for installation of flashing systems.
- C. Roofing Nails: ASTM F1667, aluminum, stainless steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- diameter, sharp-pointed, with a 3/8- to 7/16-inch- diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking or extend at least 1/8 inch through sheathing less than 3/4 inch thick.

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1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.
 - D. Screws for Fastening Composite Nail Base Insulated Roof Sheathing:
 1. Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.
 - E. Underlayment Nails: Aluminum, stainless steel, or hot-dip galvanized-steel wire nails with low-profile metal or plastic caps, 1-inch- minimum diameter.
 1. Provide with minimum 0.0134-inch- thick metal cap, 0.010-inch- thick power-driven metal cap, or 0.035-inch- thick plastic cap; and with minimum 0.083-inch- thick ring shank or 0.091-inch- thick smooth shank of length to penetrate at least 3/4 inch into roof sheathing or to penetrate through roof sheathing less than 3/4 inch thick.
- 2.08 METAL FLASHING AND TRIM
- A. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."
 - B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item unless otherwise specified in this Section or indicated on Drawings.
 1. Step Flashings: Fabricate with a headlap of 2 inches and a minimum extension of 4 inches over the underlying asphalt shingle and up the vertical surface.
 2. Cricket and Backer Flashings: Fabricate with concealed flange extending a minimum of 18 inches beneath upslope asphalt shingles and 6 inches above the roof plane.
 3. Counterflashings: Fabricate to cover 4 inches of base flashing measured vertically; and in lengths required so that no step exceeds 8 inches and overall length is no more than 10 feet.
 - a. Provide metal receivers for installation.
 4. Open-Valley Flashings: Fabricate from metal sheet not less than 24 inches wide in lengths not exceeding 10 feet, with 1-inch- high, inverted-V profile water diverter at center of valley and equal flange widths of not less than 11 inches.
 - a. Hem flange edges for fastening with metal cleats.
 - b. Add stiffening ribs in flashings to promote drainage.
 5. Drip Edges: Fabricate in lengths not exceeding 10 feet with minimum 2-inch roof-deck flange and 1-1/2-inch fascia flange with 3/8-inch drip at lower edge.
 6. Vent-Pipe Flashings: ASTM B749, Type L51121, at least 1/16 inch thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least 4 inches from pipe onto roof.

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PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored and that provisions have been made for flashings and penetrations through asphalt shingles.
 - 3. Verify that vent stacks and other penetrations through roofing are installed and securely fastened.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF INSULATED ROOF SHEATHING

- A. Install insulated roof sheathing panels in accordance with manufacturer's instructions.

3.03 INSTALLATION OF UNDERLAYMENT MATERIALS

- A. Comply with asphalt shingle and underlayment manufacturers' written installation instructions and with recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems" applicable to products and applications indicated unless more stringent requirements are specified in this Section or indicated on Drawings.
- B. Self-Adhering, Polymer-Modified Bitumen Sheet: Install, wrinkle free, on roof deck.
 - 1. Comply with low-temperature installation restrictions of underlayment manufacturer.
 - 2. Install lapped in direction that sheds water.
 - a. Lap sides not less than 4 inches.
 - b. Lap ends not less than 6 inches, staggered 24 inches between succeeding courses.
 - c. Roll laps with roller.
 - 3. Cover underlayment within seven days.

3.04 INSTALLATION OF METAL FLASHING AND TRIM

- A. Install metal flashings and trim to comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

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1. Install metal flashings in accordance with recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
 2. Bed flanges of metal flashings using asphalt roofing cement or elastomeric flashing sealant.
- B. Step Flashings: Install with a headlap of 2 inches and extend over underlying shingle and up the vertical face.
1. Install with lower edge of flashing just upslope of, and concealed by, butt of overlying shingle.
 2. Fasten to roof deck only.
- C. Cricket and Backer Flashings: Install against roof-penetrating elements extending concealed flange beneath upslope asphalt shingles and beyond each side.
- D. Counterflashings: Coordinate with installation of base flashing and fit tightly to base flashing. Lap joints a minimum of 4 inches secured in a waterproof manner.
1. Install in reglets or receivers.
- E. Open-Valley Flashings: Install centered in valleys, lapping ends at least [8 inches] **<Insert dimension>** in direction that sheds water. Fasten upper end of each length to roof deck beneath overlap.
1. Secure hemmed flange edges into metal cleats spaced [8 inches] [12 inches] [24 inches] **<Insert dimension>** apart and fastened to roof deck.
 2. Adhere minimum [9-inch-] **<Insert dimension>** wide strips of self-adhering, polymer-modified bitumen sheet to metal flanges and to underlying self-adhering sheet, polymer-modified bitumen sheet.
 - a. Place strips parallel to and over flanges so that they will be just concealed by installed shingles.
 3. Provide a closure at the end of the inverted-V profile of the valley metal to minimize water and ice infiltration.
- F. Rake Drip Edges: Install over underlayment materials and fasten to roof deck.
- G. Eave Drip Edges: Install below underlayment materials and fasten to roof deck.
- H. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.
- 3.05 INSTALLATION OF ASPHALT SHINGLES
- A. Install asphalt shingles in accordance with manufacturer's written instructions and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
- B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip at least 7 inches wide with self-sealing strip face up at roof edge.

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- C. Install first and remaining courses of laminated asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- D. Fasten asphalt shingle strips with a minimum of five roofing nails, but not less than the number indicated in manufacturer's written instructions for roof slope and design wind speed indicated on Drawings and for warranty requirements specified in this Section.
1. Locate fasteners in accordance with manufacturer's written instructions.
 2. Where roof slope exceeds 18:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
 3. Where roof slope is less than 4:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
 4. When ambient temperature during installation is below 50 deg F, hand seal self-sealing asphalt shingles by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
- E. Woven Valleys: Extend succeeding asphalt shingle courses from both sides of valley [12 inches] **<Insert dimension>** beyond center of valley, weaving intersecting shingle-strip courses over each other. Use one-piece shingle strips without joints in valley.
1. Do not nail asphalt shingles within 6 inches of valley center.
- F. Closed-Cut Valleys: Extend asphalt shingle strips from one side of valley [12 inches] **<Insert dimension>** beyond center of valley.
1. Use one-piece shingle strips without joints in valley.
 2. Fasten with extra nail in upper end of shingle. Install asphalt shingle courses from other side of valley and cut back to a straight line 2 inches short of valley centerline.
 3. Trim upper concealed corners of cut-back shingle strips.
 4. Do not nail asphalt shingles within 6 inches of valley center.
 5. Set trimmed, concealed-corner asphalt shingles in a 3-inch- wide bed of asphalt roofing cement.
- G. Open Valleys: Cut and fit asphalt shingles at open valleys, trimming upper concealed corners of shingle strips.
1. **[Maintain uniform width of exposed open valley] [Widen exposed portion of open valley 1/8 inch in 12 inches]** from highest to lowest point.
 2. Extend shingle a minimum of 4 inches over valley metal.
 3. Set valley edge of asphalt shingles in a 3-inch- wide bed of asphalt roofing cement.
 4. Do not nail asphalt shingles to metal open-valley flashings.

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- H. Ridge Vents: Install continuous ridge vents over asphalt shingles in accordance with manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.
- I. Hip and Ridge Shingles: Maintain same exposure of cap shingles as roofing-shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds.
 - 1. Fasten with roofing nails of sufficient length to penetrate sheathing.
 - 2. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

END OF SECTION

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SECTION 07 41 13.16 - STANDING-SEAM METAL ROOFING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Standing-seam metal roofing system including the following:
 - 1. Formed metal roofing panels.
 - 2. Underlayment.
 - 3. Roof insulation.
 - 4. Air barrier / vapor retarder.
 - 5. Substrate board.

1.02 DEFINITIONS

- A. Metal Roofing System: Metal roof panels, attachment system components, underlayment, **[thermal insulation]** and accessories necessary for a complete weathertight roofing system.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, insulation, and accessories; and special details and the following:
 - 1. Thickness of insulation.
 - 2. Underlayment terminations.
 - 3. Tie-in with adjoining air barrier.
- C. Samples: For each type of metal panel indicated.

1.04 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for roofing indicating compliance with solar reflectance requirements.
- B. Product test reports.
- C. Warranties: Sample of special warranties.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance data.

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1.06 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Solar Reflectance Index: Not less than [75] [23] [16] when calculated according to ASTM E1980, based on testing identical products by a qualified testing agency.
- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- C. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

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2.02 STANDING-SEAM METAL ROOF PANELS

- A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
 - 1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.
 - 2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1637.
- B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. SWL Standing Seam; Morin - A Kingspan Group Company.
 - 2. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: 0.032 inch.
 - b. Surface: Smooth, flat finish.
 - c. Exterior Finish: Two-coat fluoropolymer .
 - d. Color: As selected by Architect from manufacturer's full range.
 - 3. Clips: One-piece fixed to accommodate thermal movement.
 - 4. Panel Coverage: 12 inches.
 - 5. Panel Height: 1.75 inches.

2.03 AIR BARRIER / VAPOR RETARDER

- A. Self-Adhering-Sheet Air Barrier / Vapor Retarder: ASTM D 1970, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 30-mil-total thickness; cold applied, with slip-resisting surface compatible with adhered insulation and release paper backing. Provide primer when recommended by manufacturer.
 - 1. Mastic: Type recommended by manufacturer for sealing penetrations and terminations in air barrier / vapor retarder.

2.04 FIELD-INSTALLED METAL ROOFING INSULATION

- A. Dual-Density Polyisocyanurate Composite Board: ASTM C 1289, with maximum flame-spread and smoke-developed indexes of 75 and 500, respectively, based on tests performed on unfaced core, and as follows:
 - 1. High Density Layer: Type II, Class 4 inorganic coated glass facers, Grade 1.
 - 2. Normal Density Layer: Type II, Class 2 inorganic coated glass facers.

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3. Basis-of-Design Product: Subject to compliance with requirements, provide the following product, or a comparable product upon Architect's approval:
 - a. Johns Manville; Invisa Foam.

2.05 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 milsthick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Titanium PSU30; Owens Corning.
 - b. Blueskin PE200HT; Henry.
 - c. Grace Ultra; GCP Applied Technologies.
 - d. Jiffy Seal Ice and Water Guard HT; Protecto Wrap Company.
 2. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
 3. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.
- B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.06 SUBSTRATE BOARDS

- A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M; Type X, 5/8 inch.
- B. Substrate-Board Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FMG 4470, designed for fastening substrate board to substrate.

2.07 MISCELLANEOUS MATERIALS

- A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Pressure Plates: Provide metal pressure plates beneath clips, fabricated from material recommended by manufacturer.
 4. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

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- B. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- C. Gutters and Downspouts: Formed from same material as roof panels according to SMACNA's "Architectural Sheet Metal Manual." Finish to match metal roof panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
 - 2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.08 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.09 FINISHES

- A. Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat.
 - 2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

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PART 3 - EXECUTION

3.01 PREPARATION

- A. Substrate Board: Install substrate boards over roof deck on entire roof surface. Attach with substrate-board fasteners.
 - 1. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 - 2. Comply with UL requirements for fire-rated construction.

3.02 AIR BARRIER / VAPOR RETARDER INSTALLATION

- A. Air Barrier / Vapor Retarder: Install over substrate board. Extend air barrier / vapor retarder to cover entire roof. Tie into building air barrier at transitions from roofing to adjacent construction. Repair tears or punctures immediately before concealment by other work.

3.03 ROOFING INSULATION INSTALLATION

- A. Board Insulation: Place insulation in thickness indicated to cover entire roof.
- B. Install roof panel clips and pressure plates over insulation in accordance with manufacturer's instructions.

3.04 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply over the entire roof surface.
- B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels if required by manufacturer.
- C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07 62 00 "Sheet Metal Flashing and Trim."

3.05 INSTALLATION OF STANDING SEAM METAL ROOF PANELS

- A. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

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1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.

B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.06 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Touch up minor scratches and abrasions in finishes in accordance with finish manufacturer's instructions.

END OF SECTION

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SECTION 07 42 13.16 - METAL PLATE WALL PANELS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Metal plate wall panel assemblies.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 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. Review methods and procedures related to metal plate wall panel installation, including manufacturer's written instructions.
 - 3. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 4. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal plate wall panels.
 - 5. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 6. Review temporary protection requirements for metal plate wall panel assembly during and after installation.
 - 7. Review procedures for repair of panels damaged after installation.
 - 8. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

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- B. Delegated-Design Submittal: For metal plate wall panel assemblies, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal plate wall panels to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by Fabricator.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for metal plate system fabrication and installation.
 - 1. Build mockup of typical panel assembly , including corner, supports, attachments, and accessories.
 - 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.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.08 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

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1.09 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Fabricator's standard form in which fabricator agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design metal plate wall panel assemblies.
- B. Structural Performance: Provide metal plate wall panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E330:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Deflection Limits: For wind loads, no greater than 1/180 of the perimeter framing member span and L/60 center of panel.
- C. Seismic Performance: metal plate wall panel system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- D. Thermal Movements: Include expansion and contraction points as needed to allow for free and noiseless thermal movements from surface temperature changes.
 - 1. Temperature Change (Range): minus 20 deg F to 175 deg F, material surfaces.

2.02 METAL PLATE WALL PANELS

- A. Owner-Furnished Material: Weathering steel metal plate wall panels.
- B. Metal Plate Wall Panel Systems: Provide metal plate wall panel systems fabricated from factory-formed components designed to accept Owner-furnished metal plate panels. Include attachment assembly components , panel stiffeners, and accessories required for weathertight system.

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1. Basis-of-Design System: Subject to compliance with requirements, provide NorthClad EF Exposed Fastener Panel System or comparable system by one of the following:
 - a. American Metalcraft, Inc.
 - b. Dri-Design.
 - c. Keith Panel Systems.
 - d. Protean.
 - e. Sobotec.

C. Wall Panel Attachment Components: Formed from extruded aluminum.

2.03 MISCELLANEOUS MATERIALS

- A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal plate wall panels unless otherwise indicated.
- B. Flashing and Trim: Provide flashing and trim formed from same material as metal plate wall panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal plate wall panels.
- C. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal plate wall panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

2.04 FABRICATION

- A. General: Fabricate and finish metal plate wall panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal plate wall panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations or recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

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2. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.05 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal plate wall panel supports, and other conditions affecting performance of the Work.
 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal plate wall panel manufacturer.
 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal plate wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and assemblies penetrating metal plate wall panels to verify actual locations of penetrations relative to seam locations of metal plate wall panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and metal plate wall panel manufacturer's written recommendations.

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3.03 METAL PLATE WALL PANEL SYSTEM INSTALLATION

- A. General: Install metal plate wall panel system according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal plate wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal plate wall panels.
 - 2. Flash and seal metal plate wall panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal plate wall panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal plate wall panel work proceeds.
 - 6. Align bottoms of metal plate wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
- B. Fasteners:
 - 1. Use stainless steel fasteners.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal plate wall panel manufacturer.
- D. Attachment Assembly, General: Install attachment assembly required to support metal plate wall panels and to provide a complete weathertight wall system, including extrusions, tracks, drainage channels, panel clips, and anchor channels.
 - 1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
- E. Panel Installation: Attach metal plate wall panels to supports at locations, spacings, and with fasteners recommended by Fabricator to achieve performance requirements specified.
 - 1. Install using Fabricator's standard assembly with vertical channel that provides support, draining at base of wall. Install vertical channels at locations, spacings, and with fasteners recommended by Fabricator. Attach metal plate wall panels with exposed, gasketed fasteners.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

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1. Install components required for a complete metal plate wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal plate wall panel Fabricator; or, if not indicated, provide types recommended in writing by system Fabricator.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, or SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.04 ERECTION TOLERANCES

- A. Site Verifications of Conditions:
1. Verify conditions of substrate previously installed under other Sections are acceptable for the metal plate wall system installation. Provide documentation indicating detrimental conditions to the metal plate wall system performance.
 2. Once conditions are verified, metal plate wall system installation tolerances are as follows:
 - a. Shim and align metal plate wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.05 FIELD QUALITY CONTROL

- A. Fabricator's Field Service: Engage a factory-authorized service representative to inspect completed metal plate wall panel installation, including accessories.
- B. Metal plate wall panels will be considered defective if they do not pass test and inspections.
- C. Additional inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare inspection reports.

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METAL PLATE WALL PANELS
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3.06 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal plate wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal plate wall panel installation, clean finished surfaces as recommended by metal plate wall panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal plate wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 07 46 46 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes fiber-cement siding.

1.02 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For fiber-cement siding including related accessories.
- C. Sample warranty.
- D. Maintenance data.

1.03 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 FIBER-CEMENT SIDING

- A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide James Hardie Building Products, Inc.; Hardie Panel, or comparable product by one of the following:
 - a. James Hardie Building Products, Inc.
 - b. Nichiha Fiber Cement.
- B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.
- C. Nominal Thickness: Not less than 5/16 inch.
- D. Panel Texture: 48-inch- wide sheets with smooth texture.
- E. Factory Priming: Manufacturer's standard acrylic primer.

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FIBER-CEMENT SIDING
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2.02 ACCESSORIES

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
- B. Flashing: Provide aluminum flashing complying with Section 07 62 00 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
 - 1. Finish for Aluminum Flashing: High-performance organic finish.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
 - 1. Install fasteners no more than 24 inches o.c.
- B. Install joint sealants as specified in Section 07 92 00 "Joint Sealants" and to produce a weathertight installation.

3.02 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION

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SECTION 07 54 19 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Polyvinyl-chloride roofing membrane assembly including the following:
 - 1. Adhered polyvinyl chloride (PVC) roofing system.
 - 2. Substrate board.
 - 3. Air barrier / vapor retarder.
 - 4. Roof insulation.
 - 5. Cover board.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
 - 2. Division 22 Sections for roof drains.

1.02 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
 - 1. Layout and thickness of insulation.
 - 2. Flashings and membrane termination details.
 - 3. Flashing details at penetrations.
 - 4. Tapered insulation layout, thickness, and slopes.
 - 5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
 - 6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
 - 7. Tie-in with adjoining air barrier.
- C. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

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1.04 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for adhesives and sealants, indicating VOC content.
- B. Manufacturer Certificates:
 - 1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of compliance with performance requirements.
 - 2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- C. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.
- D. Field quality-control reports.
- E. Sample Warranties: For manufacturer's special warranties.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing 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 and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

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- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.08 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.09 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, air barrier / vapor retarder, substrate board, and other components of roofing system.
 - 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, air barriers / vapor retarders, and, for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Adhesives:
 - a. VOC content limits for field applications.
 - 2. Sealants:
 - a. VOC content limits for field applications.

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2.02 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.
 - 1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
 - 2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:
 - 1. Zone 1' (Center Roof Area Field): **[insert value]** lbf/sq. ft.
 - 2. Zone 1 (Roof Area Field): **[insert value]** lbf/sq. ft.
 - 3. Zone 2 (Roof Area Perimeter): **[insert value]** lbf/sq. ft.
 - a. Location: From roof edge to 0.6h inside roof edge.
 - 4. Zone 3 (Roof Area Corners): **[insert value]** lbf/sq. ft.
 - a. Location: 0.2h deep by 0.6h long in each direction from building corner.
- D. Solar Reflectance Index: Not less than 75 when calculated according to ASTM E1980, based on testing identical products by a qualified testing agency.
- E. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.03 POLYVINYL CHLORIDE (PVC) ROOFING

- A. PVC Sheet: ASTM D4434/D4434M, Type II, glass-fiber reinforced, felt backed.
 - 1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide Sika Sarnafil G410 Feltback or comparable product by approved manufacturer.
 - 3. Thickness: 80 mils.
 - 4. Exposed Face Color: White.

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- B. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

2.04 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 - 1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard unreinforced PVC sheet flashing, 55 mils thick, minimum, of same color as PVC sheet.
- C. PVC-Coated Metal Sheet Flashing: Manufacturer's standard PVC-coated, heat-weldable sheet metal flashing, 0.0239-inch thick minimum, with 20 mils thick PVC coating of same color as PVC sheet laminated to one side.
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
- D. Liquid-Applied Flashing: Manufacturer's standard reinforced flashing, 80 mils thick, minimum.
- E. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- F. Bonding Adhesive: Manufacturer's standard.
- G. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
- I. Miscellaneous Accessories: Provide preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.05 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M, fiber-reinforced gypsum board, as recommended by roofing membrane manufacturer.
 - 1. Thickness: Type X, 5/8 inchthick.

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- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.06 AIR BARRIER / VAPOR RETARDER

- A. Sheet Air Barrier / Vapor Retarder: Manufacturer's recommended SBS-modified bitumen sheet product, minimum 30-mil-total thickness; self-adhering, cold adhesive applied, or torch applied, with slip-resisting surface compatible with adhered insulation and release paper backing. Provide primer when recommended by manufacturer.
 - 1. Mastic: Type recommended by manufacturer for sealing penetrations and terminations in air barrier / vapor retarder.

2.07 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by PVC roof membrane manufacturer.
- B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. Compressive Strength: 20 psi minimum.
- C. Tapered Insulation: Provide factory-tapered insulation boards.
 - 1. Material: Match roof insulation.
 - 2. Minimum Thickness: 1/4 inch.
 - 3. Slope:
 - a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
 - b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.08 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.

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- D. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.
1. Thickness: 1/4 inch.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 31 00 "Steel Decking."
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.03 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.
- C. Coordinate installation and transition of roofing system component serving as an air barrier with adjacent air barrier material and assemblies.

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3.04 INSTALLATION OF SUBSTRATE BOARD

- A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows.
 - 1. At steel roof decks, install substrate board at right angle to flutes of deck.
 - a. Locate end joints over crests of steel roof deck.
 - 2. Tightly butt substrate boards together.
 - 3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - 4. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.05 INSTALLATION OF AIR BARRIER / VAPOR RETARDER

- A. Self-Adhering-Sheet: Prime substrate if required by manufacturer. Install sheet over area to receive air barrier / vapor retarder, side and end lapping each sheet a minimum of 3-1/2 and 6 inches, respectively.
 - 1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
 - 2. Seal laps by rolling.
 - 3. Tie to adjacent air barrier materials and assemblies.
- B. Completely seal air barrier / vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.06 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Metal Decking:
 - 1. Install base layer of insulation with end joints staggered not less than 12 inches in adjacent rows.
 - a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch in width.

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- d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
 - 1) Trim insulation so that water flow is unrestricted.
 - e. Fill gaps exceeding 1/4 inch with insulation.
 - f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - g. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
 - 1) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
- a. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
 - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
 - 1) Trim insulation so that water flow is unrestricted.
 - e. Fill gaps exceeding 1/4 inch with insulation.
 - f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - g. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - 1) Set each layer of insulation in insulation adhesive, firmly pressing and maintaining insulation in place.

3.07 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.
 - 1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - 2. At internal roof drains, conform to slope of drain sump.
 - a. Trim cover board so that water flow is unrestricted.
 - 3. Cut and fit cover board tight to nailers, projections, and penetrations.
 - 4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

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- a. Set cover board in insulation adhesive, firmly pressing and maintaining insulation in place.

3.08 INSTALLATION OF ADHERED ROOF MEMBRANE

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- F. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.
- G. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.
- H. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- I. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.09 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

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- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.10 INSTALLATION OF PVC-COATED SHEET METAL FLASHING

- A. Install preformed PVC-coated sheet metal flashings and flashing accessories and attach to substrates according to roofing system manufacturer's written instructions.
- B. Clean seam areas, overlap membrane onto flashing and hot-air weld to ensure a watertight installation.

3.11 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
- B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.12 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

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- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

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SECTION 07 60 00 - FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Manufactured Products:
 - a. Manufactured reglets[**and counterflashing**].
 - 2. Formed Products:
 - a. Formed sheet metal fabrications.
 - 3. Liquid-applied flashing.
- B. Related Sections:
 - 1. Section 07 65 00 "Flexible Flashing" for flexible flashing membranes.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation layouts of flashing and sheet metal, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 - 1. Include details for forming, joining, supporting, and securing flashing and sheet metal, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work.
 - 2. Include identification of material, thickness, weight, and finish for each item.
- C. Samples: For each exposed product and for each finish specified.

1.03 INFORMATIONAL SUBMITTALS

- A. Maintenance data.

1.04 QUALITY ASSURANCE

- A. Flashing and Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

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PART 2 - PRODUCTS

2.01 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
 - 1. As-Milled Finish: One-side bright mill finish.
 - 2. Factory Prime Coating: Where painting after installation is indicated, pretreat with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of 0.2 mil.
 - 3. Exposed Coil-Coated Finishes: Fluoropolymer.
 - a. Color: As indicated by manufacturer's designations.
 - 4. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
 - 5. Color Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - a. Color: **[Champagne] [Light bronze] [Medium bronze] [Dark bronze] [Black] <Insert color>**.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; **[2B (bright, cold rolled)]** finish.
- D. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
 - 2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; structural quality.
 - 3. Exposed Finish: Fluoropolymer.
 - a. Color: As indicated by manufacturer's designations.

2.02 MISCELLANEOUS MATERIALS

- 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 **[or manufactured item]** unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal **[or manufactured item]**.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

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- a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
 4. Fasteners for Metallic-Coated Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.
- C. Solder:
1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
 2. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in flashing and sheet metal and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.03 REGLETS

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated **[with factory-mitered and -welded corners and junctions] [with interlocking counterflashing on exterior face, of same metal as reglet]**.
1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:

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- a. Cheney Flashing Company.
 - b. Fry Reglet Corporation.
 - c. Heckmann Building Products Inc.
 - d. Hickman, W. P. Company.
 - e. Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
 - f. Keystone Flashing Company, Inc.
 - g. National Sheet Metal Systems, Inc.
 - h. Sandell Manufacturing Company, Inc.
3. Material: [**Stainless steel**, 0.019 inch **thick**] [**Copper**, 16 oz./sq. ft.] [**Aluminum**, 0.024 inch **thick**] [**Galvanized steel**, 0.022 inch **thick**].
 4. Finish: [**Mill**] [**With manufacturer's standard color coating**] <Insert finish>.

2.04 FABRICATION, GENERAL

- A. General: Custom fabricate flashing and sheet metal to comply with recommendations in SMACNA's "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. Tin edges to be seamed, form seams, and solder.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

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2.05 SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers,[**gutter bead reinforcing bars,**] and gutter accessories from same metal as gutters.
1. Expansion Joints: [**Lap type**] [**Butt type**] [**Butt type with cover plate**] [**Built in**].
 2. Accessories: [**Continuous removable leaf screen with sheet metal frame and hardware cloth screen**] [**Wire ball downspout strainer**] [**Valley baffles**].
 3. Gutters with Girth up to 15 Inches: Fabricate from the following materials:
 - a. Copper: [16 oz./sq. ft.] <Insert weight>.
 - b. Aluminum: [0.032 inch] <Insert thickness> thick.
 - c. Stainless Steel: [0.016 inch] <Insert thickness> thick.
 - d. Zinc-Tin Alloy-Coated Stainless Steel: [0.015 inch] <Insert thickness> thick.
 - e. Galvanized Steel: [0.022 inch] <Insert thickness> thick.
 - f. Aluminum-Zinc Alloy-Coated Steel: [0.022 inch] <Insert thickness> thick.
 4. Gutters with Girth 16 to 20 Inches: Fabricate from the following materials:
 - a. Copper: [16 oz./sq. ft.] <Insert weight>.
 - b. Aluminum: [0.040 inch] <Insert thickness> thick.
 - c. Stainless Steel: [0.019 inch] <Insert thickness> thick.
 - d. Zinc-Tin Alloy-Coated Stainless Steel: [0.018 inch] <Insert thickness> thick.
 - e. Galvanized Steel: [0.028 inch] <Insert thickness> thick.
 - f. Aluminum-Zinc Alloy-Coated Steel: [0.028 inch] <Insert thickness> thick.
 5. Gutters with Girth 21 to 25 Inches: Fabricate from the following materials:
 - a. Copper: [20 oz./sq. ft.] <Insert weight>.
 - b. Aluminum: [0.050 inch] <Insert thickness> thick.
 - c. Stainless Steel: [0.025 inch] <Insert thickness> thick.
 - d. Zinc-Tin Alloy-Coated Stainless Steel: [0.024 inch] <Insert thickness> thick.
 - e. Galvanized Steel: [0.034 inch] <Insert thickness> thick.
 - f. Aluminum-Zinc Alloy-Coated Steel: [0.034 inch] <Insert thickness> thick.
 6. Gutters with Girth 26 to 30 Inches: Fabricate from the following materials:
 - a. Copper: [24 oz./sq. ft.] <Insert weight>.
 - b. Aluminum: [0.063 inch] <Insert thickness> thick.
 - c. Stainless Steel: [0.031 inch] <Insert thickness> thick.
 - d. Galvanized Steel: [0.040 inch] <Insert thickness> thick.
 - e. Aluminum-Zinc Alloy-Coated Steel: [0.040 inch] <Insert thickness> thick.
 7. Gutters with Girth 31 to 35 Inches: Fabricate from the following materials:
 - a. Copper: [24 oz./sq. ft.] <Insert weight>.
 - b. Stainless Steel: [0.038 inch] <Insert thickness> thick.
 - c. Galvanized Steel: [0.052 inch] <Insert thickness> thick.

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- d. Aluminum-Zinc Alloy-Coated Steel: [0.052 inch] **<Insert thickness>** thick.
- B. Downspouts: Fabricate **[round] [rectangular] [open-face]** downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Fabricated Hanger Style: SMACNA figure designation **[1-35A] [1-35B] [1-35C] [1-35D] [1-35E] [1-35F] [1-35G] [1-35H] [1-35I] [1-35J]**.
 2. Manufactured Hanger Style: SMACNA figure designation **[1-34A] [1-34B] [1-34C] [1-34D] [1-34E]**.
 3. Hanger Style: **<Insert description>**.
 4. Fabricate from the following materials:
 - a. Copper: [16 oz./sq. ft.] **<Insert weight>**.
 - b. Aluminum: [0.024 inch] **<Insert thickness>** thick.
 - c. Stainless Steel: [0.016 inch] **<Insert thickness>** thick.
 - d. Galvanized Steel: [0.022 inch] **<Insert thickness>** thick.
 - e. Aluminum-Zinc Alloy-Coated Steel: [0.022 inch] **<Insert thickness>** thick.
 - f. Zinc-Tin Alloy-Coated Stainless Steel: [0.015 inch] **<Insert thickness>** thick.
- C. Copings: Fabricate in minimum 96-inch- long, but not exceeding 10-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and **[drill elongated holes for fasteners on]** interior leg. Miter corners, seal, and solder or weld watertight. Fabricate from the following materials:
1. Joint Style: **[Butt, with 12-inch- wide, concealed backup plate] [Butt, with 6-inch- wide, exposed cover plates] [Butt, with 12-inch- wide, concealed backup plate and 6-inch- wide, exposed cover plates]**.
 2. Fabricate from the following material:
 - a. Copper: [24 oz./sq. ft.] **<Insert weight>**.
 - b. Aluminum: [0.050 inch] **<Insert thickness>** thick.
 - c. Stainless Steel: [0.025 inch] **<Insert thickness>** thick.
 - d. Galvanized Steel: [0.040 inch] **<Insert thickness>** thick.
 - e. Aluminum-Zinc Alloy-Coated Steel: [0.040 inch] **<Insert thickness>** thick.
 - f. Zinc-Tin Alloy-Coated Stainless Steel: [0.024 inch] **<Insert thickness>** thick.
- D. Counterflashing **[and Flashing Receivers]**: Fabricate from the following materials:
1. Copper: [16 oz./sq. ft.] **<Insert weight>**.
 2. Aluminum: [0.032 inch] **<Insert thickness>** thick.
 3. Stainless Steel: [0.019 inch] **<Insert thickness>** thick.
 4. Galvanized Steel: [0.022 inch] **<Insert thickness>** thick.
 5. Aluminum-Zinc Alloy-Coated Steel: [0.022 inch] **<Insert thickness>** thick.
 6. Zinc-Tin Alloy-Coated Stainless Steel: [0.018 inch] **<Insert thickness>** thick.

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- E. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12-foot- long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch- high, end dams where flashing is discontinuous. Fabricate from the following materials:
1. Stainless Steel: [0.016 inch] <Insert thickness> thick.
 2. Zinc-Tin Alloy-Coated Stainless Steel: [0.015 inch] <Insert thickness> thick.
- F. Opening Flashings in Frame Construction: Fabricate head, sill,[jamb,] and similar flashings to extend [4 inches] <Insert extension> beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:
1. Copper: [16 oz./sq. ft.] <Insert weight>.
 2. Aluminum: [0.032 inch] <Insert thickness> thick.
 3. Stainless Steel: [0.016 inch] <Insert thickness> thick.
 4. Galvanized Steel: [0.022 inch] <Insert thickness> thick.
 5. Aluminum-Zinc Alloy-Coated Steel: [0.022 inch] <Insert thickness> thick.
 6. Zinc-Tin Alloy-Coated Stainless Steel: [0.015 inch] <Insert thickness> thick.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. General: Anchor flashing and sheet metal and other components of the Work securely in place, with provisions for thermal and structural movement so that completed flashing and sheet metal shall not rattle, leak, or loosen, and shall remain watertight. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete flashing and sheet metal system.
1. Install flashing and sheet metal true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install flashing and sheet metal to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 4. Install exposed flashing and sheet metal without excessive oil canning, buckling, and tool marks.
 5. Install sealant tape where indicated.
 6. Torch cutting of flashing and sheet metal is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Coat back side of [uncoated aluminum] [and] [stainless-steel] flashing and sheet metal with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

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- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of [10 feet] **<Insert dimension>** with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate **[wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws] [metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance] <Insert size requirement>**.
- E. Seal joints as shown and as required for watertight construction.
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
 - 1. Do not solder **[metallic-coated steel] [and] [aluminum]** sheet.
 - 2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 - 3. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
 - 4. Copper Soldering: Tin edges of uncoated copper sheets using solder for copper.
- G. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

3.02 SHEET METAL FLASHING INSTALLATION

- A. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored **[gutter brackets] [straps] [twisted straps]** spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
 - 1. Install gutter with expansion joints at locations indicated, but not exceeding, [50 feet] **<Insert dimension>** apart. Install expansion-joint caps.
 - 2. Install continuous gutter screens on gutters with noncorrosive fasteners, **[removable] [hinged to swing open]** for cleaning gutters.
- B. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.

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- C. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.
 - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at [24-inch] [16-inch] <Insert spacing> centers.
 - 2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at [24-inch] <Insert spacing> centers.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant.
- E. Through-Wall Flashing: Installation of through-wall flashing is specified in Division 04 Section "[Unit Masonry] [Stone Masonry]."
- F. Reglets: Installation of reglets is specified in [Division 03 Section "Cast-in-Place Concrete] [Division 04 Section "Unit Masonry]."
- G. Opening Flashings in Frame Construction: Install continuous head, sill,[jamb,] and similar flashings to extend [4 inches] <Insert extension> beyond wall openings.

3.03 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as flashing and sheet metal are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION

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SECTION 07 65 00 - FLEXIBLE FLASHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Self-adhering flexible flashing.
 - 2. Extruded-silicone sheet flexible flashing.
 - 3. Liquid-applied flexible flashing.
- B. Related Sections:
 - 1. Section 07 25 00 "Weather Barriers" for flexible flashings integral to weather barrier assemblies.
 - 2. Section 07 60 00 "Flashing and Sheet Metal" for sheet metal flashing.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation layouts of flashing, including plans, elevations, expansion-joint locations, and keyed details.
 - 1. Include details for forming, joining, supporting, and securing flashing, including termination points, expansion joints, edge conditions, special conditions, and connections to adjoining work.
 - 2. Include identification of material and thickness for each item.
- C. Samples: For each exposed product and for each finish specified.

1.03 INFORMATIONAL SUBMITTALS

- A. Maintenance data.

1.04 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockups of typical exterior assemblies incorporating supporting construction, wall construction, cladding, window, glazed framing assemblies, door frames and sills, anchors, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of flexible flashings, and sealing of laps, gaps, terminations, and penetrations including, attachments, and accessories.
 - a. Coordinate construction of mockups to permit inspection and testing of flexible flashing before concealment with external components.

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- b. If Architect determines mockups do not comply with requirements, reconstruct mockups until approved.
- 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.
- 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Flexible Flashing Performance, General: Flexible flashing seals with adjacent construction shall be capable of performing as a continuous air and water barrier. Flexible flashing shall be capable of accommodating substrate movement, construction material changes, penetrations, and transitions without deterioration, water penetration under pressure differential, and air leakage exceeding specified limits.
- B. Self-Adhering Flexible Flashing Performance: Self-adhering flexible flashing shall meet minimum performance requirements when tested according to AAMA 711.

2.02 SELF-ADHERING FLEXIBLE FLASHING

- A. Self-Adhering Flexible Flashing: Cold-applied flashing tape, a minimum of 30 mils thick, consisting of a polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing, in factory cut widths.
 - 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. GCP Applied Technologies; Perm-A-Barrier Wall Flashing.
 - b. Henry; Blueskin TWF.
 - c. W.R. Meadows; Air-Shield Thru-Wall Flashing.
 - 2. Locations: Transition flashing at sheathing, metal flashings, and other locations indicated.
- B. High Temperature Self-Adhering Membrane Flashing: Cold-applied flashing tape, a minimum of 30 mils thick, consisting of a polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing, in factory cut widths.
 - 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Protecto Wrap: Sill Pan Flash Butyl.
 - b. Henry; FortiFlash Butyl Waterproof Flashing Membrane.
 - c.
 - d.
 - 2. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
 - 3. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.

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4. Locations:
 - a. Beneath metal copings.
 - b. Other locations indicated.
 - C. Foil-Faced Self-Adhering Membrane Flashing: Cold-applied flashing tape, a minimum of 30 mils thick, consisting of a glass scrim reinforced aluminum foil laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing, in factory cut widths.
 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Henry; Metal Clad.
 - b. Polyguard; Aluma-Flash.
 - c. W.R. Meadows; Air-Shield Aluminum Flashing.
 - d. Karnak; 550 Patch-N-Go.
 - e. Soprema; Soprasolin HD.
 - f. GCP
 2. Locations:
 - a. Glazed framing assemblies.
 - b. Wall penetrations and wall openings.
 - c. Other locations indicated.
 - D. Liquid Mastic: Liquid mastic recommended by flashing manufacturer.
- 2.03 EXTRUDED-SILICONE SHEET FLEXIBLE FLASHING
- A. Extruded-Silicone Sheet Flashing: Manufacturer's standard seal consisting of precured low-modulus silicone extrusion, with manufacturer's recommended neutral-curing silicone sealant for bonding extrusions to substrates.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 2. Sheet Flashing Width: [4 inches] **[Joint size indicated on Drawings]** **[plus 0.75 inch]** **[plus 1 inch]** **<Insert dimension>**.
 3. Sheet Flashing Color: **[Custom color as directed by Architect]** **[As selected by Architect from full range of industry colors]** **<Insert color>**.
 4. Locations:
 - a. Glazed framing assemblies.
 - b. Other locations indicated.
- 2.04 LIQUID-APPLIED FLEXIBLE FLASHING
- A. Multicomponent, Reinforced, Polymethyl Methacrylate (PMMA) Flashing:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Kemper System Kemperol AC Speed FR **[product indicated on Drawings]** **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:

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- a. Soprema.
 - b. Siplast.
2. Membrane-Reinforcing Fabric: Manufacturer's recommended polyester fabric reinforcement.
3. Thickness: 90 mils, minimum.
4. Primer: As recommended by manufacturer for substrates indicated.
5. Finish Coat: Manufacturer's standard finish coat of type required and recommended for application over PMMA flashing membrane.
 - a. Color: As selected by Architect from manufacturer's full range.
6. Locations:
 - a. Door sills.
 - b. Rough openings.
 - c. Transitions at waterproofing membranes.
 - d. Other locations indicated.

2.05 MISCELLANEOUS MATERIALS

- A. General: Provide materials required for complete flashing installation as recommended by manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. General: Install flashing securely in place, with provisions for thermal and structural movement so that completed flashing shall not leak and shall remain watertight.
 1. Install flashing and sheet metal true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install flashing to fit substrates and conform to geometry of area receiving flashing resulting in watertight performance.

3.02 SELF-ADHERING FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
 1. Clean, prepare, prime, and treat substrates according to manufacturer's written instructions.
 2. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
 3. Apply in a shingled manner to shed water without interception by any exposed sheet edges.
 4. Roll firmly to enhance adhesion to substrates.

3.03 EXTRUDED-SILICONE SHEET FLEXIBLE FLASHING INSTALLATION

- A. Apply extruded-silicone sheet flashing where indicated to comply with manufacturer's written instructions.

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1. Apply silicone sealant to each side of joint to produce a bead of size complying with flashing system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
2. Press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact with substrate.
3. Complete installation of seal system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

3.04 LIQUID-APPLIED FLEXIBLE FLASHING INSTALLATION

- A. Apply flashing where indicated to comply with manufacturer's written instructions.
 1. Clean, prepare, prime, and treat substrates according to manufacturer's written instructions.
 2. Mix materials and apply flashing by roller, notched squeegee, trowel, or other suitable application method.
 3. Apply first coat of liquid-applied flashing, embed membrane-reinforcing fabric, and apply second coat of liquid-applied flashing to completely saturate reinforcing fabric and to obtain a seamless reinforced flashing membrane free of entrapped gases and pinholes, with an average dry film total thickness of 90 mils.
 4. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
 5. Apply masking tape to each side of joint, outside of area to be covered by flashing system.

3.05 CLEANING AND PROTECTION

- A. Protect flexible flashings from damage during application and remainder of construction period, according to manufacturer's written instructions.
 1. Protect flexible flashings from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace flexible flashing materials according to manufacturer's written instructions.
 2. Protect flexible flashings from contact with incompatible materials and sealants not approved by manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION

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SECTION 07 71 29 - MANUFACTURED ROOF EXPANSION JOINTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Bellows-type roof expansion joints.

1.02 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For roof expansion joints.
- C. Samples: For each exposed product and for each color specified.
- D. Qualification Data: For Installer.
- E. Product Test Reports: For each fire-barrier provided as part of a roof-expansion-joint assembly, for tests performed by a qualified testing agency.
- F. Sample Warranties: For special warranty.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Installer of roofing membrane.

1.04 WARRANTY

- A. Special Warranty: Manufacturer and Installer agree to repair or replace roof expansion joints and components that leak, deteriorate beyond normal weathering, or otherwise fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide fire-barrier assemblies with fire-test-response characteristics as determined by testing identical products, per test method indicated, by UL or another testing agency acceptable to authorities having jurisdiction. Fire-barrier products shall bear classification marking of qualified testing agency.

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2.02 BELLOWS-TYPE ROOF EXPANSION JOINTS

- A. Source Limitations: Obtain bellows-type roof expansion joints approved by roofing manufacturer and that are part of roofing membrane warranty.
- B. Flanged Bellows Roof Expansion Joint: Manufactured, continuous, waterproof, joint-cover assembly, consisting of exposed membrane bellows, laminated to flexible, closed-cell support foam, and secured along each edge to a metal flange for nailing to substrate. Provide factory-fabricated units for corner and joint intersections and horizontal and vertical transitions including those to other building expansion joints
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties, Inc.; BRJ Series and BRJW Series, or comparable product by one of the following:
 - a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
 - b. Balco, Inc.
 - c. Building Materials Corporation of America; GAF Materials Corporation.
 - d. InPro Corporation.
 - e. Johns Manville; a Berkshire Hathaway company.
 - f. MM Systems Corporation.
 - g. Watson Bowman Acme Corp.
 - 2. Bellows: PVC flexible membrane.
 - 3. Flanges: Galvanized steel.
 - 4. Cover Membrane: Flexible membrane, factory laminated to bellows and covering entire joint assembly and curbs.
 - 5. Secondary Seal: Continuous, waterproof membrane within joint and attached to substrate on sides of joint below the primary bellows assembly.
 - a. Thermal Insulation: Fill space above secondary seal with mineral-fiber blanket insulation; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84.
 - 6. Fire Barrier: Manufacturer's standard fire-resistant joint system with ratings determined per ASTM E 1966 or UL 2079 to resist spread of fire and to accommodate building thermal and seismic movements without impairing its ability to resist the passage of fire and hot gases.
 - a. Fire-Resistance Rating: Not less than fire-resistance rating of the roof assembly.

2.03 MATERIALS

- A. Galvanized-Steel Sheet: ASTM A 653/A 653M, hot-dip zinc-coating designation G90.
- B. PVC Membrane: ASTM D 4434, Type standard with manufacturer for application.
- C. Adhesives: As recommended by roof-expansion-joint manufacturer.

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- D. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.
- E. Mineral-Fiber Blanket: ASTM C 665.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Comply with manufacturer's written instructions for handling and installing roof expansion joints.
 - 1. Anchor roof expansion joints securely in place, with provisions for required movement.
 - 2. Install roof expansion joints true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
 - 3. Provide for linear thermal expansion of roof expansion joint materials.
 - 4. Provide uniform profile of roof expansion joint throughout its length; do not stretch or squeeze membranes.
 - 5. Provide uniform, neat seams.
 - 6. Install roof expansion joints to fit substrates and to result in watertight performance.
 - 7. Torch cutting of roof expansion joints is not permitted.
- B. Directional Changes and Other Expansion-Control Joint Systems: Install factory-fabricated units at directional changes and at transitions between roof expansion joints and exterior expansion-control joint systems specified in Division 07 Section "Expansion Control" to provide continuous, uninterrupted, and watertight joints.
- C. Splices: Splice roof expansion joints with materials provided by roof-expansion-joint manufacturer for this purpose.
 - 1. Install waterproof splices and prefabricated end dams to prevent leakage of secondary-seal membrane.
- D. Fire Barrier: Install fire barrier where indicated to provide continuous, uninterrupted fire resistance throughout length of roof expansion joint, including transitions and end joints.
- E. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

END OF SECTION

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SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Accessories installed on roofing assemblies other than mechanical or structural items including the following:
 - 1. Roof hatches.
 - 2. Heat and smoke vents.
- B. Related Sections:
 - 1. 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
 - 2. 055213 "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.
 - 3. 076000 "Flashing and Sheet Metal" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
 - 4. 077129 "Manufactured Roof Expansion Joints" for manufactured roof expansion-joint covers.

1.02 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories.
 - 1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.
- C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

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1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

2.02 ROOF HATCHES

- A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bilco; Type F-50 Roof Hatch, or comparable product by approved manufacturer.
- B. Type and Size: Single-leaf lid, 48 by 48 inches.
- C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.
- D. Hatch Material: Aluminum sheet.
 - 1. Thickness: Manufacturer's standard thickness for hatch size indicated.
 - 2. Finish: Two-coat fluoropolymer.
 - 3. Color: As selected by Architect from manufacturer's full range.
- E. Construction:
 - 1. Insulation: 2-inch- thick, polyisocyanurate board.
 - 2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 - 3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
 - 4. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
 - 5. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.

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- F. Hardware: Spring operators, hold-open arm, stainless steel spring latch with turn handles, stainless steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
1. Height: 42 inches above finished roof deck.
 2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches in diameter or galvanized-steel tube, 1-5/8 inches in diameter.
 3. Flat Bar: Galvanized steel, 2 inches high by 3/8 inch thick.
 4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
 5. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
 6. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
 7. Fabricate joints exposed to weather to be watertight.
 8. Fasteners: Manufacturer's standard, finished to match railing system.
 9. Finish: Manufacturer's standard.
 - a. Color: As selected by Architect from manufacturer's full range.

2.03 HEAT AND SMOKE VENTS

- A. Hatch-Type Heat and Smoke Vents: Manufacturer's standard, with [single] [double]-walled insulated curbs, welded or mechanically fastened and sealed corner joints, integral condensation gutter, and cap flashing. Fabricate with insulated double-walled lid and continuous weathertight perimeter lid gaskets, and equip with automatic self-lifting mechanisms and UL-listed fusible links rated at 165 deg F.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bilco; Type ACDSV Automatic Smoke Vent.
 - b. Milcor; STC-50 - Acoustical.
 2. Acoustical Rating: STC-50.
 3. Type and Size: Double-leaf lid, sized as indicated on Drawings.
 4. Loads: Minimum 40-lbf/sq. ft. external live load and 30-lbf/sq. ft. internal uplift load.
 - a. When release is actuated, lid shall open against 10-lbf/sq. ft. snow or wind load and lock in position.
 5. Heat and Smoke Vent Standard: Provide units that have been tested and listed to comply with UL 793.
 6. Curb, Framing, and Lid Material: Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet.
 - a. Thickness: Manufacturer's standard thickness for hatch size indicated but not less than 0.079 inch.

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- b. Finish: Baked enamel or powder coat.
- c. Color: As selected by Architect from manufacturer's full range.
- 7. Construction:
 - a. Insulation: Minimum 3 inches mineral wool board.
 - b. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 - c. Exterior Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
 - d. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
 - e. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is constant. Equip hatch with water diverter or cricket on side that obstructs water flow.
- 8. Hardware: Manufacturer's standard stainless steel; with hinges, hold-open devices, and independent manual-release devices for operation of lids.

2.04 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation.
 - 1. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
 - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- B. Aluminum Sheet: ASTM B209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
 - 1. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
 - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- C. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.
- D. Steel Pipe: ASTM A53/A53M, galvanized.

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2.05 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.
- C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- D. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
 - 1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.
 - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- F. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- G. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

2.06 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

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- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
- C. Roof-Hatch Installation:
 - 1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
 - 2. Attach safety railing system to roof-hatch curb.
 - 3. Attach ladder-assist post according to manufacturer's written instructions.
- D. Heat and Smoke Vent Installation:
 - 1. Install heat and smoke vent so top perimeter surfaces are level.
 - 2. Install and test heat and smoke vents and their components for proper operation according to NFPA 204.
- E. Seal joints with sealant as required by roof accessory manufacturer.

3.03 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

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- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09 91 00 "Painting."
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Clean off excess sealants.
- E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Sealant and backing materials.
 - 2. Acoustical sealants.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for sealants, indicating VOC content.
- B. Product Test Reports: For each kind of joint sealant.
- C. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- D. Sample Warranties: For special warranties.

1.04 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.

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3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with stone or masonry substrates.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
6. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

1.05 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.
 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.

1.06 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period:
 - a. Silicone Sealants: 20 years from date of Substantial Completion.
 - b. All Other Sealants: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 1. Sealants:
 - a. VOC content limits for field applications.

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2.02 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer for each sealant type.

2.03 JOINT SEALANTS, 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 joint-sealant manufacturer, based on testing and field experience.
- B. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- C. Nonstaining Joint Sealants: Where sealants are indicated to be nonstaining, provide products that exhibit no staining of substrates when tested according to ASTM C1248.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with the following public health and safety requirements:
 - 1. Sealant is certified for compliance with NSF standards for end-use application indicated.
 - 2. Washed and cured sealant complies with the FDA's regulations for use in areas that come in contact with food.
- E. Mildew-Resistant Joint Sealants: Where sealants are indicated to be mildew-resistant, provide products formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.04 JOINT SEALANTS

- A. Silicone: Single-component, nonsag, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
 - 1. Joint Locations: Exterior joints in vertical surfaces and horizontal nontraffic surfaces, and as follows:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints in dimension stone cladding.
 - d. Joints between different materials listed above.
 - e. Perimeter joints between materials listed above and frames of doors glazed framing systems and louvers.

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- f. Other joints as indicated on Drawings.
- 2. Basis-of-Design Product: The Dow Chemical Company; DowSil 790, 791, or 795 at Contractor's option.
 - a. Subject to compliance with requirements, manufacturers offering comparable products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GE Construction Sealants; Momentive Performance Materials Inc.
 - 2) Pecora Corporation.
 - 3) Sika Corporation; Joint Sealants.
 - 4) Tremco Incorporated.
- B. Silicone: Single-component, nonsag, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Joint Locations: Sealant joints in contact with weather barrier, weather barrier flashing materials, and as follows:
 - a. Perimeter joints between materials listed above and frames of doorsglazed framing systems and louvers.
 - 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. The Dow Chemical Company; DowSil 758 Silicone Weather Barrier Sealant.
 - b. Pecora Corporation; AVB Silicone.
- C. Silicone: Mildew-resistant, single-component, nonsag, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Joint Locations: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces, and as follows:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints in wet locations.
 - c. Other joints as indicated on Drawings.
 - 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary.
 - b. The Dow Chemical Company; DowSil 786.
- D. Urethane: Multicomponent, pourable, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.
 - 1. Joint Locations: Exterior joints in horizontal traffic surfaces, and as follows:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Other joints as indicated on Drawings.
 - 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Corporation; MasterSeal SL 2.
 - b. Pecora Corporation; Dynatrol II SG or Urexpan NR 200/201.
 - c. Sika Corporation; Joint Sealants; Sikaflex 2c SL.
 - d. Tremco Incorporated; THC 900/901.

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- E. Urethane: Multicomponent, nonsag, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T and NT.
1. Joint Locations: Interior joints in horizontal traffic surfaces, and as follows:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated on Drawings.
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Corporation; MasterSeal NP 2.
 - b. LymTal International Inc; Iso-Flex 881 or Iso-Flex 885 SG.
 - c. Pecora Corporation; Dynatred.
 - d. Sika Corporation; Joint Sealants; Sikaflex 2c NS TG.
- F. Urethane: Single-component, nonsag, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Joint Locations: Interior joints in vertical surfaces and horizontal nontraffic surfaces, and as follows:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of unit masonry walls.
 - d. <Insert other joints>.
 - e. Other joints as indicated on Drawings.
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Pecora Corporation; Dynatrol I-XL.
 - b. Polymeric Systems, Inc; Flexiprene 1000.
 - c. Sika Corporation; Joint Sealants; Sikaflex Textured Sealant.
 - d. Tremco Incorporated; Dymonic.
- G. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
1. Joint Locations: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement, and as follows:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - c. Other joints as indicated on Drawings.
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Corporation; MasterSeal NP 520.
 - b. Bostik, Inc.; Bosti-Flex Plus.
 - c. Pecora Corporation; AC-20.
 - d. Tremco Incorporated; Tremflex 834.

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- H. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 in accordance with ASTM D2240.
1. Joint Locations: Interior, exposed sawcuts and non-moving control joints in concrete slabs.
 2. Color: As selected by Architect from manufacturer's full range.
 3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Corporation; MasterSeal CR 190.
 - b. Sika Corporation; Joint Sealants; Sikadur 51.

2.05 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834. Sealant effectively reduces airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E90.
1. Joint Location:
 - a. Acoustical joints where indicated.
 - b. Other joints as indicated.
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Accumetric LLC; BOSS 826 Acoustical Sound Sealant.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.; RCS20 Acoustical.
 - c. Grabber Construction Products; Acoustical Sealant GSC.
 - d. Hilti, Inc.; CP 506 Smoke and Acoustical Sealant.
 - e. Pecora Corporation; AC-20 FTR or AIS-919.
 - f. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - g. Tremco Incorporated; Tremflex 834.

2.06 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), unless otherwise recommended by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

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2.07 MISCELLANEOUS MATERIALS

- A. Primer: Material 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.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove laitance and form-release agents from concrete.
 - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by 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.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.02 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 C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind 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.

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1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. 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 in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.
- G. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters including heads of walls, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- 3.03 CLEANING
- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION

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SECTION 07 95 00 - EXPANSION CONTROL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Interior expansion control systems.
 - 2. Exterior expansion control systems.
- B. Related Sections:
 - 1. 07 7129 - Manufactured Roof Expansion Joints: For factory-fabricated roof expansion control.

1.02 SUBMITTALS

- A. Shop Drawings: For each expansion control system specified. Include plans, elevations, sections, details, splices, blockout requirement, attachments to other work, and line diagrams and a tabular schedule of expansion control systems.
- B. Samples: For each exposed expansion control system and for each color and texture specified.
- C. Product Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
 - 1. Manufacturer and model number for each expansion control system.
 - 2. Expansion control system location cross-referenced to Drawings.
 - 3. Nominal joint width.
 - 4. Movement capability.
 - 5. Classification as thermal or seismic.
 - 6. Materials, colors, and finishes.
 - 7. Product options.
 - 8. Fire-resistance ratings.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
 - 1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.

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2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.

- B. Coordination: Coordinate installation of exterior wall expansion control systems with roof expansion control systems to ensure that wall transitions are watertight. Roof expansion joint assemblies are specified in Division 07 Sections.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Where indicated, provide expansion control systems with fire barriers identical to those of systems tested for fire resistance per UL 2079 or ASTM E 1966 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Hose Stream Test: Wall-to-wall and wall-to-ceiling systems shall be subjected to hose stream testing.
- B. Seismic Performance: Expansion control systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified[**and the system will be fully operational after the seismic event**]."
 2. Component Importance Factor is [**1.5**] [**1.0**].

2.03 INTERIOR EXPANSION CONTROL SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or a comparable product by one of the following:
 1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
 2. Balco, Inc.
 3. Construction Specialties, Inc.
 4. JointMaster/InPro Corporation.
 5. Michael Rizza Company, LLC.
 6. MM Systems Corporation.
 7. Nystrom, Inc.
 8. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
- B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.
- C. Wall-to-Wall:
 1. Basis-of-Design Product: Construction Specialties, Inc.; AFW Series.
 2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings .
 - b. Minimum Joint Width: As indicated on Drawings .
 - c. Maximum Joint Width: As indicated on Drawings .
 - d. Movement Capability: -25 percent/+75 percent.

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- e. Type of Movement: As indicated on Drawings .
- f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that of adjacent construction.
- 3. Type: Glide plate .
 - a. Metal: Aluminum.
 - 1) Finish: Manufacturer's standard.

D. Wall Corner:

- 1. Basis-of-Design Product: Construction Specialties, Inc.; AFWC Series..
- 2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Minimum Joint Width: As indicated on Drawings.
 - c. Maximum Joint Width: As indicated on Drawings.
 - d. Movement Capability: -25 percent/+75 percent.
 - e. Type of Movement: As indicated on Drawings .
 - f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that of adjacent construction.
- 3. Type: Glide plate.
 - a. Metal: Aluminum.
 - 1) Finish: Manufacturer's standard.

2.04 EXTERIOR EXPANSION CONTROL SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or a comparable product by one of the following:
 - 1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
 - 2. Balco, Inc.
 - 3. Chase Construction Products; Division of Chase Corporation.
 - 4. Construction Specialties, Inc.
 - 5. D. S. Brown Company (The).
 - 6. EMSEAL Corporation.
 - 7. Erie Metal Specialties, Inc.
 - 8. JointMaster/InPro Corporation.
 - 9. LymTal International, Inc.
 - 10. Michael Rizza Company, LLC.
 - 11. MM Systems Corporation.
 - 12. Nystrom, Inc.
 - 13. RJ Watson, Inc.
 - 14. Schul International Company, Inc.
 - 15. Tremco Incorporated.
 - 16. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
 - 17. Williams Products, Inc.
- B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.
- C. Wall-to-Wall:

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1. Basis-of-Design Product: Construction Specialties, Inc.; SC Series.
2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings .
 - b. Minimum Joint Width: As indicated on Drawings .
 - c. Maximum Joint Width: As indicated on Drawings .
 - d. Movement Capability: -25 percent/+75 percent.
 - e. Type of Movement: As indicated on Drawings .
 - f. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that of adjacent construction.
3. Type: Elastomeric seal.
 - a. Metal: Aluminum.
 - b. Seal Material: Manufacturer's standard.
 - 1) Color: As selected by Architect from manufacturer's full range.
 - c. Pantograph Mechanism: Manufacturer's standard pantographic wind-load support mechanism with stainless-steel fasteners.

2.05 ACCESSORIES

- A. Moisture Barriers: Manufacturer's standard moisture barrier consisting of a continuous, waterproof membrane within joint and attached to substrate on sides of joint below the primary cover.
 1. Drain-Tube Assemblies: Equip moisture barrier with drain tubes and seals to direct collected moisture to exterior-wall expansion control system.

2.06 MATERIALS

- A. Aluminum: ASTM B 221, Alloy 6063-T5 for extrusions; ASTM B 209, Alloy 6061-T6 for sheet and plate.
 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Elastomeric Seals: ASTM E 1783; preformed elastomeric membranes or extrusions to be installed in metal frames.
- C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required fire-resistance rating.
- D. Moisture Barrier: Flexible elastomeric material, EPDM, minimum 45 mils thick.
- E. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M.
- F. Accessories: Manufacturer's standard anchors, clips, fasteners, and other accessories as indicated or required for complete installations.

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PART 3 - EXECUTION

3.01 PREPARATION

- A. Prepare substrates according to expansion control system manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems.

3.02 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion control systems.
 - 1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 - 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper expansion control system installation and performance.
 - 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 - 4. Repair or grout blockout as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
 - 5. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted.
 - 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.
- C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 - 1. Provide in continuous lengths for straight sections.
 - 2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.

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- E. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion control system materials and associated work so complete assemblies comply with assembly performance requirements.
 - 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- F. Moisture Barrier: Provide at all exterior joints and where indicated on Drawings. Provide drainage fittings at a maximum of 50 feet or where indicated on Drawings.

3.03 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete.
- B. Protect the installation from damage by work of other Sections.

END OF SECTION

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SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Standard hollow-metal doors and frames.

1.02 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.03 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 - 7. Details of anchorages, joints, field splices, and connections.
 - 8. Details of accessories.
 - 9. Details of moldings, removable stops, and glazing.
- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

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1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal 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.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amweld International, LLC.
 - 2. Ceco Door Products; an Assa Abloy Group company.
 - 3. Curries Company; an Assa Abloy Group company.
 - 4. Deansteel.
 - 5. Fleming-Baron Door Products.
 - 6. Mesker Door Inc.
 - 7. Pioneer Industries, Inc.
 - 8. Security Metal Products Corp.
 - 9. Steelcraft; an Ingersoll-Rand company.

2.02 PERFORMANCE REQUIREMENTS

- A. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than [0.50 deg Btu/F x h x sq. ft.] [0.40 deg Btu/F x h x sq. ft.] [0.38 deg Btu/F x h x sq. ft.] **<Insert U-factor>** when tested according to ASTM C518.

2.03 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.
 - 1. Doors:

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- a. Type: As indicated in the Door and Frame Schedule.
- b. Thickness: 1-3/4 inches.
- c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
- d. Edge Construction: Model 2, Seamless.
- e. Core: Manufacturer's standard .
- 2. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
 - b. Construction: Face welded.
- 3. Exposed Finish: Prime.

2.04 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - f. Bottom Edges: Close bottom edges of doors[where required for attachment of weather stripping] with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - g. Core: Manufacturer's standard .
 - 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
 - b. Construction: Face welded.
 - 3. Exposed Finish: Prime.

2.05 BORROWED LITES

- A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch.
- B. Construction: Face welded.

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- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.06 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
 - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.07 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

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- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 08 81 00 "Glass Glazing."

2.08 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. 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.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted hairline joints.
 - 1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.

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3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.09 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.02 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 2. Floor Anchors: Secure with postinstalled expansion anchors.

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- a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Solidly pack mineral-fiber insulation inside frames.
 - 4. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
 - C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 - 1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
 - D. Glazing: Comply with installation requirements in Section 08 81 00 "Glass Glazing" and with hollow-metal manufacturer's written instructions.
- 3.03 REPAIR
- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
 - B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
 - C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

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SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Solid-core flush wood doors with wood-veneer faces.
 - 2. Factory finishing flush wood doors.
 - 3. Factory fitting flush wood doors to frames and factory machining for hardware.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
 - 2. Section 08 81 00 "Glass Glazing" for glass view panels in flush wood doors.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
 - 1. Door core materials and construction.
 - 2. Door edge construction
 - 3. Door face type and characteristics.
 - 4. Factory-machining criteria.
 - 5. Factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:
 - 1. Door schedule indicating door location, type, size, fire protection rating, and swing.
 - 2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
 - 3. Details of frame for each frame type, including dimensions and profile.
 - 4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 - 5. Dimensions and locations of blocking for hardware attachment.
 - 6. Dimensions and locations of mortises and holes for hardware.
 - 7. Clearances and undercuts.
 - 8. Requirements for veneer matching.
 - 9. Doors to be factory finished and application requirements.
- C. Samples for Initial Selection: For factory-finished doors.
- D. Samples for Verification:

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1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 1. Documentation for composite wood products, indicating compliance with emissions testing or certification.
- B. Sample Warranty: For special warranty.

1.04 CLOSEOUT SUBMITTALS

- A. Special warranties.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.06 FIELD CONDITIONS

- A. Environmental Limitations: 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 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Delamination of veneer.
 - b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

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PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Flush Wood Door Manufacturers: Subject to compliance with requirements, unless indicated otherwise, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Masonite Architectural.
 2. Lynden Door, Inc.
 3. Oregon Door.
 4. Oshkosh Architectural Door Company.
 5. Poncraft Door Company.
 6. Vancouver Door Company.
 7. VT Industries Inc.

2.02 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
1. Composite Wood Products:
 - a. Formaldehyde emissions testing or certification.

2.03 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.
1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

2.04 VENEERED-FACED FLUSH WOOD DOORS FOR TRANSPARENT FINISH

- A. Interior Doors:
1. Performance Grade:
 - a. ANSI/WDMA I.S. 1A Heavy Duty unless otherwise indicated on Drawings.
 - b. ANSI/WDMA I.S. 1A Extra Heavy Duty: Public toilets assembly spaces, exits, and where indicated on Drawings.
 2. ANSI/WDMA I.S. 1A Grade: Premium.
 3. Faces: Single-ply wood veneer not less than 1/50 inch thick.
 - a. Wood Species, Cut, and Matching: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.
 - b. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 4. Exposed Vertical Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A.

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5. Core for Non-Fire-Rated Doors:
 - a. ANSI A208.1, Grade LD-1 or Grade LD-2 particleboard.
 - 1) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 08 71 00 "Door Hardware."
6. Construction: Five or seven plies, stiles and rails bonded to core, with entire unit abrasive planed before veneering.

2.05 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
 1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
- B. Factory machine doors for hardware that is not surface applied.
 1. Locate hardware to comply with DHI-WDHS-3.
 2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
 3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
 4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.

2.06 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
 1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 2. Finish faces, all four edges, edges of cutouts, and mortises.
 3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
 1. Architectural Woodwork Standards Grade: Premium.
 2. Finish: Architectural Woodwork Standards System-5, Varnish, Conversion.
 3. Staining: Match existing as directed by Architect.
 4. Sheen: Satin.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.

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1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Hardware: For installation, see Section 08 71 00 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.03 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

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SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames for walls and ceilings.
 - 2. Floor access doors and frames.

1.02 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material.
- D. Schedule: Types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.01 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Access Panel Solutions.
 - 2. Acudor Products, Inc.
 - 3. Alfab, Inc.
 - 4. Babcock-Davis.
 - 5. Cendrex Inc.
 - 6. Elmdor/Stoneman Manufacturing Co.; Div. of Acorn Engineering Co.
 - 7. Jensen Industries; Div. of Broan-Nutone, LLC.
 - 8. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
 - 9. Karp Associates, Inc.
 - 10. Larsen's Manufacturing Company.
 - 11. Maxam Metal Products Limited.
 - 12. Metropolitan Door Industries Corp.
 - 13. MIFAB, Inc.
 - 14. Milcor Inc.
 - 15. Nystrom, Inc.
 - 16. Williams Bros. Corporation of America (The).

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- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
- C. Flush Access Doors with Exposed Flanges :
 - 1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
 - 2. Locations: As indicated on Drawings.
 - 3. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage.
 - a. Finish: Factory prime.
 - 4. Frame Material: Same material, thickness, and finish as door.
- D. Flush Access Doors with Concealed Flanges :
 - 1. Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.
 - 2. Locations: As indicated on Drawings.
 - 3. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage.
 - a. Finish: Factory prime.
 - 4. Frame Material: Same material and thickness as door.

2.02 FLOOR ACCESS DOORS AND FRAMES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Acudor Products, Inc.
 - 2. Babcock-Davis.
 - 3. Bilco Company (The).
 - 4. Cendrex Inc.
 - 5. Dur-Red Products.
 - 6. Halliday Products.
 - 7. Jensen Industries; Div. of Broan-Nutone, LLC.
 - 8. Karp Associates, Inc.
 - 9. Maxam Metal Products Limited.
 - 10. Metropolitan Door Industries Corp.
 - 11. MIFAB, Inc.
 - 12. Milcor Inc.
 - 13. Nystrom, Inc.
 - 14. U.S.F. Fabrication.
 - 15. Williams Bros. Corporation of America (The).
- B. Floor Doors, General: Equip each door with adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with red vinyl grip that allows for one-handed closure, and recessed lift handle.
- C. Recessed Cover Aluminum Floor Door:
 - 1. Frame: Mill finish aluminum, angle profile.

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2. Door: Single leaf; 1/4-inch-thick aluminum plate with 1-inch-deep recess for application of finish materials.
3. Loading Capacity: 300 lbf/sq. ft. pedestrian live load.

D. Hardware: Provide the following:

1. Hinges: Heavy-duty, **[zinc-coated steel] [aluminum] [stainless-steel] [brass]** butt hinges with stainless-steel pins.
2. Latch: Stainless-steel slam latch.
3. Lock: **[Staple for a padlock] [Recessed hasp] [Keyed deadbolt lock] [Hasp and staple]**.
4. Hardware Material: **[Manufacturer's standard] [Stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and all brackets, hinges, pins, and fasteners]**.

E. Insulation: **[Fiberglass] [Urethane]** with liner pan.

F. Safety Accessories: Safety **[chains] [net] [railing]**.

2.03 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Frame Anchors: Same type as door face.

D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.04 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.

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- 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. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.05 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
 - 1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
- E. Aluminum Finishes:
 - 1. Mill finish.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.02 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.

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SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Insulated service doors.
- B. Related Sections:
 - 1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel supports.

1.02 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 2. Show locations of controls, locking devices, and other accessories.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Maintenance data.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
 - 1. Design Wind Load: As indicated on Drawings.
 - 2. Testing: According to ASTM E 330.
- B. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

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2.02 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Cornell Iron Works, Inc.; Thermiser ESD20, or comparable product by one of the following:
 - a. ACME Rolling Doors.
 - b. Alpine Overhead Doors, Inc.
 - c. Alumatec Pacific Products.
 - d. Amarr Garage Doors.
 - e. ASTA Door Corporation.
 - f. C.H.I. Overhead Doors.
 - g. City-Gates.
 - h. Clipay Building Products.
 - i. Cookson Company.
 - j. Janus International Corporation.
 - k. Lawrence Roll-Up Doors, Inc.
 - l. McKeon Rolling Steel Door Company, Inc.
 - m. Metro Door.
 - n. Overhead Door Corporation.
 - o. QMI Security Solutions.
 - p. Raynor.
 - q. Southwestern Rolling Steel Door Co.
 - r. Wayne-Dalton Corp.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000.
- C. Curtain R-Value: 8 deg F x h x sq. ft./Btu.
- D. Door Curtain Material: Galvanized steel.
- E. Door Curtain Slats: Flat profile slats of 3-1/4-inch center-to-center height.
 - 1. Insulated-Slat Interior Facing: Metal.
- F. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.
- G. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- H. Hood: Match curtain material and finish .
 - 1. Mounting: As shown on Drawings.
- I. Electric Door Operator:

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1. Usage Classification: Heavy duty, 25 or more cycles per hour and over 90 cycles per day.
2. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
3. Obstruction-Detection Device: Automatic photoelectric sensor.
4. Control Station(s): Where shown on Drawings.

J. Curtain Accessories: Equip door with weatherseals .

K. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.03 MATERIALS, GENERAL

- 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.

2.04 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
1. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
 2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

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2.05 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.06 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

2.07 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.08 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.

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1. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
 2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
- D. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.
1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
 - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.
- E. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 2. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
- F. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Power-Operated Doors: Install according to UL 325.
- C. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer. Adjust seals to provide tight fit around entire perimeter.

3.02 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

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OVERHEAD COILING DOORS
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END OF SECTION

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SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Exterior storefront framing.
 - 2. Exterior manual-swing entrance doors.
- B. Related Sections:
 - 1. Section 08 81 00 "Glass Glazing" for storefront glazing.

1.02 PREINSTALLATION MEETINGS

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples: For each exposed finish required.

1.04 INFORMATIONAL SUBMITTALS

- A. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.
- B. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.
- D. Product test reports.
- E. Field quality-control reports.
- F. Sample warranties.

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G. Maintenance data.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.06 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows 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 MANUFACTURERS

- A. Basis-of-Design Assembly: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
 - 1. Arcadia, Inc.
 - 2. Kawneer North America, an Arconic company.
 - 3. Oldcastle, Inc.
 - 4. YKK AP America Inc.
- B. Source Limitations: Obtain all components of aluminum-framed entrances and storefront, including framing and accessories, from single manufacturer.

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2.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, 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.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.
- E. Structural: Test according to ASTM E 330 as follows:
 - 1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
 - 1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. .

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2. Entrance Doors:
 - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
 - b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
 - G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
 1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..
 - H. Energy Performance: Certify and label energy performance according to NFRC as follows:
 1. Thermal Transmittance (U-factor):
 - a. Fixed glazing and framing areas shall have U-factor of not more 0.41 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
 - b. Thermal Entrance Doors: Door framing and glazing assembly shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.26 as determined according to NFRC 200.
 3. Condensation Resistance: When tested to AAMA Specification 1503, the CRF shall not be less than 68 for fixed framing and glass.
 - I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- 2.03 FRAMING
- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 1. Basis-of-Design Product: Arcadia, Inc.; TC670 Series Storefront.
 2. Construction: Thermally broken.
 3. Glazing System: Retained mechanically with gaskets on four sides.
 4. Glazing Plane: Front.
 5. Finish: High-performance organic finish.
 6. Fabrication Method: Field-fabricated stick system.
 - B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
 - C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

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D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209.
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.04 THERMAL ENTRANCE DOOR SYSTEMS

- A. Thermal Entrance Doors: Manufacturer's high-performance thermal glazed entrance doors for manual-swing operation.
1. Basis-of-Design Product: Arcadia, Inc.; WS512T Thermal Wide Stile.
 2. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 3. Door Design: As indicated.
 4. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

2.05 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 "Door Hardware."

2.06 GLAZING

- A. Glazing: Comply with Section 088100 "Glass Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

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2.07 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
- B. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- C. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

2.08 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. 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. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- G. 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.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

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2.09 ALUMINUM FINISHES

- A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat.
 - 1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions .
 - 2. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 "Joint Sealants" to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install glazing as specified in Section 08 81 00 "Glass Glazing."
- F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

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3.02 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - a. Perform a minimum of three tests in areas as directed by Architect.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION

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SECTION 08 51 13 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes aluminum windows for interior locations.
- B. Related Sections:
 - 1. Section 08 56 19 "Pass Windows" for operable pass windows.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: For aluminum windows.
 - 1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Arcadia, Inc.; AR450 Series, or comparable product by one of the following:
 - 1. Kawneer North America.
 - 2. Oldcastle Building Envelope.
 - 3. YKK AP America Inc.
- B. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.02 ALUMINUM WINDOWS

- A. Types: Provide the following types in locations indicated on Drawings:
 - 1. Fixed.
- B. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

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2.03 GLAZING

- A. Glass and Glazing: Manufacturer's standard glazing system that produces weathertight seal. Comply with requirements indicated in Section 08 81 00 "Glass Glazing."
- B. Glazing System: Manufacturer's standard.
- C. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
 - 1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.04 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.05 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.06 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class II, Color Anodic Finish: AA-M12C22A32/A34 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker) complying with AAMA 611.
 - 1. Color: Dark bronze.

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PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to adjacent construction.

3.03 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
 - 1. Keep protective films and coverings in place until final cleaning.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION

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SECTION 08 56 19 - PASS WINDOWS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Sliding, pass windows.

1.02 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, and attachments to other work.
- C. Samples: For frame members with factory-applied finishes.

PART 2 - PRODUCTS

2.01 SLIDING, PASS WINDOWS

- A. Provide horizontal-sliding, pass windows.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Noise Barriers; QuietLite Sound Control Windows, or comparable product by one of the following:
 - a. Arcadia, Inc.
 - b. Kawneer North America, an Arconic company.
 - c. Oldcastle, Inc.
 - d. YKK AP America Inc.
- B. Sound Transmission Class (STC): Rated for not less than 35 STC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413.
- C. Configuration: As indicated on Drawings.
- D. Framing: Fabricate framing and tracks assembly from aluminum as follows:
 - 1. Profile: Manufacturer's standard, with minimum face dimension indicated.
 - a. Minimum Face Dimension: 2 inches, unless indicated otherwise.
 - 2. Depth: As indicated on Drawings.
- E. Sliding Window Hardware: Provide roller track designed for sill track support of horizontal-sliding glazed panel. Provide manufacturer's standard pull and lock with two keys for each horizontal-sliding glazed panel.
- F. Glazing and Glazing Materials: Comply with Division 08 Section "Glass Glazing."

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2.02 FABRICATION

- A. General: Fabricate pass windows to provide a complete system for assembly of components and anchorage of units.
 - 1. Provide units that are reglazable.
 - 2. Prepare pass windows for glazing unless preglazing at the factory is indicated.
- B. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.
- C. Glazing Stops: Finish glazing stops to match pass window framing.
 - 1. Secure-Side (Exterior) Glazing Stops: Welded or integral to framing.
 - 2. Nonsecure-Side (Interior) Glazing Stops: Removable, coordinated with glazing indicated.
- D. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- E. Preglazed Fabrication: Preglaze window units at factory, where required for applications indicated. Comply with requirements in Division 08 Section "Glass Glazing."

2.03 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: Dark bronze .

2.04 ACCESSORIES

- A. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.
- B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- C. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers and with a proven record of compatibility with surfaces contacted in installation.
- D. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B 633; provide sufficient strength to withstand design pressures indicated.

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PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for embedded and built-in anchors to verify actual locations of pass window connections before pass window installation.
- B. Inspect built-in and cast-in anchor installations, before installing pass windows, to verify that anchor installations comply with requirements. Prepare inspection reports.

3.02 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing pass windows to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.
- B. Glazed Framing: Provide sealant or gasket-glazed framing. Comply with installation requirements in Division 08 Section "Glass Glazing."
- C. Removable Glazing Stops and Trim: Fasten components with security fasteners.
- D. Fasteners: Install pass windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials.
- E. Sealants: Comply with requirements in Division 07 Section "Joint Sealants" for installing sealants, fillers, and gaskets.
 - 1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
 - 2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.

3.03 CLEANING AND PROTECTION

- A. Lubricate sliding pass window hardware.

END OF SECTION

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SECTION 08 81 00 - GLASS GLAZING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Windows.
 - 2. Doors.
 - 3. Storefront framing.
 - 4. Glazing sealants and accessories.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.04 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for sealants, indicating VOC content.
- B. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Sample Warranties: For special warranties.

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1.05 QUALITY ASSURANCE

- A. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- B. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.06 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 - 2. Determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates in accordance with ASTM C 1087.
 - 3. Submit to testing agency, number of pieces as recommended by sealant manufacturer of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 - 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
 - 6. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.07 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

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- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.02 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Sealants:
 - a. VOC content limits for field applications.

2.03 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E1300.
 - 1. Design Wind Pressures: As indicated on Drawings and in accordance with ASCE 7.
 - 2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
 - 3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

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- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
 2. For laminated-glass lites, properties are based on products of construction indicated.
 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 4. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
 5. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.04 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
 2. IGMA Publication Insulating Glazing Tolerances: IGMA TB-1200, "Guidelines for Insulating Glass Dimensional Tolerances."
 3. IGMA Publication for Insulating Glass: IGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
 4. IGMA Publication for Thermal Stress: IGMA TM-1500, "Guidelines to Reduce Instances of Thermal Stress."
 5. NGA Publications: "Guidelines for the Appearance of Insulating Glass Unit Edges in Commercial Applications at the Time of Installation."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
1. Wildland-Urban Interface Fire Area Glazing: For multipane glazing, provide a minimum of one tempered safety glazing pane.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

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- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.05 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Heat-Strengthened and Fully Tempered Float Glass: ASTM C1048, Kind HS (heat strengthened) and Kind FT (fully tempered), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
1. Bow and Warpage Tolerance: 50 percent less than ASTM C 1048.
 2. Distortion Limits: Calculated using LiteSentry Osprey Distortion + Flatness Inspection System for Glass and Plastic.
 - a. Peak-to-Valley Roll Wave:
 - 1) Peak-to-Valley Distance:
 - a) No dimension greater than 0.005 inch, with an average not to exceed 0.003 inch, central area.
 - b) No dimension greater than 0.008 inch within 250 mm of the leading and trailing edge.
 3. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 4. Kind HS glass greater than 1/4 inch in thickness shall meet strength requirements in accordance with ASTM C 1048.

2.06 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.
1. Sealing System: Dual seals.
 2. Perimeter Spacer: Provide manufacturer's standard spacer material and construction as required to meet Performance Requirements in Division 08 door, window, and framing assembly sections scheduled to receive insulating glass glazing.
 - a. Provide from one of the following:
 - 1) Aluminum with dark bronze, color anodic finish.
 - 2) Stainless steel.
 - 3) Polypropylene-covered stainless steel in color selected by Architect.
 - b. Color: As selected by Architect from manufacturer's full range.
 3. Desiccant: Molecular sieve or silica gel, or blend of both.

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2.07 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class as recommended by manufacturer. Use NT.

2.08 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks, Spacers, and Edge Blocks:
 - 1. Type recommended by sealant or glass manufacturer with a Shore A durometer hardness of 85, plus or minus 5.
- C. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.01 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

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- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.02 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.03 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

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- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.04 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

3.05 GLASS GLAZING SCHEDULE

- A. GL-1: Monolithic, fully tempered float glass.
 - 1. Glass: Clear float glass.
 - 2. Minimum Thickness: 6 mm.
- B. GL-2: Low-E-coated, clear insulating glass.
 - 1. Overall Unit Thickness: 1 inch (25 mm).
 - 2. Minimum Thickness of Each Glass Lite: 6 mm.
 - 3. Outdoor Lite: Heat-strengthened float glass.
 - 4. Interspace Content: Air.
 - 5. Indoor Lite: Heat-strengthened float glass.
 - 6. Low-E Coating:
 - a. Basis-of-Design Product: Vitro Architectural Glass; Solarban 90.
 - b. Location: Sputtered on second surface.

END OF SECTION

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SECTION 08 91 19 - FIXED LOUVERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fixed metal louvers.
 - 2. Blank-off panels for louvers

1.02 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
 - 1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
 - 2. Show mullion profiles and locations.
- C. Samples: For each type of metal finish required.

1.04 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- B. Windborne-debris-impact-resistance test reports.
- C. Sample Warranties: For manufacturer's special warranties.

1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

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1.06 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.07 WARRANTY

- A. 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 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. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
 - 1. Air Balance Inc.; a Mestek company.
 - 2. Air Flow Company, Inc.
 - 3. Airolite Company, LLC (The).
 - 4. All-Lite Architectural Products.
 - 5. American Warming and Ventilating, Inc.; a Mestek company.
 - 6. Arrow United Industries; a division of Mestek, Inc.
 - 7. Construction Specialties, Inc.
 - 8. Greenheck Fan Corporation.
 - 9. Industrial Louvers, Inc.
 - 10. NCA Manufacturing, Inc.
 - 11. Reliable Products, Inc.
 - 12. Ruskin Company; Tomkins PLC.
 - 13. United Enertech Corp.

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2.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
- B. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.03 FIXED EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Sightproof, Drainable-Blade Louver:
 - 1. Basis-of-Design Product: Construction Specialties, Inc.; Model B5157.
 - 2. Louver Depth: 5 inches.
 - 3. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch for frames.
 - 4. Mullion Type: Exposed.
 - 5. Louver Performance Ratings:
 - a. Free Area: Not less than 8.3 sq. ft. for 48-inch- wide by 48-inch- high louver.
 - b. Point of Beginning Water Penetration: Not less than 1000 fpm.
 - c. Air Performance: Not more than 0.45-inch wg static pressure drop at 550-fpm free-area intake velocity.
 - 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.04 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Bird screening, except where insect screening is indicated.
- B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

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- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 - 1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
 - 2. Finish: Mill finish unless otherwise indicated.
- D. Louver Screening for Aluminum Louvers:
 - 1. Bird Screening: Flattened, expanded aluminum, 5/8 by 0.050 inch thick.
 - 2. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

2.05 BLANK-OFF PANELS

- A. Uninsulated Blank-Off Panels: Metal sheet attached to back of louver.
 - 1. Aluminum sheet for aluminum louvers, not less than 0.050-inch nominal thickness.
 - 2. Panel Finish: Same finish type applied to louvers, but black color.
 - 3. Attach blank-off panels with clips or sheet metal screws.
- B. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.
 - 1. Thickness: As indicated on Drawings.
 - 2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
 - 3. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam.
 - 4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
 - 5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
 - 6. Panel Finish: Same type of finish applied to louvers, but black color.
 - 7. Attach blank-off panels with clips or sheet metal screws.

2.06 MATERIALS

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - 3. For color-finished louvers, use fasteners with heads that match color of louvers.

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- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.07 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Include supports, anchorages, and accessories required for complete assembly.
- D. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.08 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and openings, with Installer present, 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. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

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3.03 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 92 00 "Joint Sealants" for sealants applied during louver installation.

3.04 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

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SECTION 09 05 61.13 - MOISTURE VAPOR EMISSION CONTROL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Fluid-applied membrane-forming systems that control the moisture-vapor-emission rate of interior concrete installed as required prior to installation of floor coverings, floor coatings, and other flooring products and systems.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
 - 2. Section 07 26 00 "Vapor Retarders" for vapor retarders under concrete slabs-on-grade.
 - 3. Division 09 Sections for flooring system substrate requirements.

1.02 DEFINITIONS

- A. MVE: Moisture vapor emission.
- B. MVER: Moisture vapor emission rate.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.04 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for coatings, indicating VOC content.
- B. Product Test Reports: For each MVE-control system, for tests performed by a qualified testing agency.
- C. Preinstallation testing reports.
- D. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.

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- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating directions for storage and mixing with other components.

1.07 FIELD CONDITIONS

- A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.
 - 1. Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than 65 deg F and not more than 85 deg F at least 48 hours before use.
 - 2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg F or more than 85 deg F and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
 - 3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg F higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace vapor retarder and floor coverings, floor coatings, and other flooring products and systems that fail due to moisture vapor emission and moisture born contaminants within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Coatings:
 - a. VOC content limits for field applications.

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2.02 PERFORMANCE REQUIREMENTS

- A. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:
 - 1. MVER: Maximum 30 lb of water/1000 sq. ft. when tested according to ASTM F1869.
 - 2. Relative Humidity: Maximum 90 percent when tested according to ASTM F2170 using in situ probes.
- B. Water-Vapor Transmission: Through MVE-control system, maximum 0.06 perm when tested according to ASTM E96/E96M.
- C. Tensile Bond Strength: For MVE-control system, greater than 200 psi with failure in the concrete according to ASTM D7234.
- D. Alkalinity Insensitivity: Insensitivity to alkaline environment up to, and including, pH 14 in a bath test when tested according to ASTM D1308.

2.03 MVE-CONTROL SYSTEM

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Aquafin Building Product Systems.
 - 2. KOSTER American Corporation.
 - 3. Sika Corporation.
 - 4. Synthetics International.
- B. MVE-Control System: ASTM F3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.
 - 1. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
 - 2. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.

2.04 ACCESSORIES

- A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000-psi compressive strength after 28 days when tested according to ASTM C109/C109M.

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- B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.
- C. Cementitious Underlayment: If required to maintain manufacturer's warranty, provide MVE-control system manufacturer's cement-based underlayment.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of system indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Preinstallation Testing:
 - 1. Testing Agency: Engage a qualified testing agency to perform tests.
 - 2. Alkalinity Testing: Perform pH testing according to ASTM F710. Install MVE-control system in areas where pH readings are less than 7.0 and in areas where pH readings are greater than 8.5.
 - 3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Install MVE-control system in locations where concrete substrate MVER exceeds 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Internal Relative Humidity Test: Using in situ probes, ASTM F2170. Install MVE-control system in locations where concrete substrates exhibit relative humidity level greater than 75 percent.
 - 4. Tensile-Bond-Strength Testing: For typical locations indicated to receive installation of MVE-control system, install minimum 100-sq. ft. area of MVE-control system to prepared concrete substrate and test according to ASTM D7234.
 - a. Proceed with installation only where tensile bond strength is greater than 200 psi with failure in the concrete.
- B. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.

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1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
2. Provide concrete surface profile complying with ICRI 310.2R CSP 3 by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
3. After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.
4. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
5. Fill surface depressions and irregularities with patching and leveling material.
6. Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
7. Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
8. Before installing MVE-control systems, broom sweep and vacuum prepared concrete.

- C. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

3.03 INSTALLATION

- A. Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.
1. Install primers as required to comply with manufacturer's written instructions.
- B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.
- C. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.
- D. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.
- E. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.
- F. Install cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

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3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform installation inspections.
- B. Installation Inspections: Inspect substrate preparation and installation of system components to ensure compliance with manufacturer's written instructions and to ensure that a complete MVE-control system is installed without deficiencies.
 - 1. Verify that surface preparation meets requirements.
 - 2. Verify that component coats and complete MVE-control-system film thicknesses comply with manufacturer's written instructions.
 - 3. Verify that MVE-control-system components and installation areas that evidence deficiencies are repaired according to manufacturer's written instructions.
- C. MVE-control system will be considered defective if it does not pass inspections.

3.05 PROTECTION

- A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.
- B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

END OF SECTION

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SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
 - 2. Suspension systems for interior ceilings and soffits.
 - 3. Grid suspension systems for gypsum board ceilings.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Load Tables: For non-structural metal framing assemblies indicated to comply with performance requirements and design criteria, provide manufacturers' published load tables annotated to show compliance, for each type of framing assembly.
- C. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of non-structural metal framing; fabrication; and fastening and anchorage details.
 - 2. Indicate framed openings, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. CEMCO; California Expanded Metal Products Co.
 - 2. ClarkDietrich Building Systems.
 - 3. SCAFCO Steel Stud Company.
 - 4. Steel Network, Inc. (The).

2.02 PERFORMANCE REQUIREMENTS

- A. Design framing systems in accordance with American Iron and Steel Institute Publication AISI S220, except as otherwise shown or specified.
- B. Performance: Provide non-structural metal framing assemblies capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Load: 5 lbf/sq. ft. uniform air-pressure differential acting perpendicular to covering material supported by metal framing.

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2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Walls Scheduled for Brittle Finishes Including Ceramic Tile: Horizontal deflection greater than $1/360$ of the wall height, and as recommended by wall finish manufacturer.
 - b. Wall Assemblies: Horizontal deflection greater than $1/240$ of the wall height.
 - c. Ceiling Assemblies and Suspension Systems: Vertical deflection greater than $1/240$.
- C. Design framed openings to withstand design loads, gravity loads, and construction tolerances with a maximum deflection not to exceed that recommended by manufacturer of product or system in opening.
- D. Partial Height Partitions: Design to withstand the following loads without damage to finishes and permanent deformation of the assembly:
 1. Top of Partition:
 - a. Uniform load of 50 pounds per linear foot applied perpendicularly.
 - b. Concentrated load of 200 lbf applied perpendicularly at any point.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
- E. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.
- F. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.03 FRAMING SYSTEMS

- A. Thickness: Where metal thickness is indicated, it is a minimum. Provide framing members in thicknesses as needed to comply with requirements indicated.
- B. Framing Members, General: Comply with ASTM C754 for conditions indicated.
 1. Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.
 2. Protective Coating: ASTM A653/A653M, G40 , hot-dip galvanized unless otherwise indicated.
- C. Studs and Tracks: ASTM C645.
 1. Steel Studs and Tracks:
 - a. Minimum Base-Steel Thickness: As indicated on Drawings or if not indicated, as required by performance requirements for horizontal deflection
 - b. Depth: As indicated on Drawings.

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- D. Deflection Track System: Where indicated, provide one of the following:
1. Single Long-Leg Track System: ASTM C645 top track with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
 2. Double-Track System: ASTM C645 top outer tracks, inside track with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
 3. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. Partial Height Partition Reinforcement: Steel reinforcement members designed to support out-of-plane loading in partial height partitions that are unsupported at the top track.
1. Product: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ClarkDietrich Building Systems; Pony Wall.
 - b. SCAFCO Steel Stud Company; Ponywall.
 - c. Steel Network, Inc. (The); MidWall.
 2. Minimum Yield Strength and Base-Metal Thickness: As required to meet performance requirements indicated.
 3. Height and Depth: As required to meet performance requirements indicated.
- F. Pre-Fabricated Headers and Jambs: Manufacturer's proprietary shape used to form header beams and jambs, of web depths indicated, unpunched, with stiffened flanges and as follows:
1. Product: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Clark Dietrich Building Systems; RedHeader.
 - b. SCAFCO Steel Stud Company; Priceless Header and Kwik Jamb System
 2. Minimum Yield Strength and Base-Metal Thickness: As required to meet performance requirements indicated.
 3. Flange Widths: As required to meet performance requirements indicated.
- G. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Steel Thickness: As indicated on Drawings .
- H. Pre-Fabricated Backing System: Manufacturer's proprietary shape used to provide support for wall mounted items, and as follows:
1. Product: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Clark Dietrich Building System:
 - 1) Notched Track.

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- 2) Backer Bar.
 - 2. Backing System Type: As required to meet performance requirements indicated.
 - I. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch- wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
 - J. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
 - 3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
 - K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-steel thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.
 - L. Z-Shaped Clips: With slotted or nonslotted web, face flange, minimum uncoated-steel thickness of 0.034 inch, and depth required to fit insulation thickness indicated.
- 2.04 SUSPENSION SYSTEMS
- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
 - B. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
 - C. Flat Hangers: Steel sheet, in size indicated on Drawings.
 - D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.
 - 1. Depth: As indicated on Drawings.
 - E. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
 - 2. Steel Studs and Tracks: ASTM C645.
 - a. Minimum Base-Steel Thickness: As indicated on Drawings .
 - b. Depth: As indicated on Drawings.
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch deep.
 - a. Minimum Base-Steel Thickness: As indicated on Drawings .

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2.05 GRID SUSPENSION SYSTEMS

- A. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries, Inc.; "Drywall Grid Systems."
 - b. Rockfon, LLC; Chicago Metallic "Drywall Grid System."
 - c. USG Corporation; "Drywall Suspension System."
 - 2. Structural Classification: Heavy-duty system.

2.06 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
 - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.03 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

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- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.04 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Deflection System Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Direct Furring:
 - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

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3.05 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Hangers: 48 inches o.c.
 - 2. Carrying Channels (Main Runners): 48 inches o.c.
 - 3. Furring Channels (Furring Members): 16 inches o.c. unless indicated otherwise.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 5. Do not attach hangers to steel roof deck.
 - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

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- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

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SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
- B. Related Sections:
 - 1. Section 06 16 43 "Gypsum Sheathing" for gypsum sheathing for exterior applications.
 - 2. Section 07 92 00 "Joint Sealants" for acoustical sealants installed as part of STC-rated gypsum board assemblies.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.04 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

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PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. American Gypsum.
 2. CertainTeed Corp.
 3. Georgia-Pacific Gypsum LLC.
 4. Continental Building Products.
 5. National Gypsum Company.
 6. PABCO Gypsum.
 7. USG Corporation.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.03 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C1396/C1396M.
1. Thickness: 5/8 inch.
 2. Long Edges: Tapered.

2.04 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.

2.05 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.

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- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

2.06 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Sound Attenuation Blankets: As specified in Division 09 Section "Acoustic Insulation."
- C. Acoustical Joint Sealant: As specified in Division 07 Section "Sealants."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.

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- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

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3.03 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: As indicated on Drawings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) or horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 - 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - 3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 - 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.04 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:

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1. Cornerbead: Use at outside corners unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.
4. U-Bead: Use where indicated.

3.05 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 4: Surfaces scheduled for light-textured finishes, wallcoverings, flat paints and panel surfaces that will be exposed to view, unless otherwise indicated .
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
 3. Level 5: Surfaces scheduled for gloss and semigloss coatings, wall and ceiling areas abutting window mullions or skylights, curved surfaces, long hallways, large surface areas flooded with artificial and/or natural lighting and where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.06 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

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SECTION 09 30 33 - STONE TILING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Slate tile.
 - 2. Crack isolation membranes.
 - 3. Metal edge strips.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
 - 2. Section 07 92 00 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.02 DEFINITIONS

- A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Dimension Stone Tile: Modular stone that has been selected and stock fabricated into units less than 3/4 inch thick without any facial dimensions greater than 2 ft..
- C. Module Size: Actual tile size plus joint width indicated.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations of each type of stone tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in substrates and finished stone tile surfaces.
- C. Samples for Initial Selection: For tile, grout, and accessories involving color selection.
- D. Samples for Verification:
 - 1. Full-size units of each type of stone tile in each finish required.
 - 2. Range Samples consisting of at least three full-size units of each type of stone tile, exhibiting extremes of the full range of color and other visual characteristics expected. Range Samples establish the standard by which individual stone tiles are judged.
 - 3. Metal edge strips in 6-inch lengths.

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1.04 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for sealers, indicating VOC content.
- B. Product Test Reports:
 - 1. Slip-resistance test reports from qualified independent testing agency.

1.05 QUALITY ASSURANCE

- A. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

1.06 FIELD CONDITIONS

- A. Environmental Limitations: Do not install stone tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers for Setting and Grouting Materials:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ARDEX Americas.
 - b. Custom Building Products.
 - c. H.B. Fuller Construction Products Inc. / TEC.
 - d. Laticrete International, Inc.
 - e. MAPEI Corporation.
 - f. Parex USA, Inc.
- B. Source Limitations for Setting and Grouting Materials: Obtain setting and grouting materials from single manufacturer and aggregate from single source or producer.
- C. Source Limitations for Stone Tile: Obtain tile of each type and color or finish from single source or producer.
- D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 - 1. Crack isolation membrane.
 - 2. Metal edge strips.

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2.02 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Sealers:
 - a. VOC content limits for field applications.

2.03 PERFORMANCE REQUIREMENTS

- A. Slip Resistance, Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products in accordance with the following:
 - 1. Level Surfaces, Dry and Wet: DCOF of not less than 0.42 in accordance with ANSI A326.3.

2.04 PRODUCTS, GENERAL

- A. Pattern Orientation: For stone varieties with a directional pattern, provide tile with pattern as indicated on Drawings.

2.05 SLATE TILE

- A. Slate Tile Type:
 - 1. Varieties and Sources:
 - a. As indicated on Drawings.
 - 2. Module Size: As indicated on Drawings.
 - 3. Abrasion Resistance of Stone Tile for Floors: Provide stone with a value of not less than 10 in accordance with ASTM C1353/C1353M or ASTM C241/C241M.

2.06 CRACK ISOLATION MEMBRANES

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch nominal thickness.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Noble Company (The); Nobleseal CIS.
- C. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bostik, Inc; Hydroment GoldPlus.

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- b. Custom Building Products; RedGard Waterproofing and Crack Prevention Membrane.
- c. H.B. Fuller Construction Products Inc. / TEC; HydraFlex - Waterproofing Crack Isolation Membrane.
- d. Laticrete International, Inc.; Laticrete Hydro Ban.
- e. MAPEI Corporation; Mapelastic CI.

2.07 SETTING MATERIALS

- A. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.

2.08 GROUT MATERIALS

- A. Grout Colors: As selected by Architect from manufacturers full range.
- B. High-Performance Tile Grout: ANSI A118.7.

2.09 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayment and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Profile as indicated, height to match tile and setting-bed thickness, designed specifically for tiling applications.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.
 - 2. Exposed Finish: As selected by Architect from manufacturer's full range.
- C. Temporary Protective Coating: Formulated to protect exposed surfaces of stone tile against adherence of mortar and grout; compatible with stone, mortar, and grout products and easily removable after grouting is completed without damaging grout or stone tile.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming stone tile and grout surfaces, specifically approved for materials and installations indicated by stone tile producers and grout manufacturers.
- E. Grout Sealer: Grout manufacturer's standard product for stone type and application indicated that does not change color or appearance of grout.

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PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions where stone tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting stone tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for stone tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.
- B. Fill cracks, holes, and depressions in concrete substrates for stone tile floors installed with thinset mortar with trowelable patching compound specifically recommended by tile-setting material manufacturer.
- C. Substrate Flatness:
 - 1. For stone tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/6 inch in 12 inches when measured from tile surface high points.
 - 2. For stone tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/6 inch in 24 inches when measured from tile surface high points.
- D. Field-Applied Temporary Protective Coating: If needed to prevent grout from staining or adhering to exposed stone tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed stone tile surfaces.

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3.03 INSTALLATION OF STONE TILE SYSTEM

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
 - 1. Allow crack isolation membrane to cure before installing tile or setting materials over it.
- B. Install stone tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in stone tile installation schedules. Comply with parts of the ANSI A108 series that are referenced in TCNA installation methods specified in stone tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Stone tile floors consisting of stone tiles 8 by 8 inches or larger.
- C. Wipe backs of stone tiles with a damp cloth to remove dirt and dust before units are installed.
- D. Extend stone tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- E. Accurately form intersections and returns. Perform cutting and drilling of stone tile without marring visible surfaces. Carefully grind cut edges of stone tile abutting trim, finish, or built-in items for straight aligned joints. Fit stone tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap stone tile.
- F. Finish cut stone tile edges that will not be concealed by other construction by grinding and honing cut surfaces and easing edges to match factory-fabricated edges unless otherwise indicated.
- G. Jointing Pattern: Lay stone tile in grid pattern unless otherwise indicated. Lay out stone tile work and center stone tile fields in both directions in each space or on each wall area. Lay out stone tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- H. Pattern Orientation: For stone varieties with directional pattern, orient pattern as indicated on Drawings.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

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1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Locate expansion joints as recommended by tile and tile installation material manufacturers, but not less than the following:
 - a. Interior Locations: 20-25 feet in each direction.
 - b. Interior Locations at Above Ground Concrete Slabs: 8-12 feet in each direction.
 - c. Interior Locations Exposed to Direct Sunlight or Moisture: 8-12 feet in each direction.
 - d. Exterior Locations: 8-12 feet in each direction.
 - e. Perimeter joints.

J. Metal Edge Strips: Install at locations indicated .

K. Grout Sealer: Apply grout sealer to grout joints in tile floors in accordance with manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.04 CLEANING AND PROTECTION

- A. Remove and replace tile that is damaged or that does not match adjoining stone tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean stone tile surfaces so they are free of foreign matter.
 1. Remove grout residue from stone tile as soon as possible.
 2. Clean grout smears and haze from stone tile in accordance with stone tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by stone tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of stone tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
- C. Protect installed stone tile floors with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by stone tile manufacturer, apply coat of neutral protective cleaner to completed stone tile walls and floors.
- D. Prohibit foot and wheel traffic from stone tiled floors for at least seven days after grouting is completed.
- E. Before final inspection, remove protective coverings and rinse neutral protective cleaner from stone tile surfaces.

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3.05 INTERIOR STONE TILE INSTALLATION SCHEDULE

A. Interior Floor Installations:

1. Stone Tile Over Concrete:

- a. TCNA F113 STONE, F113A STONE: On-ground and above-ground concrete.
 - 1) Membrane: Crack-isolation membrane, in accordance with installation method TCNA F125-Full.
 - 2) Mortar: Improved modified dry-set mortar.
 - a) Provide thinset mortar unless medium-bed mortar is recommended by tile or mortar manufacturer.
 - 3) Grout: High-performance grout, sanded or unsanded as recommended by tile manufacturer .
- b. TCNA F125-Full STONE: On-ground and above-ground concrete; Crack isolation membrane.
 - 1) Use with tile types that are 6 by 6 inches or larger, in conjunction with corresponding installation method.

END OF SECTION

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SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Acoustical panels and exposed suspension systems for interior ceilings.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for ceiling products, indicating compliance with emissions testing or certification.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.06 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

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PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated or comparable product by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corporation.
 - 3. Rockfon (Rockwool International).
 - 4. USG Corporation.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.02 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Ceiling Products:
 - a. VOC emissions testing or certification.

2.03 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E1264.
 - 2. Smoke-Developed Index: 50 or less.

2.04 ACOUSTICAL PANELS

- A. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264.
- B. Basis-of-Design Product: As indicated on Drawings.

2.05 METAL SUSPENSION SYSTEM

- A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.
 - 1. Structural Classification: Heavy-duty system, unless noted otherwise.
- B. Metal Suspension System:

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1. Basis-of-Design Product: As indicated on Drawings.

2.06 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B633, Class SC 1 (mild) service condition.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.
- F. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.
- G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- H. Seismic Struts: Compression struts designed to accommodate seismic forces.
- I. Seismic Perimeter Retention System: One of the following:
 1. Seismic Wall Molding: 2-inch molding.
 2. Seismic Perimeter Clips: Manufacturer's standard clips designed to accommodate seismic forces.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
 - 1) Armstrong World Industries, Inc; BERC Series.
 - b. Molding Profile: Manufacturer's standard 7/8-inch-wide profile, as selected by Architect.

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2.07 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
 - 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.08 ACOUSTICAL SEALANT

- A. Acoustical Sealant: As specified in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.03 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:

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1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling-suspension members and to supports above. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim, except where indicated on Drawings.

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- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
 - 1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 - 2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 3. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 - 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 5. Install seismic clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.

3.04 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

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SECTION 09 64 55 - RESILIENT WOOD STAGE FLOOR ASSEMBLIES

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: Fabrication and installation of resilient stage subflooring and performance surface as indicated on the Drawings and specified herein.
- B. Related Work:
 - 1. Division 01 – General Requirements
 - 2. Section 03 30 00 – Cast-In-Place Concrete
 - 3. Section 08 71 00 – Door Hardware: Hardware for Thresholds at Door Openings

1.03 SYSTEM DESCRIPTION

- A. A damp-proof vapor barrier to prevent moisture intrusion.
- B. A semi-sprung subfloor consisting of resilient blocks/pads, insulation, wood sleepers, and 2 layers of T&G plywood.
- C. A sacrificial top layer with a matte black paint finish.

1.04 REFERENCES

- A. ANSI E1.26: Recommended Testing Methods and Values for Shock Absorption of Floors Used in Live Performance Venues
- B. ANSI E1.34: Measuring and Specifying the Slipperiness of Floors Used in Live Performance Venues
- C. ASTM D2103-10: Standard Specification for Polyethylene Film and Sheeting

1.05 SUBMITTALS

- A. Provide materials list of items proposed to be provided.

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- B. Submit data sufficient to demonstrate compliance with specifications and drawing requirements, including technical data showing compliance with ANSI E1.26 values.
- C. Submit shop drawing with fully dimensioned details showing installation, and catalog cuts of items to be provided. Manufacturer or producer's standard drawings and technical information may be acceptable when complete enough to determine acceptability.
- D. Submit 18" x 18" mockup of floor assembly with proposed finish.
- E. Test Reports: Submit in duplicate to Architect using an approved independent testing agency, arranged and paid for by the Contractor.
 - 1. Moisture Control Testing: Undertake tests to determine moisture present in existing concrete slabs prior to starting work, obtaining written approval from approved product manufacturer, or his authorized representative, prior to installation of any work of this section. Do not install floors over concrete where the moisture is measured to be greater than 5%.
 - 2. Humidity Level Tests: Test storage and in-service use areas to ensure that the Relative Humidity levels conform to the manufacturer's latest printed recommendations, ranging between 35% to 50% maintaining a temperature range of 55° F. and 78° F. (12.8° C. and 25.6° C.).

1.06 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 - 1. Installed surfaces and level changes shall be compliant with requirements of CBC Chapter 11B and ADAAG.
 - 2. Heat, light and ventilation shall be provided and operating during installation, and until the completion of the project; maintaining a temperature range of 55 degrees to 78 degrees F. and a relative humidity range of 35 to 50 percent.
- B. Products and materials to be provided are to be from manufacturers and producers regularly engaged full-time in the manufacture or production of theatrical stage and dance floors, with a history of successful manufacture or production acceptable to the Owner.
- C. In addition to complying with pertinent codes and regulations, comply with industry and trade standards normally associated with this product or material, except where specified product or material is superior in quality to industry and trade standards.

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- D. Qualifications of Installers: Installers shall be approved by the flooring products manufacturer and shall have at least five (5) years proven experience consistent with the Work of this section, as well as have passed the installation program of a certified wood flooring manufacturer.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver products and materials to the project, and store in a safe, dry place with shop-supplied protection and labeling intact and legible until set, applied, or installed.
- B. Materials shall not be delivered, stored or installed until all masonry, painting, plastering, tile work, marble and terrazzo work are completed. All overhead mechanical work, lighting, fire sprinklers, and rigging systems are installed. Room temperature of at least 55 to 80 degrees and relative humidity of 35 to 50 percent are to be maintained. Ideal installation/storage conditions are the same as those which will prevail when the building is occupied.
- C. Use reasonable means necessary to protect products and materials before, during, and after installation.
- D. In event of damage, regardless of responsibility and culpability, make repairs and replacements necessary to satisfaction of Owner, at no additional cost to Owner.

E. PROJECT/SITE CONDITIONS

1. Sequence:
 - a. Do not install floor system until concrete has been cured at least 60 days and the requirements in Paragraph 1.05.E are obtained. Concrete will be free of sealers, hardeners and curing agents.
 - b. Permanent heat, light and ventilation shall be installed and operating during and after installation. Maintaining a temperature range of 55 to 80 degrees and a relative humidity range of 35 to 50 percent.
2. Concrete Slab Tolerances: Ensure receiving slabs are smooth and level to at least a tolerance of 1/8-inch: 10 ft. (3mm; 3m) radius, with not greater than 1/2- inch (12.7mm) deviation in level over entire length of floor area; ensure high areas are ground down and low areas are filled before proceeding with Work of this section.
3. Concrete Slab Depressions: Ensure dimensions are correct as required to accept flooring systems prior to proceeding with Work of this section.

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1.08 WARRANTY

- A. Provide Owner with a written warranty as a condition of work acceptance, signed by Contractor and installer (where applicable), agreeing to maintain, repair and/or replace products and materials for three (3) years following acceptance, without additional cost to Owner. Sacrificial layer(s) are to be warranted for one (1) year, against defects in installation and materials only.

1.09 REGULATORY REQUIREMENTS

- A. Flooring shall be stable, firm, and slip resistant. CBC Section 11B-302.1.

PART 2- PRODUCTS

2.01 PERFORMANCE

- A. Flooring system is to exhibit uniformity in properties listed below. The tested value at any point on the floor shall be within 5% of the average value for any property.
- B. Shock Absorption: Flooring system should achieve a minimum KA of 40%, not to exceed 65%, per ANSI E1.26.
- C. Deformation: Standard deformation, StV, shall not exceed 5mm, per ANSI E1.26.
- D. Deformation Depression: W_{500} shall not exceed 20%, per ANSI E1.26.
- E. Rolling Load: Flooring system shall be rated for >1500N rolling load.
- F. Point Load: Flooring system shall be capable of handling the following loads. Adjust sleeper spacing and resilient pad size/thickness/durometer as required to meet criteria.
 - 1. Stage: 150 PSF

2.02 FLOORING SYSTEM

- A. Vapor Barrier: Minimum 6mil thickness, clear polyethylene film sheets; conforming to ASTM D2103-10; to full length of slab areas, maximum standard width to minimize jointing.
- B. Resilient Pads: Mason Industries Super W 4"x4"x3/4" Neoprene Pad or equivalent. Thickness, quantity and durometer to be selected to meet performance specifications of flooring system.
- C. Wood Sleepers: 2"x4" clear pine.

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- D. Insulation: Un-faced fiberglass insulation with thickness equal to 25%-50% of height of void below subfloor (approximately 1"). Install in continuous fashion between rows of resilient pads.
- E. Wood Subfloor: Two layers of ¾" void-free tongue and groove plywood.
- F. Performance Surface: ¼" S2S Linseed Tempered Hardboard.
- G. Finish: Rosco ToughPrime satin black primer.
- H. Vented Base Moulding: Base moulding with venting. See Architectural drawings for color and material.

2.03 APPROVED MANUFACTURERS

- A. American Harlequin Corporation
1531 Glen Ave.
Moorestown, NJ 08057
800.642.6440
www.harlequinfloors.com
- B. Stagestep, Inc.
4701 Bath St. #46B
Philadelphia, PA 19137
800.523.0960
www.stagestep.com
- C. Hur Flooring Company
15204 Stagg St.
Van Nuys, CA 91405
888.434.8449
www.hurflooring.com
- D. O'Mara Sprung Floors
3116 Eugene St.
Burton, MI 48519
810.743.8281
www.sprungfloors.com
- E. Junckers Hardwood
270 Lafayette St. #1200
New York, NY 10012
800.878.9663
www.junckers.com

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PART 3- EXECUTION

3.01 INSPECTION

- A. Examine existing concrete slab for proper installation.
- B. Verify required slab depression for accepted flooring system prior to wood floor installation.

3.02 FLOORING INSTALLATION

- A. Acclimatization: Wood performance flooring materials to be placed in stage area for at least 72 hours prior to installation.
- B. Moisture Protection: Place moisture barrier over entire slab area to receive wood flooring, overlapping joints 6 inches (150mm) and extending up walls 2 inches (50mm). Seal edges using a compatible sealant, as recommended by manufacturer.
- C. Sub-Floor: Install plywood with the seams of each layer offset as indicated in detail drawings.
- D. Performance Surface:
 - 1. Tempered Hardboard:
 - a. Install panels with long dimension running stage left/right. Provide an upstage/downstage seam at center stage.
 - b. Paint both sides and edges of panels with a minimum of 2 coats of specified finish and allow to cure at least 24 hours prior to panel installation.
 - c. Attach sacrificial layer with screws. Countersink and predrill screw holes to ensure a flat surface after installation.
- E. Provide expansion space at walls and terminations of flooring. At sides leave 1/4-inch space for every running 10 feet in width. In length, leave 1/8-inch space for every running 10 feet in length.
- F. Division and Trimming Strips: Apply wood strips, matching color and finish of flooring, where changes of floor finishes occur; apply metal plates and/or thresholds to cover spaces at doorways and changes in floor finish.
- G. Install at perimeter-void, air-flow cove base, 3" x 4", with ventilating ports. Fasten screws through base into plastic anchors set in walls. Screw heads shall be countersunk and color shall match base. Carefully miter inside and outside corners. Base material to be selected by architect.

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3.03 CLEANING

- A. After completion of this work, clean up and remove resultant debris from the site.

END OF SECTION

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SECTION 09 65 00 - RESILIENT FLOORING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Resilient tile flooring.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
 - 2. Section 09 65 13 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient flooring.
 - 1. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
- C. Samples: For each exposed product and for each color, texture, and pattern specified, in manufacturer's standard size, but not less than 6-by-9-inch sections.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for adhesives , indicating VOC content.
 - 2. Documentation for flooring products, indicating compliance with emissions testing or certification.
- B. Product Test Reports:
 - 1. Slip-resistance test reports from qualified independent testing agency.
- C. Qualification Data: For Installer.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of resilient flooring to include in maintenance manuals.

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1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for resilient flooring installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by resilient flooring manufacturer for installation techniques required.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive resilient flooring during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during resilient flooring installation.
- D. Close spaces to traffic for 48 hours after resilient flooring installation.
- E. Install resilient flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Adhesives:
 - a. VOC content limits for field applications.
 - 2. Flooring Products:
 - a. VOC emissions testing or certification.

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2.02 PERFORMANCE REQUIREMENTS

- A. Slip Resistance, Coefficient of Friction: Provide flooring with the following values as determined by testing identical products in accordance with the following:
 - 1. Level Surfaces, Dry and Wet: DCOF of not less than 0.42 in accordance with ANSI A326.3.

2.03 RESILIENT TILE FLOORING

- A. Solid Vinyl Floor Tile:
 - 1. Basis-of-Design Product: As indicated on Drawings.
 - 2. Tile Standard: ASTM F1700.
 - a. Class: Class III, Printed Film Vinyl Tile.
 - b. Type: A, Smooth Surface.
 - 3. Colors and Patterns: As indicated by manufacturer's designations.

2.04 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient flooring and substrate conditions indicated.
- C. High Performance Adhesives: Type recommended by manufacturer where heavy static or rolling loads exist.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient flooring.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrates according to resilient flooring manufacturer's written instructions to ensure adhesion of resilient flooring.

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- B. Concrete Substrates: Prepare according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient flooring manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient flooring until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient flooring.

3.03 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

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- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.04 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient flooring.
- B. Perform the following operations immediately after completing resilient flooring installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient flooring from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient flooring until Substantial Completion.

END OF SECTION

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SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for adhesives, indicating VOC content.
 - 2. Documentation for resilient base, indicating compliance with emissions testing or certification.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.05 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.

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- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Allstate Rubber Corp.
 - 2. Flexco.
 - 3. Johnsonite.
 - 4. Mannington Commercial.
 - 5. Roppe.
 - 6. VPI, LLC, Floor Products Division.

2.02 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Adhesives:
 - a. VOC content limits for field applications.
 - 2. Resilient Base:
 - a. VOC emissions testing or certification.

2.03 RESILIENT BASE

- A. Product Standard: One of the following:
 - 1. ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 - 2. ASTM F1861, Type TP (rubber, thermoplastic).
 - 3. ASTM F1861, Type TV (vinyl, thermoplastic).
- B. Style and Location:
 - 1. Style A, Straight: Provide in areas with carpet.
 - 2. Style B, Cove: Provide in areas with resilient floor coverings.
- C. Thickness: 0.125 inch.
- D. Height: As indicated on Drawings.

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- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed or preformed.
- G. Inside Corners: Job formed or preformed.
- H. Colors: As indicated by manufacturer's designations .

2.04 MOLDING ACCESSORIES

- A. Description: Provide rubber or vinyl molding accessories as follows:
 - 1. As indicated on drawings.
- B. Profile and Dimensions: As indicated.
- C. Locations: Provide rubber molding accessories in areas indicated.
- D. Colors and Patterns: As indicated by manufacturer's designations.

2.05 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

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- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.03 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.04 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

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3.05 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

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SECTION 09 68 13 - TILE CARPETING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Modular carpet tile.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
 - 2. Section 02 41 19 "Selective Demolition" for removing existing floor coverings.
 - 3. Section 09 65 13 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Pile direction.
 - 8. Type, color, and location of insets and borders.
 - 9. Type, color, and location of edge, transition, and other accessory strips.
 - 10. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.

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1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for adhesives, indicating VOC content.
 - 2. Documentation for flooring products, indicating compliance with emissions testing or certification.
- B. Qualification Data: For Installer.
- C. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- D. Sample Warranty: For special warranty.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Carpet and Rug Institute's CRI 104.

1.07 FIELD CONDITIONS

- A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

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- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.08 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 2. Failures include, but are not limited to, the following:
 - a. More than 10 percent edge raveling, snags, and runs.
 - b. Dimensional instability.
 - c. Excess static discharge.
 - d. Loss of tuft-bind strength.
 - e. Loss of face fiber.
 - f. Delamination.
 3. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
1. Adhesives:
 - a. VOC content limits for field applications.
 2. Flooring Products:
 - a. VOC emissions testing or certification.

2.02 CARPET TILE

- A. Products: As indicated on drawings.
- B. Performance Characteristics:
1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
 2. Optical Smoke Density Rating: Does not exceed 450 according to ASTM E662.

2.03 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

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- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

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- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.03 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns indicated on Drawings or recommended in writing by carpet tile manufacturer.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

3.04 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

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END OF SECTION

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SECTION 09 72 11 - TACKABLE WALL COVERINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Tackable wall coverings.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show location and extent of each wall-covering type. Indicate termination points.
- C. Samples
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wall coverings.
- E. Maintenance Data: For wall covering to include in maintenance manuals.

1.03 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Surface-Burning Characteristics: As follows, per ASTM E 84:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.

PART 2 - PRODUCTS

2.01 TACKABLE WALL COVERING

- A. Tackable Wall Covering Material:
 - 1. Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish with surface-burning characteristics indicated.
 - 2. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with integral color throughout with surface-burning characteristics indicated.

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2.02 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application; as recommended in writing by wall-covering manufacturer.
- B. Primer/Sealer: Mildew resistant, complying with requirements in Division 09 Section "Painting" and recommended in writing by wall-covering manufacturer for intended substrate.
- C. Aluminum Frames[**and Trim**]: Fabricated from not less than 0.062-inch- thick, extruded aluminum; [**standard size and shape**] [**slim size and standard shape**] [**of size and shape indicated on Drawings**] <Insert size and shape>.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.
- B. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
 - 2. Metals: If not factory primed, clean and apply metal as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 3. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 4. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- C. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- D. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.
- E. Match pattern 72 inches above the finish floor.
- F. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
- G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.
- H. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.

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- I. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION

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SECTION 09 81 00 - ACOUSTIC INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Acoustic blanket insulation.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.03 QUALITY ASSURANCE

- 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.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.02 ACOUSTIC INSULATION

- A. Acoustic Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Thickness:
 - a. Partitions: As required to fill cavity.
 - b. Above Suspended Ceilings: 12 inches, unless otherwise indicated.
 - 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Partitions:
 - 1) Johns Manville; Unfaced Fiberglass Batts.
 - 2) Owens Corning; Pink Next Gen Sound Attenuation Batts.
 - b. Above Suspended Ceilings:
 - 1) Johns Manville; Unfaced Fiberglass Batts.

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- 2) Owens Corning; Pink Next Gen Sound Attenuation Batts.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- 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. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness.
- E. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by attaching flanges of insulation to flanges of studs.
 - 5. Where acoustic blankets are indicated for sound attenuation above ceilings, install acoustic blanket insulation over entire ceiling area in thicknesses indicated.

END OF SECTION

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SECTION 09 84 33 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes shop-fabricated, fabric-wrapped, sound-absorbing wall panel units tested for acoustical performance.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For sound-absorbing wall units. Include mounting devices and details.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Product certificates.
- E. Maintenance data.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide sound-absorbing wall units meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 or NFPA 286.

2.02 SOUND-ABSORBING WALL UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
 - 1. Acoustical Panel Systems (APS, Inc.).
 - 2. Acoustical Solutions, Inc.
 - 3. Armstrong World Industries.
 - 4. AVL Systems, Inc.
 - 5. Benton Brothers Solutions, Inc.
 - 6. Conwed Designscape; an Owens Corning company.
 - 7. Decoustics Limited; a CertainTeed Ceilings company.

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8. Essi Acoustical Products.
9. Golterman & Sabo.
10. Kinetics Noise Control, Inc.
11. Lamvin, Inc.
12. MBI Products Company, Inc.
13. Panel Solutions, Inc.
14. Perdue Acoustics.
15. Pinta Acoustic, Inc.
16. Proudfoot Company, Inc. (The).
17. Sound Concepts Canada, Inc.
18. Sound Management Group LLC.
19. Tectum Inc.
20. Wall Technology, Inc.; an Owens Corning company.
21. Working Walls, Inc.

- B. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core.
1. Basis-of-Design Product: Indicated on Drawings.
 2. Mounting: Back mounted with manufacturer's standard adhesive tape strips , secured to substrate.
 3. Core: Manufacturer's standard .[**Provide wood or plywood nailing strips in core where indicated.**]
 4. Edge Construction: Manufacturer's standard.

2.03 MATERIALS

- A. Core Materials: Manufacturer's standard.
- B. Facing Material: Fabric from same dye lot; color and pattern as indicated by manufacturer's designations.
- C. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit.

2.04 FABRICATION

- A. General: Use manufacturer's standard construction except as otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
1. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent units.

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- C. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install sound-absorbing wall units in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with sound-absorbing wall unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align and level fabric pattern and grain among adjacent units.
- D. Clip loose threads; remove pills and extraneous materials.
- E. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

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SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Surface preparation and the application of paint systems on interior and exterior substrates.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 DEFINITIONS

- A. Sheen Levels:
 - 1. Flat: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
 - 2. Eggshell: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
 - 3. Satin: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
 - 4. Semi-Gloss: 35 to 70 units at 60 degrees, according to ASTM D523.
 - 5. Gloss: 70 units and greater at 60 degrees, according to ASTM D523.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include preparation requirements and application instructions.
 - 2. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.

1.04 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for paints and coatings, indicating VOC content.

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1.05 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 3 articles for the paint category indicated.
- B. Source Limitations: Obtain products for each coating system from single source from single manufacturer.

2.02 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Paints and Coatings:
 - a. VOC content limits for field applications.

2.03 PAINT PRODUCTS, GENERAL

- A. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. Colors: As indicated in a color schedule.

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PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Masonry (Clay and CMUs): 12 percent.
 - 2. Wood: 15 percent.
 - 3. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

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- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates:
 - 1. Metal Substrates Galvanized in Accordance with ASTM A 123 and ASTM A 153: Prepare substrates in accordance with ASTM D 6386.
 - 2. Other Galvanized Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.03 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

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- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
 - 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.04 FIELD QUALITY CONTROL

- A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

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3.05 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, 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 painted surfaces.

3.06 INTERIOR PAINTING SCHEDULE

- A. Gypsum Board; Acrylic Latex: Provide one of the following systems:
 - 1. Benjamin Moore:
 - a. Primer: Ultra Spec 500 Interior Latex Primer.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: Ultra Spec 500 Interior.
 - d. Sheen:
 - 1) Walls: Eggshell, unless indicated otherwise.
 - 2) Ceilings: Flat, unless indicated otherwise.
 - 2. Sherwin Williams:
 - a. Primer: ProMar 200 Zero VOC Interior Latex Primer B28 Series.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: ProMar 200 Zero VOC Interior Latex.
 - d. Sheen:
 - 1) Walls: Eggshell, unless indicated otherwise.
 - 2) Ceilings: Flat, unless indicated otherwise.
 - 3. PPG:
 - a. Primer: Speedhide ZERO VOC Interior Latex Primer.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: Speedhide ZERO VOC Interior Latex.
 - d. Sheen:
 - 1) Walls: Eggshell, unless indicated otherwise.
 - 2) Ceilings: Flat, unless indicated otherwise.
- B. Wood Trim, Wood Doors, Wood Frames and Other Interior Wood and Wood-Based Items as Indicated; Acrylic Latex. Provide one of the following systems:
 - 1. Benjamin Moore:
 - a. Primer: Ultra Spec 500 Interior Latex Primer.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: Advance Waterborne Interior Alkyd.
 - d. Sheen: Semi-gloss, unless indicated otherwise.
 - 2. Sherwin Williams:
 - a. Primer: S-W PrepRite Multi-Purpose Latex Primer.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: Promar 200 WB Acrylic Alkyd.
 - d. Sheen: Semi-gloss, unless indicated otherwise.

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3. PPG:
 - a. Primer: Speedhide Interior Sealer Quick Drying 6-2.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: Speedhide Int/Ext Water Borne Alkyd.
 - d. Sheen: Semi-gloss, unless indicated otherwise.
- C. Ferrous and Non Ferrous Metals Including: Exposed metal fabrications, steel doors, steel door frames, grilles, panels, stairs, railings, and other miscellaneous metal items indicated; Direct to Metal Acrylic. Provide one of the following systems:
 1. Rustoleum Sierra Performance:
 - a. Primer: S-37 System Metalmax DTM Acrylic Urethane.
 - b. Intermediate Coat: None required.
 - c. Top Coat: Same as Primer.
 - d. Sheen: Semi-gloss, unless indicated otherwise.
 2. Sherwin Williams:
 - a. Primer: Pro Industrial ProCryl Primer B66-1300.
 - b. Intermediate Coat: None required.
 - c. Top Coat: Pro Industrial Acrylic B66-1151 Series.
 - d. Sheen: Semi-gloss, unless indicated otherwise.
 3. PPG:
 - a. Primer: Pitt-Tech Plus EP PRIMER Int/Ext Rust Inhibitive Primer.
 - b. Intermediate Coat: None required.
 - c. Top Coat: 90-1610 Pitt-Tech Plus EP DTM Light Industrial.
 - d. Sheen: Semi-gloss, unless indicated otherwise.
- D. **[Concrete] [and] [Concrete Masonry]**; Acrylic Latex: Provide one of the following systems:
 1. Benjamin Moore:
 - a. Primer:
 - 1) Concrete: Super Spec Masonry Interior/Exterior 100% Acrylic Masonry Sealer N/066.
 - 2) Concrete Masonry: Super Spec Latex Block Filler 160.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: Ultra Spec 500 Interior.
 - d. Sheen: Eggshell, unless indicated otherwise.
 2. Sherwin Williams:
 - a. Primer:
 - 1) Concrete: Loxon Concrete & Masonry Primer.
 - 2) Concrete Masonry: PrepRite Block Filler.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: ProMar 200 Zero VOC Eg-Shel, B20 Series.
 - d. Sheen: Eggshell, unless indicated otherwise.
 3. PPG:
 - a. Primer:
 - 1) Concrete: Perma-Crete Interior/Exterior Alkali Resistant Primer.

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- 2) Concrete Masonry: Speedhide Interior/Exterior Masonry Block Filler Latex 6-7 Series.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: Speedhide ZERO VOC Eggshell, 6-53XX Series.
 - d. Sheen: Eggshell, unless indicated otherwise.
- E. Mechanical And Electric Equipment Items: Provide one of the following systems:
- 1. Tnemec:
 - a. One Coat: Uni-Bond DF Series 115; 3.0 DFM.
 - b. Color: White.
 - 2. PPG:
 - a. One Coat: Speedhide Super Tech Interior Dry Fog Flat 6-723XI.
 - b. Color: White.

END OF SECTION

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SECTION 10 11 00 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Markerboards.
 - 2. Tackboards.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of panel joints.
 - 2. Include sections of typical trim members.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Maintenance Data: For visual display surfaces to include in maintenance manuals.
- E. Warranties: Sample of special warranties.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 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.

1.04 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period: 50 years from date of Substantial Completion.

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1.05 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Lighting: Do not install wall covering until a permanent level of lighting is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Claridge Products and Equipment, Inc.
 - b. PolyVision Corporation; a Steelcase company.
- B. Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish[**with surface-burning characteristics indicated**].
- C. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout[**with surface-burning characteristics indicated**].
- D. Hardboard: ANSI A135.4, tempered.
- E. Particleboard: ANSI A208.1, Grade M-1.
- F. Fiberboard: ASTM C 208.
- G. Extruded Aluminum: ASTM B 221, Alloy 6063.

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2.02 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application; as recommended in writing by wall-covering manufacturer.
- B. Primer/Sealer: Mildew resistant, complying with requirements in Division 09 Section "Painting" and recommended in writing by wall-covering manufacturer for intended substrate.

2.03 MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and porcelain-enamel face sheet with **[high]** **[low]**-gloss finish.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Best-Rite Manufacturing.
 - b. Claridge Products and Equipment, Inc.
 - c. Egan Visual Inc.
 - d. Ghent Manufacturing, Inc.
 - e. Marsh Industries, Inc.; Visual Products Group.
 - f. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 - g. PolyVision Corporation; a Steelcase company.
 - 2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
 - 3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

2.04 TACKBOARD ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Best-Rite Manufacturing.
 - 2. Claridge Products and Equipment, Inc.
 - 3. Egan Visual Inc.
 - 4. Ghent Manufacturing, Inc.
 - 5. Marsh Industries, Inc.; Visual Products Group.
 - 6. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 - 7. PolyVision Corporation; a Steelcase company.
- B. Natural-Cork Tackboard **<Insert designation>**: 1/4-inch- thick, natural cork sheet factory laminated to 1/4-inch- thick **[hardboard]** **[particleboard]** backing.

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- C. Plastic-Impregnated-Cork Tackboard **<Insert designation>**: 1/4-inch- thick, plastic-impregnated cork sheet factory laminated to 1/4-inch- thick **[hardboard]** **[particleboard]** backing.

2.05 MARKERBOARD AND TACKBOARD ACCESSORIES

- A. Aluminum Frames**[and Trim]**: Fabricated from not less than 0.062-inch- thick, extruded aluminum; **[standard size and shape]** **[slim size and standard shape]** **[of size and shape indicated on Drawings]** **<Insert size and shape>**.
1. Field-Applied Trim: Manufacturer's standard, **[snap-on trim with no visible screws or exposed joints]** **[slip-on trim]** **[screw-on trim with Phillips flat-head screws]**.
 2. Factory-Applied Trim: Manufacturer's standard.
- B. Factory-Applied Wood Trim: **[Red oak]** **[Walnut]** **[Manufacturer's standard species]** **<Insert species>**, not less than 1/2 inch thick; **[standard size and shape]** **[of size and shape indicated on Drawings]** **<Insert size and shape>**.
- C. Field-Applied Wood Trim: Comply with requirements specified in Division 06 Section **"[Finish Carpentry]** **[Interior Architectural Woodwork]**."
- D. Chalktray: Manufacturer's standard, continuous.
1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
 2. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.
- E. Map Rail: Provide the following accessories:
1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 inches wide.
 2. End Stops: Located at each end of map rail.
 3. Map Hooks: **[Two]** **<Insert number>** map hooks for every [48 inches] **[1200 mm]** **<Insert dimension>** of map rail or fraction thereof.
 4. Map Hooks and Clips: **[Two]** **<Insert number>** map hooks with flexible metal clips for every [48 inches] **[1200 mm]** **<Insert dimension>** of map rail or fraction thereof.
 5. Flag Holder: **[One]** **<Insert number>** for each room.
 6. Paper Holder: Extruded aluminum; designed to hold paper by clamping action.

2.06 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.

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- B. Visual Display Boards: **[Factory]** **[Field]** assemble visual display boards unless otherwise indicated.
1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.
- C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.
1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, **[balanced around center of board, as acceptable to Architect]** **[as indicated on approved Shop Drawings]**.
 2. Provide manufacturer's standard vertical-joint **[spline]** **[H-trim]** system between abutting sections of **[chalkboards]** **[markerboards]**.
 3. Provide manufacturer's standard mullion trim at joints between **[chalkboards]** **[markerboards]** **[and]** **[tackboards]** of combination units.
 4. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.
- D. Modular Visual Display Boards: Fabricated with integral panel clips attached to core material.
- E. Aluminum Frames **[and Trim]**: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.07 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.

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- B. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- C. Field-Assembled Visual Display Units: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.
 - 1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, **[balanced around center of board, as acceptable to Architect] [as indicated on approved Shop Drawings]**.
 - 2. Provide manufacturer's standard vertical-joint **[spline] [H-trim]** system between abutting sections of **[chalkboards] [markerboards]**.
- D. Visual Display Boards: Attach visual display boards to wall surfaces with **[egg-size]** **<Insert coverage>** adhesive gobs at 16 inches o.c., horizontally and vertically.
- E. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches o.c. Secure both top and bottom of boards to walls.
 - 1. Field-Applied Aluminum Trim: Attach trim over edges of visual display boards and conceal grounds and clips. Attach trim to boards with fasteners at not more than 24 inches o.c.
 - a. Attach chalktrays to boards with fasteners at not more than 12 inches o.c.
 - 2. Field-Applied Wood Trim: Install trim according to requirements in Division 06 Section "**[Finish Carpentry] [Interior Architectural Woodwork]**."
- F. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room. Cover and protect visual display surfaces.

END OF SECTION

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SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Panel signs.
 - 2. Post-and-panel signs.
 - 3. Dimensional characters.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
 - 2. Division 26 for illuminated, self-luminous, and photoluminescent exit sign units.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Product Schedule: For signs. Use same designations indicated on Drawings or specified.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for adhesives, indicating VOC content.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

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PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Adhesives:
 - a. VOC content limits for field applications.

2.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.
- B. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- C. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and California Building Code, Chapter 11.

2.03 PANEL SIGNS

- A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ACE Sign Systems, Inc.
 - b. Advance Corporation.
 - c. Allen Industries Architectural Signage.
 - d. Allen Markings.
 - e. APCO Graphics, Inc.
 - f. ASE, Inc.
 - g. ASI Sign Systems, Inc.
 - h. Best Sign Systems, Inc.
 - i. Bunting Graphics, Inc.
 - j. Clarke Systems.
 - k. Cosco.
 - l. Diskey Architectural Signage Inc.
 - m. Fossil Industries, Inc.
 - n. Inpro Corporation.
 - o. Mohawk Sign Systems.
 - p. Nelson-Harkins Industries.
 - q. Poblocki Sign Company, LLC.
 - r. Seton Identification Products; a Brady Corporation company.

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- s. Signs & Decal Corp.
- t. Stamprite Supersine; a division of Stamp Rite Inc.
- u. Vista System.
- v. Vomar Products, Inc.
- 2. Sign Material: As indicated on Drawings .
 - a. Surface-Applied, Flat Graphics: Applied vinyl film or baked enamel or powder coat.
 - b. Surface-Applied, Raised Graphics: Applied polymer characters and Braille.
- 3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: As indicated on Drawings.
 - b. Corner Condition in Elevation: As indicated on Drawings .
- 4. Mounting: As indicated on Drawings .

2.04 POST-AND-PANEL SIGNS

- A. Exterior Parking Sign: Sign of single-panel configuration; with smooth, uniform surfaces and support assembly; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Sign Material: Galvanized steel or aluminum sheet:
 - a. Surface-Applied Finish and Graphics: Engineer-grade reflective finish.
 - 1) Color: As indicated on Drawings.
 - 2. Posts: Steel.
 - a. Shape: As indicated on Drawings.
 - b. Size: As indicated on Drawings.
 - c. Installation Method: As indicated on Drawings .

2.05 DIMENSIONAL CHARACTERS

- A. Cutout Characters: Characters with uniform faces; square-cut, smoothed edges; precisely formed lines and profiles; and as follows:
 - 1. Basis-of-Design Products: Subject to compliance with requirements, provide Matthews Architectural Products; Metal Letters, or comparable product by one of the following:
 - a. A.R.K. Ramos.
 - b. ACE Sign Systems, Inc.
 - c. APCO Graphics, Inc.
 - d. ASI Sign Systems, Inc.
 - e. Cosco.
 - f. Diskey Sign Company.
 - g. Gemini Signage; Gemini, Inc.
 - h. Metal Arts.
 - i. Metallic Arts.
 - j. Southwell Company (The).
 - k. Steel Art Company.
 - l. inpro Corporation.
 - 2. Character Material: Sheet or plate aluminum .
 - 3. Character Height: As indicated on Drawings.

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4. Thickness: As indicated on Drawings.
5. Finishes:
 - a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
6. Mounting: As indicated on Drawings .

2.06 SIGN MATERIALS

- A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D4802, Type UVF (UV filtering).
- D. Polycarbonate Sheet: Coated, mar-resistant, UV-stabilized polycarbonate, with coating on both sides.
- E. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

2.07 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:
 1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
- B. Adhesive: As recommended by sign manufacturer.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.08 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.

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3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into indicated sign surface to produce precisely formed copy, incised to uniform depth.
1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
 2. Engraved Opaque Acrylic Sheet: Fill engraved graphics with manufacturer's standard enamel.
 3. Face-Engraved Clear Acrylic Sheet: Fill engraved copy with manufacturer's standard enamel. Apply manufacturer's standard opaque background color coating to back face of acrylic sheet.
- C. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.
- D. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
- E. Post Fabrication: Fabricate posts designed for structural performance indicated and of lengths required for installation method indicated for each sign.
1. Steel Posts: Fabricate from minimum 0.120-inch- thick, steel tubing unless otherwise indicated.
 - a. Hot-dip galvanize post assemblies after fabrication according to ASTM A123/A123M.
 2. Direct Burial: Fabricate posts 36 inches longer than height of sign to permit direct burial or embedment in concrete foundations or concrete-filled postholes.
 3. Baseplates: Fabricate posts with baseplates welded to bottom of posts. Drill holes in baseplate for anchor-bolt connection.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

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4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Accessible Signage: Install in locations on walls as indicated on Drawings and according to the accessibility standard.
- C. Mounting Methods:
1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
 3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
 4. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
 5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
 6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
- D. Remove temporary protective coverings and strippable films as signs are installed.

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3.02 INSTALLING POSTS

A. Direct-Burial Method:

1. Excavation: Excavate posthole to dimensions indicated. Reconstruct subgrade that is not firm, undisturbed, or compacted soil, or that is damaged by freezing temperatures, frost, rain, accumulated water, or construction activities by excavating an additional 12 inches, backfilling with satisfactory soil or well-graded aggregate, and compacting to original subgrade elevation.
2. Setting in Earth: Set post in position, support to prevent movement, and backfill with satisfactory soil or well-graded aggregate as recommended in writing by manufacturer. Place and compact backfill in 6-inch lifts, compacting each lift.
3. Setting in Cast-in-Place Concrete: Set post in position, support to prevent movement, and place concrete for concrete foundation as indicated on Drawings.
4. Setting in Preformed Hole in Concrete Foundation: Form or core drill holes in concrete foundation not less than 3/4 inch larger than outside dimension of post for installing posts in concrete. Set post in position, shim to prevent movement, and fill annular space between post and hole with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.

B. Baseplate Method:

1. Preset Anchor Bolts: Set post baseplate in position over anchor bolts projecting from concrete foundation, shim and support post to prevent movement, place washers and nuts, and tighten. Fill shim space with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.
2. Drilled-in-Place Anchor Bolts: Set post baseplate in position over concrete foundation, locate and drill anchor holes, shim and support post to prevent movement, place washers and anchor bolts, and tighten. Fill shim space with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.

END OF SECTION

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SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Abuse-resistant wall coverings.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
 - 1. Include plans, elevations, sections, and attachment details.
- C. Samples: For each exposed product and for each color and texture specified, 12 inches long.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for adhesives, indicating VOC content.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
 - 2. Keep plastic materials out of direct sunlight.
 - 3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

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PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.02 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Adhesives:
 - a. VOC content limits for field applications.

2.03 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.

2.04 ABUSE-RESISTANT WALL COVERINGS

- A. Abuse-Resistant Sheet Wall Covering: Fabricated from semirigid, plastic sheet wall-covering material.
 - 1. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings or comparable products by one of the following:
 - a. Construction Specialties, Inc.
 - b. Inpro Corporation.
 - c. Koroseal Interior Products, LLC.
 - 2. Color and Texture: As indicated by manufacturer's designations.
 - 3. Height: As indicated.
 - 4. Trim and Joint Moldings: Extruded rigid plastic that matches wall-covering color.
 - 5. Mounting: Adhesive.

2.05 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Adhesive: As recommended by protection product manufacturer.

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2.06 FABRICATION

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.07 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

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3.03 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Abuse-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.04 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

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SECTION 10 82 00 - GRILLES AND SCREENS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fixed, formed-metal screens.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include fabrication and installation layouts of grille and screen panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
- C. Samples: For each type of metal finish required.

1.03 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.04 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design grilles and screens and support system, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.

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- B. Structural Performance: Grilles and screens shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
 - 2. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- C. Seismic Performance: Grilles and screens, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.02 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. Provide materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.03 MATERIALS

- A. Owner-Furnished Material: Weathering steel metal plate wall panels.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Dissimilar Metals: Type 304 stainless-steel fasteners.
- D. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.

2.04 FABRICATION, GENERAL

- A. Fabricate grilles and screens to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of surfaces exposed to public view.

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2. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

- B. Join frame members to each other with fillet welds, threaded fasteners, or both, as standard with manufacturer unless otherwise indicated or size of assembly makes bolted connections between frame members necessary.

2.05 SCREENS

- A. Fabricate screens from perforated weathering steel sheet or plate of thickness, size, and pattern indicated. Form perforations by punching, cutting, or drilling to produce openings of sizes and shapes indicated. Roll, press, and grind perforated metal to flatten and to remove burrs and deformations.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Attachment Assembly, General: Install attachment assembly required to support grilles and screens including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
 1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
- B. Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard horizontal and vertical members that provide support and secondary drainage assembly, draining to the exterior at horizontal joints.
 1. Install grille and screen panels to allow individual panels to be installed and removed without disturbing adjacent panels.
- C. Provide anchorage devices and fasteners where needed to secure to in-place construction.
- D. Perform cutting, drilling, and fitting required. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.

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- F. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- G. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.
- H. Protect galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint.

3.02 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align grille and screen units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.03 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as units are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, clean finished surfaces as recommended by manufacturer. Maintain in a clean condition during construction.
- B. Replace grilles and screens that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 11 61 00 - THEATRICAL LIGHTING SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Construction Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.
- B. TL Drawings.

1.02 REFERENCES

- A. National Fire Protection Association (NFPA)
- B. National Electrical Code (NEC)
- C. American National Safety Institute (ANSI)
- D. Entertainment Services and Technology Association (ESTA)
- E. National Electrical Manufacturers Association (NEMA).
- F. California State and City of Mammoth Lakes Building Code.

1.03 RESPONSIBILITY AND RELATED WORK

- A. The written specification and drawings TL0.00 through TLX.XX shall be collectively referred to herein as the Contract Documents.
- B. Contractor shall provide, based on the Contract Documents, a complete, turnkey system, tested and ready for acceptance testing. The Contract Documents are developed to the extent required to properly convey design intent and system infrastructure. It is understood by the contractor that they are to supply additional equipment, as required, to provide a complete and working system.
- C. System features or devices which are mentioned in one part of the Contract Documents may not be shown in the other. In case of conflict between the written specifications and the drawings, Contractor must seek clarification from the Consultant. If the Contractor fails to obtain such clarification, the interpretation of the Consultant will prevail.
- D. Contractor shall obtain all licenses and permits necessary for the execution of any work pertaining to the installation within this scope of work.
- E. Refer to TL0.00 for division of responsibilities related to the theatrical lighting system.

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1.04 DEFINITION OF TERMS & ABBREVIATIONS:

- A. Provide: to supply and install.
- B. Furnish: to supply to another contractor for installation.
- C. Supply: to supply but not install.
- D. Install: to install but not supply.
- E. OFE: Owner furnished (supplied) equipment. Equipment will be provided to contractor for installation.
- F. NIC: Not In Contract. Refers to items that are not included in the scope of work outlined in this section but may be shown for coordination purposes or reference.
- G. Future: Equipment that will be provided by owner later. Accommodations shall be provided for future equipment as shown on the drawings.

1.05 SYSTEM DESCRIPTION

- A. The theatrical lighting system will also control the architectural lighting in the auditorium, allowing for a single integrated point of control. The theatrical lighting system will use LED-based lighting fixtures where practical, to reduce the operating cost and maintenance effort required to keep the system running.
- B. LIGHTING POWER AND CONTROLS
 - 1. Fixtures with integrated dimming capabilities will be used. No dimmer rack or portable dimmer packs will be provided. Non-dimmed power circuits will be distributed to the lighting positions that will accommodate these fixtures (LED or automated lights) as well as providing the opportunity for temporary portable dimmer packs to be used with conventional light fixtures if desired.
 - 2. Controls for the theatrical lighting system will include:
 - a. Entry stations to control the house lighting. These will be button stations positioned at each door to the space, including backstage entrances.
 - b. The buttons will recall presets that include both architectural and theatrical fixtures.
 - c. Activation of the main lighting control console will lock out these stations to prevent accidental lighting changes during performances.
 - d. A lighting control console with at least 4 DMX Universes (expandable to at least 8), sACN (lighting) network connectivity, and the ability to support a minimum of 2 touch screen monitors.
 - e. A remote focus app that can be used with iOS and Android devices via WiFi connected to the lighting network.
 - f. A stage manager's panel, with DMX inputs to the DMX distribution system, and a touchscreen that can control basic theatrical and house lighting presets as well as AV functions.

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C. LIGHTING INSTRUMENTS

1. The lighting instrument package will include:
 - a. LED Ellipsoidals (beam angles TBD)
 - b. LED PARs
 - c. LED Cyc Lights
 - d. Followspot(s)
 - e. LED Work Lights above the stage will be controlled via the theatrical lighting controls system. These lights may be part of the electrical package. Running lights will consist of low-level path lighting using blue LED fixtures in designated areas. These lights will be part of the electrical package. Cue lighting is not anticipated in this project.

D. LOOSE EQUIPMENT

1. The loose equipment package will consist of:
 - a. DMX cables
 - b. Cat5e Ethernet cables with Ethercon connectors
 - c. 20A Powercon and TRUE1 extension cables
 - d. Powercon to SPG adapters
 - e. 50lb weighted bases
 - f. 1.5" ID pipes of varying lengths
 - g. Rotolocks

1.06 PRE-BID SUBMITTALS

- A. Comply with all requirements of Division 1.
- B. Bid Clarifications. Contractor is responsible for reading and understanding all information presented in these specifications and related documents outlined in Section 1. Discrepancies between drawings and specifications or other errors or omissions should be brought to the Consultant's attention a minimum of 5 days prior to bid date. Failure to do so does not relieve the contractor from the requirement to provide a fully operational and turnkey system. In this event, the Contractor agrees to abide by the decision of the Consultant for resolution.
- C. Contractor Qualifications. The following contractors are pre-qualified for this project. Additional contractors will be considered by the Owner and Consultant upon receipt of qualifications as outlined in Bid Submittals section below.

| | |
|---|---|
| Contractor Name Contact: Email: Phone: Address: | Contractor Name Contact: Email: Phone: Address: |
| Contractor Name Contact: Email: Phone: | Contractor Name Contact: Email: Phone: |

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| | |
|----------|----------|
| Address: | Address: |
|----------|----------|

1.07 BID SUBMITTALS

- A. Comply with all requirements of Division 1.
- B. Submit according to conditions of the Construction Contract and Project Manual.
- C. Bidders that have not been pre-qualified shall submit the following information:
 - 1. Company profile including history, number of employees, facility size and completed projects.
 - 2. Installer shall have previously installed at least three jobs of similar magnitude, completed within the last five years. A resume shall be provided for these projects including project name, scope of services, year completed, and contact information for a reference. Provide at least one such completed job for inspection by the Architect and/or consultant.
 - 3. Installer shall have five years of experience with equipment and systems of the types specified, shall maintain a fully staffed and equipped service facility, and shall be a franchised dealer and authorized service facility for the major brands specified, and shall be properly licensed to work in Enter Project City, Enter Project State
 - 4. Resume of key personnel to be used on this project, including but not limited to: Project Manager; Lead Engineer; Job-Site Superintendent.
 - 5. A sample set of shop drawings or as-built documents that confirm the Contractor's capabilities to provide engineering and documentation for the project.
 - 6. A line sheet listing all manufacturers the Contractor is a dealer and/or authorized service center for.
 - 7. A description of the Contractor's abilities for in-shop assembly, fabrication, and testing.
- D. The Bidder shall disclose in the bid whether any portions of the project work will be subcontracted out. All terms of this contract, including bidding and qualification statements, shall apply to the subcontractor. Provide the following information for each subcontractor to be used:
 - 1. Name of the proposed subcontractor.
 - 2. A statement of qualifications for each subcontractor.
 - 3. A scope of work outlining what portions of the project for which the subcontractor will be responsible.
- E. Include the following information with the bid submittal:
 - 1. The total contract price.
 - 2. The total price for any add or deduct alternates.
 - 3. The price for contractor tests and adjustments as outlined in Section 3.3.
 - 4. An itemized equipment list.
 - 5. Unit pricing for all equipment listed above.
 - 6. A breakdown of the number of labor hours for each of the following:
 - a. Engineering and documentation.

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- b. On site coordination meetings and supervision.
 - c. In shop fabrication and assembly.
 - d. On site fabrication, assembly, and installation.
 - e. On site verification and testing.
 - F. Substitutions. Contractor shall note all substitutions at the time of bid. Any proposed substitutions must meet all specifications of the specified equipment. No product substitution will be accepted without the written approval of the Consultant or Owner. Consultant and owner retain the right to reject any proposed substitution.
 - G. Contractor to obtain all licenses and permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner.
- 1.08 PROJECT SUBMITTALS
- A. Comply with all requirements of Division 1.
 - B. Submit according to conditions of the Construction Contract and Project Manual.
 - C. Make each specified submittal as a coordinated package complete with all information. Uncoordinated sets will be returned without review.
 - D. Product Data: Submit within 30 days of contract award. Submit manufacturer's product data sheets for each item of equipment that will be provided as part of this contract. Submit electronically as a single PDF. All equipment cut sheets will be arranged per specification section number. Provide a table of contents and a bookmark at the start of every product sheet.
 - E. Shop Drawings
 - 1. Submit within 60 days of contract award.
 - a. Failure to submit shop drawings with ample time for evaluation shall not entitle the contractor to an extension of contract time.
 - b. There will be no work authorized on site without the prior submittal (and subsequent approval) of a complete set of shop drawings. Any exceptions to this must be in writing and approved by the Consultant.
 - c. Review of shop drawings is for general conformance with the design intent and general compliance with the contract documents of the project. Corrections, comments or markings made do not relieve the Contractor from compliance with the Contract Documents nor allow departure there from. Contractor remains responsible for detailing and accuracy, confirming and correlating quantities and dimensions, selecting fabrication processing and techniques of construction, coordinating work with that of other trades, and performing work in a safe a satisfactory manner.
 - 2. Submitted as a multi-sheet PDF document with:
 - a. Minimum 11" x 17" sheets
 - b. Table of Contents.
 - c. Bookmarks for every sheet with Sheet Name and Number

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3. Drawings shall be a standalone package containing all information required for system installation. The package shall include:
 - a. A legend of all symbols and abbreviations used in the drawing package
 - b. Plan View Drawings showing:
 - 1) Locations of all equipment and devices
 - 2) Locations of junction boxes, with associated conduits and cable fill
 - 3) Coordinated layouts of:
 - a) Equipment Rooms
 - b) Control Booths
 - c) Follow Spot Booths
 4. Section and Elevation Drawings including but not limited to:
 - a. Lighting fixture hang positions
 5. Equipment Rack Elevations including:
 - a. Location of all equipment within the rack
 - b. Heat loads for each equipment rack and calculations showing how numbers were derived
 6. AC Power Requirements
 - a. For each equipment rack show:
 - 1) Power requirements and calculations showing how numbers were derived
 - 2) Power distribution details within each rack
 7. Rigging Detail Drawings
 - a. Details will be submitted with licensed engineer stamp licensed in the state in which the project resides.
 - b. Drawings will include:
 - 1) Structural attachment details
 - 2) Welding calculations
 - 3) Types of hardware to be used
 8. Wiring Schematics
 - a. Complete and detailed wiring schematic for all systems including:
 - 1) Cable types
 - 2) Identification by number and color codes
 - 3) Detailed wiring of connections to equipment and between equipment racks
 9. Schematic drawings of any custom circuitry or equipment modifications, including connector pin-outs and component lists.
- F. Schedules showing:
1. Cable Types
 - a. Type Identifier matching Contract Documents
 - b. Manufacturer
 - c. Part Number
 - d. Signal Group
 - e. Nominal Outside Diameter
 2. Junction Boxes
 - a. Box Name
 - b. Drawing Reference

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- c. Location
 - d. Dimensions
 - e. Mounting Height
 - 3. Pull Schedule
 - a. Pull Length
 - b. Source and Destination
 - c. Wire Number
 - 4. Custom Color and Finishes for:
 - a. Fixtures
 - b. Custom Panels
 - c. Exposed Cabling
 - 5. Conduit riser diagram showing interconnect of all systems
 - 6. Terminal strip layouts for all terminal strips to be used in junction boxes or equipment racks
 - 7. Connector wiring details including connector model numbers
 - 8. Network schematic showing:
 - a. Logical Connections of all devices
 - b. IP address scheme
 - c. VLAN Scheme
 - 9. Custom Panel Details including:
 - a. Materials
 - b. Finishes
 - c. Dimensions
 - d. Connector Layout
 - e. Connector Labeling
 - 10. Lighting patch bay layouts and labeling scheme
 - 11. Mounting and orientation details for:
 - a. Access points
 - b. Wireless antenna
 - 12. Relay panel physical and electrical details
 - 13. Control systems physical and electrical details
 - 14. Distribution devices physical and electrical details
- G. Final Inspection Notification Report- Two copies of a computer-generated checkout report for the entire system will be prepared and submitted two weeks prior to system commissioning. It will include:
- 1. A complete listing of every piece of equipment including serial number, the date it was tested and by whom, the results and (if failure occurred during any previous tests) the date retested
 - 2. The final report will indicate that every device tested successfully.
 - 3. A performance test report indicating that the system meets all of the Contractor testing requirements in Section 3.3 and 3.5.
 - 4. A copy of the Final Inspection Report shall be included in the Project Manual.

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1.09 CONTRACT CLOSEOUT SUBMITTALS

- A. Comply with all requirements of Division 1.
 - 1. Submit all contract closeout documentation within 30 days after substantial completion, unless otherwise noted. Documents should be contained on a single USB Drive.
- B. Contractor shall work from approved shop drawings only. Note changes made during installation on a single set of drawings. This set of marked up drawings will not leave the jobsite until after the final system commissioning. Submit one corrected set of reproducible drawings showing work as installed. All “as-built” drawings to be provided in electronic form (ACAD 2018 or later and PDF).
- C. Contractor to provide a Project Manual prior to acceptance testing. Provide one electronic copy (PDF). This manual shall contain the following information:
 - 1. Table of Contents.
 - 2. A legend of acronyms and abbreviations must accompany all documentation.
 - 3. Contractor’s contact information for warranty and or service.
 - 4. A complete list of equipment, both installed and loose gear. Include manufacturer, model number, and serial number for all devices. Include settings (software or hardware settings) for any devices that required modification or adjustment during the acceptance testing.
 - 5. Operating manuals for each device.
 - 6. Service manuals for each device.
 - 7. Documentation of all testing results as outlined in Section 3.3 and 3.5
 - 8. Replacement parts lists of major items of equipment.
 - 9. Suggested schedule of routine maintenance. Schedule should include dates such as of replacement of all batteries, cleaning of air filters etc.
 - 10. System Operation and Instructions- Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity. This procedure should describe the operation of all system capabilities. Assume the intended reader of the manual to be unfamiliar with both the equipment and this facility.
 - 11. A list of all equipment, indicating manufacturer, model, serial number, and equipment location (i.e. panel/rack/room number). Update following acceptance testing, if changed.
 - 12. As-Built drawings to include the following:
 - a. Updated lighting hang plot with circuit numbering and control addressing.
 - b. Lighting distribution plot.
 - c. Updated instrument schedule and hook up sheets.
- D. Software Licensing and Manuals. Provide backup computer discs, all software manuals and license certificates for all software loaded on all PC’s. Include all original software installed, or downloaded, to devices in the system as part of the USB Drive.

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- E. Asbestos and PCB Certification: After completion of installation, but prior to Substantial Completion, Contractor will certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB).

1.10 DELIVERY, HANDLING, STORAGE

- A. Comply with Division 1 General Conditions.

1.11 CODE COMPLIANCE

- A. All work and materials shall comply with all applicable codes and regulations to meet or exceed Federal, State, City, and Local Building Codes and Regulations. Advise the Architect if anything in the Plans or Specifications is out of compliance with codes and/or laws prior to bidding.

1.12 PROJECT CONDITIONS

- A. Verify conditions on the job site applicable to this work. Notify the General Contractor in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The drawings diagrammatically show cabling, conduit, wiring, and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Consultant for approval, showing how the work may be installed.

1.13 WARRANTY

- A. Installer shall warrant equipment to be free of defects in materials and workmanship for not less than one year after date of Substantial Completion. Defects occurring in labor or materials within one-year warranty shall be rectified by replacement or repair. Within the warranty period, provide answer to service calls and requests for information within a 24-hour period, and repair or replace any faulty item within a 72-hour period without charge, including parts and labor.
- B. This warranty shall not include any consumable items (eg. patterns).
- C. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.
- D. Theatrical Lighting Contractor to provide Owner with exact beginning and ending dates of the warranty period. Include the name of the person to call for service and telephone number. This information to be part of Project Record Drawings.

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PART 2 - PRODUCTS

2.01 UNAUTHORISED MATERIALS

- A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB) or other hazardous materials identified by the General Contractor or Owner.
- B. All devices shall have applicable approvals from a Nationally Recognized Testing Laboratory and meet all applicable local codes and requirements. Should any equipment lack proper approval the Contractor will arrange for onsite inspections and certification at no additional expense to the Owner.

2.02 ACCEPTABLE MANUFACTURERS

- A. Model numbers and manufacturers included in this specification are listed as a standard of quality.
- B. Consultant will consider other qualified manufacturers subject to review. Submit according to conditions of the Construction Contract and Project Manual.
- C. Proposed substitutions must meet all specifications of the specified equipment. The Contractor will supply complete technical data specifications at the time of proposed substitution.
- D. The Contractor will arrange for product demo at the request of the Consultant or Owner Representative and will pay ground freight shipping to and from site, or to and from Consultant's office.
- E. No product substitution will be accepted without the written approval of the Consultant and Owner. The Owner, General Contractor, and the Consultant reserve the right to accept or refuse any substitution without condition.
- F. Upon acceptance of a substitution, Contractor assumes all responsibility for verification and coordination of all heat, power, rack space and architectural requirements.
- G. If product is discontinued and/or no longer publicly advertised as a part of a manufacturer's current product line-up at time of installation, the project team reserves the right to request a substitution of product for new and currently offered product of like function fulfilling the design intent. Substitution value will be based on fair market value of original product at time of bid.

2.03 GENERAL

- A. Equipment and materials shall be new, meet the latest published specifications of that product, and conform to applicable regulatory provisions. Take care during installation to prevent scratches, dents, chips, etc.

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- B. Theatrical Lighting Contractor shall verify all site conditions prior to fabrication and installation of all equipment. Notify Consultant of any discrepancies in site conditions or design documents as soon as identified.
- C. Wiring of power distribution cable shall be in accordance with the electrical engineer's specification.
- D. Wiring of control distribution cable shall be in accordance with the manufacturer's specification.
- E. Installation of theatrical lighting support pipes shall be in accordance with the structural engineer's specification.
- F. All products and materials to be handled and shipped in accordance with manufacturer's recommendation.
- G. Provide protective covering on equipment and furniture during construction to prevent damage or entrance of foreign matter.
- H. Replace at no expense to Owner, product damaged during delivery, storage, handling or construction.

2.04 THEATRICAL LIGHTING SYSTEM

- A. Lighting Control Console (Quantity: 1)
 - 1. ETC Ion Xe 20 with 12,288 outputs
 - 2. Provide two (2) 27" Touchscreen Monitor with Black Bezel and minimum 1920 x 1080 resolution.
 - 3. Provide one (1) appropriately sized Desktop UPS device (No cooling fans).
 - 4. Provide one (1) 15' Cat 5e Network Patch Cable
- B. Equipment Racks Wall Mounted (Quantity: 1)
 - 1. MIDDLE ATLANTIC DWR series 22" Deep Racks
 - 2. Provide appropriately sized rack for equipment listed in this spec as being located within the rack.
 - 3. Provide rack with sufficient horizontal cable managers to separate all switches and patch bays with one cable manager each. PANDUIT WMPF1E or approved equivalent.
 - 4. Provide rack with appropriately sized blank filler panels to close all unused rack spaces.
 - 5. Provide rack with sufficient and appropriately sized hook and loop fastener cable ties to neatly dress all patch cables for the lighting network.
 - 6. Provide rack with appropriately sized rack mount UPS to power all equipment located in the rack.
- C. RDM Compliant DMX Din Rail Opto Splitter (Quantity: 1)
 - 1. PATHWAY CONNECTIVITY eDIN #1009

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2. Provide unit in an appropriately sized eDIN enclosure.
 3. Provide unit with rack mount panel kit.
 4. Unit shall be mounted in equipment rack.
 5. Provide unit with power supply.
- D. DMX Rack Mount Node (Quantity: 3)
1. Luminex Luminode 12 w/RJ45.
 2. Provide complete with power supply.
 3. Provide with Gateway Rack Mount Kit.
 4. Provide with all necessary patch cables to interface with console DMX and lighting network.
 5. Unit shall be mounted in rack LER.01.
- E. Network Patch Panel (Quantity: 2)
1. Provide Bittree or approved equivalent.
 2. Provide appropriately sized network patch panel.
 3. Provide as standard rack mountable unit.
 4. Patch panel shall be located in rack LER.01.
- F. Network POE Switch (Quantity: 2)
1. CISCO CBS350-24P or approved equivalent
 2. Provide as standard rack mountable unit.
 3. Switch shall be located in rack LER.01.
 4. Provide Patch Panel with appropriate number of 3' Cat 5e network patch cables to completely patch all terminated ports of the theatrical lighting network.
- G. Network Access Point (Quantity: 1)
1. CISCO WAP571 or approved equivalent.
- H. Lighting Console Interface Panel NET/NET/NET/AC (Quantity: 1)
1. STRAND or ETC
 2. Panel labeled as LWP.01.
 3. Provide this as a flush wall plate mountable in a standard 4 Gang (Deep) backbox supplied by others.
- I. Theatrical Lighting DMX/NET Relay Rack, 48 space (Quantity: 1)
1. STRAND or ETC
 2. Provide with forty-eight (48) 20A single pole relays.
 3. Provide with 200A, 3 phase, 65kA, main breaker.
- J. Theatrical Lighting DMX/NET Relay Rack, 48 space (Quantity: 1)
1. STRAND or ETC
 2. Provide with forty-six (46) 20A single pole relays.
 3. Provide with two (2) 20A single pole breakers.
 4. Provide with 200A, 3 phase, 65kA, main breaker.
- K. Ellipsoidal Theatrical Lighting Instrument (Quantity: 45)

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1. ETC ColorSource Spot v w/shutter assembly or approved equivalent.
 - a. 19° - TBD
 - b. 26° - TBD
 - c. 36° - TBD
 - d. 50° - TBD
 2. Provide complete with c-clamp, gel frame, safety cable and 3' lead terminated to a NEMA 5-15P.
 3. Refer to Theatrical Lighting Plan and Paperwork for color, hang and focus details.
NOTE: Not all fixtures are shown on the plot.
- L. LED Par Wash Light (Quantity: 15)
1. ETC ColorSource Deep Blue Par.
 - a. Narrow Round – 15
 - b. Medium Round – 15
 2. Provide complete with hanging arms, c-clamp, safety cable, and one 3' power lead terminated to a NEMA 5-15P plug.
 3. Refer to Theatrical Lighting Plan and Paperwork for color, hang and focus details.
- M. LED Cyc Strip Light (Quantity: 6)
1. CHROMA-Q Color Force II 72.
 2. Provide with cyc lens
 3. Provide complete with hanging arms, c-clamps, safety cables, and one 3' power lead terminated to a NEMA 5-15P plug.
 4. Refer to Theatrical Lighting Plan and Paperwork for color, hang and focus details.
- N. Moving Head Profile – (Quantity: 12)
1. ELATION Fuze Profile or approved equivalent.
 2. Provide complete with clamps, two (2) safety cables.
 3. Refer to Theatrical Lighting Plan and Paperwork for color, hang and focus details.
- O. 600W LED Followspot (Quantity: 2)
1. Robert Juliat Alice 130 to 240.
 2. Provide complete with adjustable floor stand/yoke and 15' lead terminated to a 15amp NEMA 5-15 plug.
- P. LED Work Light (Quantity: 8)
1. SSRC WL-LED-150W 3600K.
 2. Provide complete with hanging arms, c-clamps, safety cables, and 3' lead terminated to a NEMA 5-15 plug.

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- Q. Lighting Wall Panel (Quantity: 6)
1. ETC NEMA Series or Approved equivalent
 2. Wall panels of the following configurations:
 - a. LWP.02 and 03:
 - 1) 1 - 120V util ckt to 1 – 5-20 flush duplex receptacle and 1 - network output control receptacle.
 - b. LWP.04 and 05:
 - 1) 4 - 120V util ckt to 4 – 5-20 flush duplex receptacle and 1 - network output control receptacle.
 - c. LWP.06 and 07:
 - 1) 5 - 120V util ckt to 5 – 5-20 flush duplex receptacle and 1 - network output control receptacle.
 3. Wall panels shall be flush mounted in wall as shown on the drawings.
 4. Wall panels shall include labeling indicating what source(s) they are fed from located on the internal faceplate of the panel. It is the responsibility of the theatrical lighting contractor to request this information.
 5. All low voltage control wiring shall be integral to the panel and shall be isolated from the high voltage wiring by a low voltage barrier.
 6. All network connectors to be uniquely labeled using LTIE.XX. Label to contain the run length of the network cable and the maximum length of extension cable allowed between the network jack and any device connected to the jack.
 7. Utility circuits shall be labeled indicating what source(s) they are fed from located adjacent to the utility circuit receptacle. It is the responsibility of the theatrical lighting contractor to request this information.
- R. Lighting Floor Pocket (Quantity: 8)
1. SSRC FP Series, Ace Backstage or Approved equivalent
 2. Floor pockets of the following configurations:
 - a. LFB.01 thru 06:
 - 1) 2 - 120V util ckt to 2 – 5-20 flush duplex receptacle and 1 - network output control receptacle.
 - b. LFB.07 and 08:
 - 1) 3 - 120V util ckt to 3 – 5-20 flush duplex receptacle and 1 - network output control receptacle.
 3. Floor pockets shall be recessed mounted in floor as shown on the drawings.
 4. Floor pockets shall include labeling indicating what source(s) they are fed from located on the internal faceplate of the pocket. It is the responsibility of the theatrical lighting contractor to request this information.
 5. All low voltage control wiring shall be integral to the pocket and shall be isolated from the high voltage wiring by a low voltage barrier.
 6. All network connectors to be uniquely labeled using LTIE.XX. Label to contain the run length of the network cable and the maximum length of extension cable allowed between the network jack and any device connected to the jack.
 7. Utility circuits shall be labeled indicating what source(s) they are fed from located adjacent to the utility circuit receptacle. It is the responsibility of the theatrical lighting contractor to request this information.

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- S. Lighting Pipe Mount Box (Quantity: 12)
1. SSRC PM Series or Approved equivalent
 2. Pipe boxes of the following configurations:
 - a. LPB.01 thru 12:
 - 1) 4 - 120V util ckt to 4 – 5-20 flush duplex receptacle and 1 - network output control receptacle.
 3. Pipe mount boxes shall be mounted to 1 ½" Schedule 40 pipe in locations as shown on the drawings.
 4. Pipe mount box pigtails shall include proper cable strain relief.
 5. Pipe mount boxes shall include labeling indicating what source(s) they are fed from located on the faceplate of the box. It is the responsibility of the theatrical lighting contractor to request this information.
 6. All low voltage control wiring shall be integral to the box and shall be isolated from the high voltage wiring by a low voltage barrier.
 7. All network connectors to be uniquely labeled using LTIE.XX. Label to contain the run length of the network cable and the maximum length of extension cable allowed between the network jack and any device connected to the jack.
 8. Utility circuits shall be labeled indicating what source(s) they are fed from located adjacent to the utility circuit receptacle. It is the responsibility of the theatrical lighting contractor to request this information.
 9. Dimmable circuits and numbering shall be located as noted on drawings
- T. Lighting Gridiron Junction Box (Quantity: 8)
1. SSRC GB Series, ETC or Approved equivalent
 2. Junction boxes of the following configurations:
 - a. LJB.01 thru 08:
 - 1) 8 – 120V at 20A terminals terminals plus appropriate number of ground terminals.
 - 2) 1 – Network output control receptacle
 3. Gridiron junction boxes shall include labeling indicating what source(s) they are fed from located on the junction box cover plate. It is the responsibility of the theatrical lighting contractor to request this information.
- U. Lighting Feeder Cable (Quantity: As Nec.)
1. Provide appropriately feeder cable to interconnect junction boxes to pipe mount boxes suspended from hoists.
 2. Provide appropriated strain relief hardware to adequately suspend cable from junction boxes and grid.
 3. Coordinate cable management with installing Rigging Contractor.
- V. Lighting Control Cable (Quantity: As Nec.)
1. Provide stranded Category 5 cable to interconnect control junction boxes to pipe mount boxes suspended from hoists.
 2. Provide appropriated strain relief hardware to adequately suspend cable from junction boxes and grid.
 3. Coordinate cable management with installing Rigging Contractor.

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- W. DMX Extension Cable. (Quantity: 86)
1. 5' – 20
 2. 10' – 40
 3. 15' – 20
 4. 25' – 6
 5. Cables shall be labeled for length using appropriately sized self-adhesive numbers 3" from both connector ends covered by clear heat shrink tubing.
 6. Cables shall be supplied with one (1) appropriately sized Velcro cable tie.
 7. Cables shall be black.
 8. Cable shall be constructed according to USITT DMX512/1990 standard.
 9. Cables shall be constructed with one (1) 5 pin XLR Male connector and one (1) 5 pin XLR Female connector.
- X. DMX Terminator (Quantity: 12)
- Y. RJ45 to 5-Pin Female Connector (Quantity: 30)
- Z. 20A PowerCon Extension Cable. (Quantity: 20)
1. 5' – 5
 2. 10' – 10
 3. 15' – 5
 4. Cables shall be labeled for length using appropriately sized self-adhesive numbers 3" from both connector ends covered by clear heat shrink tubing.
 5. Cables shall be supplied with one (1) appropriately sized Velcro cable tie.
 6. Cables shall be black.
 7. Cable shall be constructed using 12/3 SJOO-W cable.
 8. Cables shall be constructed with PowerCon Blue/Grey connectors rated for 120vac @ 20amp loads.
- AA. PowerCon Coupler (Quantity: 12)
- BB. 20A PowerCon TRUE1 Extension Cable. (Quantity: 66)
1. 5' – 15
 2. 10' – 30
 3. 15' – 15
 4. 25' – 6
 5. Cables shall be labeled for length using appropriately sized self-adhesive numbers 3" from both connector ends covered by clear heat shrink tubing.
 6. Cables shall be supplied with one (1) appropriately sized Velcro cable tie.
 7. Cables shall be black.
 8. Cable shall be constructed using 12/3 SJOO-W cable.
 9. Cables shall be constructed with PowerCon TRUE1 connectors rated for 120vac @ 20amp loads.
- CC. Color Media:
1. Provide a color media allowance for 6 – 20" x 24" sheets of R119. Final quantities TBD upon finalization of Light Plot and Paperwork.

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2.05 ARCHITECTURAL LIGHTING CONTROL SYSTEM (ETC/STRAND)

- A. Architectural Control Rack, if required by manufacturer (Quantity: 1)
 - 1. ETC Unison ERn2-RM
 - 2. Provide with one (1) P-ACP architectural control processor.
 - 3. Provide with one (1) P-SPM-E Station Power Module.
 - 4. Unit shall be mounted in rack LER.01.
- B. Architectural LCD Master Station (Quantity: 1)
 - 1. ETC Unison P-TS7-FBB
 - 2. Provide with flush back box.
 - 3. Confirm color with architect.
- C. Architectural LCD Master Station (Quantity: 1)
 - 1. ETC Unison P-TS7-FBB
 - 2. Provide with flush back box.
 - 3. Confirm color with architect.
- D. Architectural LCD Master Station (Quantity: 1)
 - 1. ETC Unison P-TS7-PE
 - 2. Provide with portable desktop stand.
 - 3. Provide Station with 25' cable.
 - 4. Confirm color with architect.
- E. Architectural Entry Station (Quantity: 2)
 - 1. ETC Unison UH10005-_1F
 - 2. Confirm color with architect.
- F. Architectural Entry Station (Quantity: 10)
 - 1. ETC Unison UH10002-_1F
 - 2. Confirm color with architect.
- G. Emergency Bypass Detection Kit (Quantity: 1)
 - 1. ETC Emergency Bypass Detection Kit EBDK
- H. Emergency Bypass DMX Controller (Quantity: 1)
 - 1. ETC DMX Emergency Bypass Controller DEBC-6
- I. Branch Circuit Emergency Transfer Switch (Quantity: 3)
 - 1. ETC Branch Circuit Emergency Transfer Switch SC1008

PART 3 - EXECUTION

3.01 GENERAL

- A. Coordinate work with other trades to avoid causing delays in construction schedule.

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- B. Mount equipment and enclosures plumb and square. Permanently installed equipment shall be firmly and safely held in place.
- C. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.
- D. Mount equipment in racks and consoles and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Consultant in writing that racks will be fabricated on site and the reasons for the change.

3.02 CONTRACTOR/THEATRICAL LIGHTING CONTRACTOR INSTALLATION

- A. Confirm by site visit and by report from electrical contractor all field conditions, which may affect manufacture and installation of the Theatrical and Architectural Lighting Systems equipment prior to fabrication. Provide any additional hardware, panels and backboxes to accommodate field conditions. Submit all changes to equipment and mounting details to Consultant for review prior to fabrication.
- B. Supply specific, detailed direction to electrical contractor as required for proper installation of all Theatrical and Architectural Lighting System equipment, coordinated with actual site conditions.
- C. The Theatrical Lighting Contractor shall furnish all items required to properly install and secure Theatrical and Architectural Lighting System equipment in place.
- D. The electrical contractor shall place, install, and connect all Theatrical Lighting System equipment with the following exceptions:
 - 1. Theatrical and architectural control wire terminations.
 - 2. Theatrical fixtures set up, hang, and focus.
 - 3. Theatrical control console set up and programming.
 - 4. Architectural control station install, setup, and programming.
- E. If any panel, distribution box, or other device requires relocation or change of mounting detail, and this fact is not known until after shipment due to sequence of work, modify equipment or provide new equipment to fit revised location or mounting detail. Notify Consultant of any such changes and submit all changes to Consultant for review prior to fabrication.
- F. The Theatrical Lighting Contractor shall terminate all control wire in dimmer banks and all control panels.
- G. All control cables within the system shall be labeled with a unique identifying number at each end of the cable. Use only pre-printed labels. Cover labels with clear heat shrink tubing. Self-adhesive labels will not be allowed without prior approval of Consultant.

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- H. Provide a service loop for all control cables and harness in place where applicable. No splices shall be allowed inside of control panels or racks. Provide terminal strips secured to panel or rack frame for all connections.
- I. Supply GC with all paint and supplies to correct minor cosmetic damage to equipment. Ensure that all equipment is clean and in perfect condition at time of Completion Checkout.
- J. Repair or replace any equipment, which has suffered non-cosmetic damage prior to time of Completion Checkout. Claims arising from repair or replacement of such damage shall be considered only after final acceptance of system by Owner.
- K. The contractor shall clean all racks, panels, and boxes of dirt, dust and debris, re-assemble all equipment, and replace all panels, covers and screws prior to time of Completion Checkout.
- L. Contractor shall not use any control equipment intended for installation for purpose of checking out wiring or circuitry prior an on-site factory trained technician testing the system (as specified above). Equipment may be used for such testing only in specific areas where proper conditions exist.

3.03 THEATRICAL LIGHTING CONTRACTOR TESTS AND ADJUSTMENTS

- A. Lamp all fixtures with the specified lamps and where applicable bench focus fixtures to a flat, even field.
- B. Hang, focus and color all lighting fixtures according to the Theatrical Fixture Layout drawing.
- C. Set up lighting control console and all related peripheral devices to include soft patching the console according to supplied paperwork.
- D. Set up and programming of architectural lighting control system and all related peripheral devices.
- E. Prior to energizing Production Lighting control systems, perform complete system checkout to verify that all items are correctly installed and shall safely operate as specified herein.
- F. Perform all tests and adjustments specified below upon Completion of installation of Production Lighting System.

3.04 TEST EQUIPMENT

- A. The following equipment shall be available for field-testing. Submit for approval, as a portion of the tender, list of test equipment.

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1. Ethernet Network cable and termination Qualifier (JDSU Lanscaper Pro NT800, or Fluke CableIQ or approved equivalent).
2. DMX512 Protocol Tester (Doug Fleenor GIZMO or approved equivalent).
3. True RMS Multimeter (Fluke 123 or approved equivalent), and clamp on ammeter (As approved).
4. Circuit tester (As approved) with adapters for all power receptacles provided in this section.
5. Incandescent loads to test 100% of Theatre Lighting Circuits.
6. Theatrical Lighting Contractor shall provide all appropriate adapters, extension cables and connectors necessary to interconnect test equipment to Theatrical Lighting system, and to perform all tests described below.
7. Theatrical Lighting Contractor shall provide sufficient field service personnel (minimum of 2) to perform all tests specified below. Coordinate with the Division 26 contractor and to assist in all tests specified below. The contractor shall provide ladders and other devices, including 4 walkie-talkies, to allow access to all devices to be tested and communication between parties.

3.05 TEST PROCEDURES

- A. Perform all following tests & provide a written test report to the consultant:
1. Test all low voltage DMX/Architectural/Network circuits for proper wiring/termination, cable length, cable faults, Power Over Ethernet (POE) quality, and inducted voltage. Qualify Network circuits for Full Duplex 100BASE-TX operation. All Network tests to be executed after all Building Systems have been energized and are operating. Provide a written report of all test results organized by box/location.
 2. Inspect all device labels to ensure that devices are correctly and clearly labeled as specified and shown in specifying consultant approved submittal drawings.
 3. Test all line voltage circuits for proper wiring, polarity, connection to proper dimmer, and inspect for correct labeling.
 4. Test all power receptacles provided in this section.
 5. Test all Control Console operations, including transfer of memory to and from storage medium. Test all storage medium provided.
 6. Test all control panels for all functions.
 7. Test all functions of all remote devices and all control plug-in points. When remote devices are NIC, but accommodations for these devices are included, provide identical devices for testing purposes.
 8. Test video systems for clear screen and high resolution of characters with no interference, "snow", color degradation, pixel shift, etc.
 9. Test all extension cables, adapters, etc.
 10. Perform visual testing of dimmer curves and consistency of dimmer readings.
- B. Repair or replace any equipment that fails to conform to specification, and schedule second set of tests and adjustments. Provide test equipment and personnel specified above.

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- C. Repeat testing and repair or replacement as required ensuring that the entire Theatrical Lighting System conforms to specification.
- D. Upon completion of testing, furnish Owner and Consultant a complete report on all field-testing and adjustment, certifying that system conforms to specification and that installation is complete and ready for inspection.

3.06 ACCEPTANCE

- A. Schedule inspection by Owner and Consultant no earlier than their receipt of above specified report.
- B. Provide all test equipment and personnel specified in "Field Testing and Adjustment" above.
- C. Coordinate with GC to ensure that no other work shall be scheduled in audience chamber or stage areas, and that all temporary bracing and scaffolding has been removed to permit full operation of and access to all equipment.
- D. At request of Consultant, repeat any and all test specified in "Field Testing and Adjustment" above in presence of Owner and Consultant.
- E. Should Owner or Consultant judge that any equipment fails to conform to specification, repair or replace that equipment within 30 days, and schedule second inspection. Should the Owner or Consultant judge that any work inspected is not substantially complete at time of Completion Checkout, schedule second inspection. Provide all equipment and personnel specified above.
- F. Schedule additional checkouts as required until Owner and Consultant judge entire Theatrical Lighting System to conform to specification. After Completion Checkout, compensate Owner for any consulting and transportation costs incurred during subsequent checkouts. Final payment shall be withheld until systems have been thoroughly tested and adjusted and found to be in proper operating condition.

3.07 INSTRUCTION OF OWNER PERSONNEL

- A. Provide four hours instruction to Owner designated personnel on the use and operation of the System, scheduled as one session, by an instructor fully knowledgeable and qualified in system operation. This instruction should include familiarization with all system components and basic operation of the lighting control console and architectural control system. The owner may videotape the instruction session at their cost. The System Reference Manuals shall be complete and on site at the time of this instruction.
- B. The lead technician for the project installation shall be present at the first two formal uses of the system.

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END OF SECTION

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SECTION 11 61 33 - THEATRICAL RIGGING & DRAPERY SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Construction Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.
- B. Theatrical equipment system drawings (TEX.XX).

1.02 SCOPE

- A. Intent: This specification covers the fabrication, furnishing, delivery, and installation of the Theatrical rigging system. The form of contract, general conditions, and the project drawings are considered to be parts of these specifications.
- B. Complete System: The Rigging Contractor shall provide all items necessary for a complete, safe, fully functional system as described herein, including all tools, scaffolding, labor, and supervision, even though they may not be specifically enumerated. Any errors, omissions or ambiguities do not relieve the Contractor of this responsibility but shall be brought to the attention of the Architect for clarification.
- C. Work Included: The work of this section shall include, but not necessarily be limited to the following:
 - 1. Theatrical Hoisting Systems
 - 2. Theatrical Curtains and Accessories
- D. Related Work: Related work which is not included in this section:
 - 1. Gridiron, head and loft block beams, and all other structural steel and miscellaneous metals not specifically called out as part of this section.
 - 2. Galleries, ladders and catwalks.
 - 3. Stage flooring.
 - 4. Theatrical lighting.
 - 5. Electrical connections, conduit, boxes and wiring of any type.

1.03 GENERAL REQUIREMENTS

- A. Field Conditions: All bidders shall fully inform themselves of the conditions under which the work is to be performed. No additional compensation shall be allowed for any labor or item the bidder could have been fully informed of prior to the bid date.
- B. Safety: The systems shall conform to all applicable code requirements and shall be in conformance with industry standards of operation and practices. All materials, arrangements, and procedures shall comply with applicable code requirements, allowing

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the users to arrange and operate a safe assembly and working environment for audience and user personnel.

- C. Insurance: In the absence of more stringent requirements, the Rigging Contractor shall maintain injury and property liability insurance coverage throughout the project's scheduled timetable, including workmen's compensation coverage for Contractor's employees.

1.04 RESPONSIBILITY AND RELATED WORK

- A. The Theatrical Rigging Contractor shall be responsible for the following:
1. Coordinate with the project Structural Engineer and verify the load capacities of the building structure where it interfaces with the rigging system.
 2. Provide all miscellaneous steel required for support of the Theatrical rigging system.
 3. Perform regular site visits (minimum of one monthly) after steel erection is completed to provide coordination with all other trades that may conflict with the installation and operation of the rigging system.
 4. Provide regular reports of all site visits to the Architect, Client, and Consultant that document all coordination issues and their resolutions in regards to the rigging system.
 5. Provide and install all rigging system components.
 6. Terminate all control distribution cable, which shall be done in accordance with the manufacturer's specification.
 7. Furnish to the Electrical Contractor for installation all line level components and their housings.
 8. Provide a factory trained technician for system commissioning, including inspection, testing, and programming for the complete project.
 9. Provide shop drawings, As-built drawings, owner training, and operation manuals.
 10. Provide accessories and minor equipment items needed for a complete system, even if not specifically mentioned herein or in the drawings, without claim for additional payment.
 11. Assume responsibility for all engineering of systems described herein, including modification of and addition to any details as required in order to fulfill the design intent of the theatrical rigging system contract documents.
 12. Furnish sufficient workmen to operate all equipment and to assist in all tests specified. Provide ladders and other access devices, including 4 walkie-talkies, to allow access to all devices to be tested and communication between parties.
 13. Contractor shall obtain all licenses and permits necessary for the execution of any work pertaining to the installation within this scope of work.
- B. The Electrical contractor shall be responsible for the following:
1. Provide, install, and terminate all high voltage feeder circuits for the theatrical rigging system.
 2. Provide and install all low voltage control cabling.
 3. Provide and install all conduit, junction boxes, electrical wireways, and cable trays required for the rigging power and control systems.

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4. Pull all high voltage and low voltage cable in conduit.
5. Provide sufficient workmen to assist Theatrical Rigging Contractor with system troubleshooting at first system energization.
6. Clean all racks, panels, and boxes of dirt, dust and debris, re-assemble all equipment, and replace all panels, covers and screws prior to time of Completion Checkout.

1.05 REFERENCES

- A. International Building Code
- B. Underwriters Laboratories (U.L.)
- C. Occupational Safety and Health Administration (O.S.H.A.)
- D. National Fire Protection Association (N.F.P.A.).
- E. National Electrical Code (N.E.C.).
- F. American National Safety Institute (A.N.S.I.).
- G. Electronics Industries Association (E.I.A).
- H. California State and City of Mammoth Lakes Building Code.
- I. National Electrical Manufacturers Association. (N.E.M.A.)
- J. Entertainment Services and Technology Technical Standards (E.S.T.A.)

1.06 SUBMITTALS

- A. Comply with all requirements of Division 1.
- B. Submit according to conditions of the Construction Contract and Project Manual.
- C. Make each specified submittal as a coordinated package complete with all information. Uncoordinated sets will be returned without review.
- D. Product Data: Submit within 30 days of contract award. Submit manufacturer's product data sheets for each item of equipment that will be provided as part of this contract. Submit electronically as a single PDF. All equipment cut sheets will be arranged per specification section number. Provide a table of contents and a bookmark at the start of every product sheet.
- E. Shop Drawings
 1. Submit within 60 days of contract award.
 - a. Failure to submit shop drawings with ample time for evaluation shall not entitle the contractor to an extension of contract time.

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- b. There will be no work authorized on site without the prior submittal (and subsequent approval) of a complete set of shop drawings. Any exceptions to this must be in writing and approved by the Consultant.
 - c. Review of shop drawings is for general conformance with the design intent and general compliance with the contract documents of the project. Corrections, comments or markings made do not relieve the Contractor from compliance with the Contract Documents nor allow departure there from. Contractor remains responsible for detailing and accuracy, confirming and correlating quantities and dimensions, selecting fabrication processing and techniques of construction, coordinating work with that of other trades, and performing work in a safe a satisfactory manner.
- 2. Submitted as a multi-sheet PDF document with:
 - a. Minimum 11" x 17" sheets
 - b. Table of Contents.
 - c. Bookmarks for every sheet with Sheet Name and Number
- F. Details for both Shop/Submittal and As-Built drawings to include the following:
 - 1. System control riser diagram
 - 2. Control wiring charts
 - 3. Wire numbers on all schematics/riser diagrams
 - 4. Rigging Equipment physical and electrical details
 - 5. Control systems physical and electrical details
 - 6. Other details or schematics required for systems operation
 - 7. All Rigging Submittals to be stamped by a licensed engineer licensed in the state of California
 - 8. Note: Consultant will supply AutoCAD files of system design, if requested.
- G. Contract Closeout Submittals:
- H. Comply with all requirements of Division 1.
 - 1. Submit all contract closeout documentation within 30 days after substantial completion, unless otherwise noted. Documents should be contained on a single USB Drive.
- I. Contractor shall work from approved shop drawings only. Note changes made during installation on a single set of drawings. This set of marked up drawings will not leave the jobsite until after the final system commissioning. Submit one corrected set of reproducible drawings showing work as installed. All "as-built" drawings to be provided in electronic form (ACAD 2018 or later and PDF).
- J. Contractor to provide a Project Manual prior to acceptance testing. Provide one electronic copy (PDF). This manual shall contain the following information:
 - 1. Table of Contents.
 - 2. A legend of acronyms and abbreviations must accompany all documentation.
 - 3. Contractor's contact information for warranty and or service.
 - 4. A complete list of equipment, both installed and loose gear. Include manufacturer, model number, and serial number for all devices. Include settings (software or

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hardware settings) for any devices that require modification or adjustment during the acceptance testing.

5. Operating manuals for each device.
6. Service manuals for each device.
7. Documentation of all testing results as outlined in Section 3.3 thru 3.5
8. Replacement parts lists of major items of equipment.
9. Suggested schedule of routine maintenance. Schedule should include dates such as annual inspection, replacement of all disposables, cleaning of equipment, etc.
10. System Operation and Instructions- Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity. This procedure should describe the operation of all system capabilities. Assume the intended reader of the manual to be unfamiliar with both the equipment and this facility.
11. A list of all equipment, indicating manufacturer, model, serial number, and equipment location (i.e. panel/rack/room number). Update following acceptance testing, if changed.

1.07 QUALITY ASSURANCE

- A. Contractor's Qualifications: Have previously installed at least 4 jobs of similar magnitude, completed within the last five years. Provide name and phone number of reference for each representative project. Identify at least one such completed job available for inspection by Consultant or Owner's Representative.
- B. Bidder will confirm in writing that Sub-contractor firm has five years' experience with equipment and systems of the types specified, that the Sub-contracting firm maintains a fully staffed and equipped service facility, and that the firm is a franchised dealer and authorized service facility for the major brands specified, and that the firm is properly licensed to work in Enter Project City, Enter Project State. Bidding contractor will identify all Sub-contractors on the Bid Response team and a detailed scope of work for each Sub-contractor.
- C. Provide a summary of the experience of the project manager, lead engineer and lead installers assigned to this project. This will include key team members of any Subcontractor. The on-site lead installer shall be an ETCP Certified Rigger.

1.08 DELIVERY, HANDLING, STORAGE

- A. Comply with Division 1 General Conditions - Materials and Equipment section.

1.09 WARRANTY

- A. The Rigging Contractor shall provide a three-year written guarantee against defects in materials or workmanship starting from the date of acceptance of equipment by the Owner's representative. The guarantee shall not cover damage due to normal wear and tear, acts of God, neglect, or improper use of equipment. Any required maintenance or replacement shall be provided by the Rigging Contractor within thirty days of notification

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by the Owner except for safety related items, which shall be corrected within 48 hours of notification. Subsequent to the expiration of the guarantee period the Rigging Contractor agrees to furnish repair and maintenance service, at the Owner's expense, within thirty days of request for such service. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.

- B. Theatrical Rigging Contractor to provide Owner with exact beginning and ending dates of the warranty period. Include the name of the person to call for service and telephone number. This information to be part of Project Record Drawings.

PART 2 - PRODUCTS

2.01 GENERAL

A. Standards:

1. Materials shall conform to the following ASTM and ANSI standard specifications:
 - a. ASTM A-36 Specification for structural steel
 - b. ASTM A 47 Specification for malleable iron casting
 - c. ASTM A 48 Specification for gray iron casting
 - d. ASTM A 120 Specification for black and hot dipped zinc coated (galvanized) steel pipe for ordinary use
 - e. ANSI B18.2.1 & 2 Specification for square and hex bolts and nuts
 - f. ANSI E1.4-2009 Entertainment Technology – Manual Counterweight Rigging Systems.
 - g. ANSI E1.22 - 2009 Entertainment Technology - Fire Safety Curtain Systems
2. In order to establish minimum standards of safety, the following factors shall be used:
 - a. Cables and fittings 8:1 Safety Factor
 - b. Cable bending ratio Sheave tread diameter is 26 times cable diameter
 - c. Maximum fleet angle 1 1/2 degrees
 - d. Steel 1/5 of yield
 - e. Bearings Two times required load at full speed for 2000 hours
 - f. Bolts Minimum SAE J429 Grade 5 (ISO R898 Class 8.8), zinc plated
 - g. Motors 1.0 Service Factor
 - h. Gearboxes - 1.25 Mechanical Strength Service Factor

- B. Materials: All materials used in this project shall be new, unused and of the latest design. Re-furbished and obsolete materials are not permitted.

C. Sheaves:

1. Sheaves shall be one of the following materials:
 - a. ASTM A-48 Class 30 grey iron castings
 - b. Nylatron or Polyamide Nylon (PA6-G)

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- c. Steel
 - 2. Groove depths shall be sufficient to encompass fully the cables and ropes. Grooves shall have sloped sides (8 degree minimum) and conform to rope and cable manufacturers' standards for groove shape and tolerance.
 - 3. Sheaves shall be supported by bearings and a machined steel shaft, which shall be keyed to one side plate to prevent rotation. Proper adjustment of the bearing shall be accomplished by means of a fine thread, self-locking nut on the opposite end of the shaft. Each sheave shall run plumb and true without rubbing its side plates when rotated.
 - D. Fabrication:
 - 1. All manufactured equipment that is dependent on field conditions shall have those conditions field verified prior to fabrication and installation of all equipment. Notify Consultant of any discrepancies in site conditions or design documents as soon as identified.
 - 2. The mechanical fabrication and workmanship shall incorporate best practices for good fit and finish. There shall be no burrs or sharp edges to cause a hazard nor shall there be any sharp corners accessible to personnel.
 - 3. All moving parts shall have specified tolerances. Sheaves shall run plumb and true and shall not scrape housings.
 - 4. All equipment shall be built and installed to facilitate future maintenance and replacement.
 - E. Finishes:
 - 1. Paint shall be the manufacturer's standard finish and color except as noted.
 - 2. All turnbuckles, clips, tracks, chains and other items of incidental hardware shall be furnished plated or painted.
 - F. Recommended Working Load: This specification calls for minimum recommended working loads for many hardware items. This is the maximum load which the manufacturer recommends be applied to properly installed, maintained, and operated new equipment. Manufacturer's recommended working loads shall be determined by calculations by a Licensed Professional Engineer and destructive testing by an independent testing laboratory. These calculations and reports shall be available for review.
 - G. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB) or other hazardous materials identified by the Owner.
- 2.02 ACCEPTABLE MANUFACTURERS
- A. The following manufacturers of Theatrical Rigging equipment shall be considered pre-Qualified to supply Theatrical Rigging equipment.
 - 1. Electronic Theater Controls
 - 2. H & H Specialties, Inc
 - 3. Wenger / J.R. Clancy, Inc.
 - 4. Thern Stage Equipment

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- B. Additional qualified manufacturers will be considered subject to review by the Owner and Consultant. The Contractor will supply complete technical data specifications at the time of proposed substitution. The Contractor will arrange for product demo at the request of the owner and will pay ground freight shipping to and from site, or to and from Consultant's office. The Owner reserves the right to accept or refuse any substitution without condition.
- C. Substitutions: Comply with Division 1 General Conditions – Substitutions section. Any proposed substitutions must meet all specifications of the specified equipment. No product substitution will be accepted without the written approval of the Consultant and Owner.
- D. The manufacturer must have a product testing program, including determination of recommended working loads for products based on destructive testing by an independent laboratory and review by an independent licensed engineer. Approval to bid does not release the manufacturer from meeting this requirement.
- E. Requirements for Approval to bid: Equipment manufacturers seeking approval must submit the following information at least 2 weeks prior to the bid opening date. Failure to submit any of the required information will automatically disqualify the manufacturers from consideration of approval.
 - 1. Evidence that the manufacturer has been in business for a minimum of eight years manufacturing Theatrical equipment.
 - 2. A listing of 8 equivalent installations including:
 - a. Name, address, and telephone number of Owner.
 - b. Name, address, and telephone number of Architect.
 - c. Scope of work.
 - 3. A brief written description of the manufacturer's operation including facilities, financial capabilities, and experience of key personnel.
 - 4. A statement from an insurance company indicating that the manufacturer carries primary product and general liability insurance of \$2,000,000 each, with excess liability coverage of \$10,000,000.
 - 5. A description of their details of their product testing program and methods along with the names and telephone number of the independent test lab and licensed professional engineer performing the product testing and review.
- F. Equipment and materials shall be new, and conform to applicable UL, CSA, or ANSI provisions. Take care during installation to prevent scratches, dents, chips, etc.
- G. The Theatrical Rigging Contractor shall verify all site conditions prior to fabrication and installation of all equipment. Notify Consultant of any discrepancies in site conditions or design documents as soon as identified.
- H. Use only components and items in the theatrical rigging systems that conform to industry practice and acceptable code standards.

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- I. Wiring of power distribution cable shall be in accordance with the electrical engineer's specification.
- J. Wiring of control distribution cable shall be in accordance with the manufacturer's specification.
- K. Installation of theatrical rigging support steel shall be in accordance with the structural engineer's specification.

2.03 MOTION CONTROL SYSTEMS

- A. Rigging Control System:
 - 1. Vantis Wall Controller.
- B. VANTIS Wall Controller:
 - 1. Enclosure: Available as either of the following.
 - a. Wall Mount - Inside a 24" H x 24" W x 9.5" D enclosure.
 - b. Rack Mount - Standard 6U 19" rack mount.
 - 2. Touchscreen:
 - a. Controller shall have a 10.1" 1920 x 1200 color touchscreen.
 - 3. Operators:
 - a. Controller shall include an illuminated "GO" button with hold-to-run operation.
 - b. Controller shall include a hard wired ESTOP operator.
 - c. Controller shall include a speed wheel for selection of speed while variable speed machine.
 - d. Controller shall include (2) USB-C ports.
 - e. Controller shall include a Remote Operator Pendant receptacle.
 - 4. Front Panel shall be able to tilt to reduce glare and improve visibility.
 - 5. Remote Operator Pendant:
 - a. Remote Operator Pendant shall provide the ability to initiate motion that has been set on the Wall Controller.
 - b. Remote Operator Pendant shall include a 30' cable.
 - c. Remote Operator Pendant shall include an illuminated "GO" button with hold-to-run operation.
 - d. Remote Operator Pendant shall include a hard wired ESTOP operator.
 - 6. Operation:
 - a. Capabilities:
 - 1) The controller shall have the ability to control up to (24) machines.
 - 2) The controller shall have the ability to control both fixed and variable speed machines.
 - 3) The controller shall be specifically designed to control overhead hoists, acoustic banners, travelers, and stage lifts. Additional machine types can be controlled as specified.
 - b. Log-in/User Profiles:
 - 1) System shall remain locked until a registered pin is entered.

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- 2) System shall enable or disable certain functions depending on which user is logged in.
- 3) Systems that do not provide user specific capabilities shall not be accepted.
- c. Basic Operation:
 - 1) Each machine shall be depicted with a button that shows machine name and current position.
 - 2) Machine selection shall be made via user touch input of the machine name button. System shall clearly indicate which machines are selected.
 - 3) UP and DOWN buttons will be available to move one or more machines in a single direction.
 - 4) Anytime a machine is selected with an end position, the end position shall be clearly shown on the machine's button.
- d. Targets:
 - 1) A target is a stored position for a single machine.
 - 2) Controller shall have (8) user recordable targets per machine (A-H).
 - 3) Each target may be given a unique name by the user.
- e. Presets:
 - 1) A preset is a group of machines with stored positions for each machine. Selecting a preset will select all machines in the preset and load the stored positions.
 - 2) Preset Record: System shall allow the user to record presets by taking a snapshot of selected machines. System shall allow users to build presets using stored targets and custom positions.
- f. Variable Speed:
 - 1) For variable speed machines, speed can be controlled by rotating the speed wheel. The speed shall be displayed on the touchscreen in the form of a speedometer. Speed adjustment shall be in increments of 5% of machine max speed.
- g. Load Sensing:
 - 1) The controller shall protect against overload and provide a method for load learning on machines with load sensing capabilities.
 - 2) Load Learning:
 - 3) System shall guide user through the load learn process to ensure the load window is set properly.
 - 4) In the event of a load fault system shall guide the user to correct the error via on-screen instruction and adjust load window as required.
- h. Dynamic Feedback:
 - 1) The system shall provide the user a clear indication of which machines are selected.
 - 2) The system shall provide the user a clear indication of the direction in which each selected machine will travel when the "GO" button is pressed.
 - 3) System shall indicate when a machine is at a target or end of travel
 - 4) Orchestra shell ceiling machines shall provide the user feedback as to whether the shell is stored or deployed.

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- i. Constraints:
 - 1) The system shall be able to limit or lock out travel based on various conditions, including shell deployment and machine position. A factory authorized technician is required to enable access to these features.
- j. Travel Adjust
 - 1) System shall allow the user to set temporary travel limits to accommodate the attachment of equipment to the moving machinery.
 - 2) Travel limits shall be available for both directions of travel.
- 7. Settings:
 - a. Machine Setting:
 - 1) User shall be able to disable a machine.
 - 2) User shall be able to adjust acceleration, deceleration, and speed within factorable allowable ranges.
 - b. Machine Groups:
 - 1) System shall provide the ability to group two or more machines together.
 - 2) Group types include:
 - a) Locked Groups:

Machines must travel together at all times.
System will select entire group whenever any machine in the group is selected.
If any machine within the group faults all will stop motion.
If at any point machines' position deviates from required tolerance all machines will stop motion. System shall guide the user in correcting the fault.
 - b) Offset Group:

If at any point machines' position deviates from required tolerance all machines will stop motion. System shall guide the user in correcting the fault.
 - c) Fault Group:

If any machine within the group faults all will stop motion.
 - c. User Settings
 - 1) System shall allow machine access to be tailored by user.
 - 2) System shall allow the ability to restrict variable speed control by user.
 - 3) System shall allow the ability to restrict preset/target record by user.
 - 4) System shall allow the ability to restrict system settings by user.
 - 5) System shall allow the ability to restrict machine settings by user.
 - d. System Settings
 - 1) User can adjust units of measure to the following:
 - a) Weight: Kilograms, Pounds.
 - b) Position: Feet-Inches, Decimal Feet, Decimal Inches, Decimal Meters, Millimeters.
 - 2) User can adjust screen brightness.
 - 3) Maximum Machines:
 - a) System can be configured to limit the number of machines that can move at one time. Limits can be specific to type of machines.

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- b) System shall have a location to record date of last inspection and provide the user with a reminder when the next inspection is recommended.
- e. Log File:
 - 1) System shall record all actions taken on the console in a log file which can be viewed either on the console or exported to assist in remote.

2.04 POWERLIFT HOIST (QUANTITY: 17)

A. Models:

- 1. Model 018-P0225F: (Quantity – 13)
 - a. Speed: 20 Feet Per Minute.
 - b. Total Capacity: 1,200 Pounds.
- 2. Model 018-P1817V: (Quantity – 4)
 - a. Speed: 0-180 Feet Per Minute.
 - b. Total Capacity: 1,750 Pounds.

B. Drum:

- 1. The hoist shall use a moving single layer drum to minimize hoist size and wire rope wear. The drum shall move along its axis as it rotates, keeping the cable takeoff points on the drum aligned with the head block sheaves incorporated in the hoist (zero fleet angle design). This shall be accomplished by the drum sliding on its axle and the motor shall remain stationary.
- 2. The drum shall be helically grooved to accept a single layer of cable accommodating the entire travel distance plus three dead wraps per cable. Drums that utilize multiple layers of cable shall not be allowed.
- 3. The hoist drum diameter shall not change along its long axis.
- 4. Cables shall be retained by a copper swage stop sleeve inside the drum. The cable retention system shall allow replacement of lift lines in situ. Cables shall be factory installed on the drum and color coded for ease of field installation.
- 5. Preloaded chase rollers shall be provided to retain lift lines in their grooves.
- 6. The pitch diameter of all drums shall meet or exceed the wire rope manufacturer's minimum recommended D/d ratio. Load bearing wire rope groove profiles shall meet the recommendations of the "Wire Rope Technical Board".
- 7. The drum shall be positively driven to move along its axle to maintain a zero-fleet angle with the grooves in the drum and the head block sheaves. The drum and axle shall be permanently lubricated.

C. Gearmotor and Brakes:

- 1. The motor, brakes, and gearbox shall be an integrated unit from a single manufacturer. For enhanced reliability, a continuous shaft shall link the brake, motor armature, and the first stage pinion gear without the use of couplings. Design of transmission components between the load and the brakes shall comply with ANSI E1.6-1 and EN 17206.
- 2. Motors shall be totally enclosed fan cooled (TEFC) per NEMA MG1.

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3. The gear reducer shall employ helical gearing. The gear case shall be cast iron, aluminum is not allowed, for protection against shock damage and to provide noise reduction. The output shaft shall have triple lip oil seals to prevent leaks.
4. The integral electro-magnetic brakes shall be spring applied and electrically released.
5. Fixed speed hoists shall incorporate a cast iron flywheel fan for soft starts and stops.
6. The brake controller shall apply the brake if the speed exceeds the commanded speed, the maximum speed.

D. Headblock, Blocks and Sheaves:

1. Hoist shall be constructed so that at least one wire rope life line can exit the machine at the rear of the hoist and the hoist can be located above the batten.
2. Sheaves:
 - a. All load bearing sheaves, both internal and external, shall have a minimum 26:1 D:d ratio to meet the wire rope manufacturer's recommendations. Sheave grooves shall be deeper than the cable diameter for cable protection. The sheave shall be equipped with a minimum 12 mm diameter machined steel shaft and two sealed, precision ball bearings. Spacers shall positively retain the cable.
3. Head Block:
 - a. Head block sheaves shall be mounted between 12-gauge steel (2.78 mm) minimum side plates that fully enclose the sheaves.
4. Loft Blocks:
 - a. The block and associated mounting hardware shall have a recommended working load of at least 500 lbs. (226.6 KG).
 - b. External loft blocks shall be provided with idlers to support ongoing lift lines with an individual groove for each lift line to prevent tangling. The use of un-grooved idler drums is known to cause tangling and jams and is not allowed.

E. Wire Rope and Cable Fittings:

1. Wire Rope Lift Cables:
 - a. All lift cables shall be 3/16 inch (4.77 mm) diameter 7 x 19 construction, galvanized utility cable, with a breaking strengths of 4,200 lbs. (1,905 KG).
 - b. Damaged or deformed cable shall not be used. All wire rope rigging shall be installed so as to prevent abrasion of the wire rope against any part of the building construction or other equipment.
2. Cable Fittings:
 - a. Swaged sleeve fittings shall be copper Nicopress. Aluminum sleeves are not permitted. Swaged fittings shall be installed per the fitting manufacturer's instructions, using the appropriate tools, and checked with the appropriate Nicopress "Go - No go" gauge. Swage tool used and number of crimps required shall be recorded and provided to the user with user's manual.
 - b. Eyes shall be formed over galvanized steel, wire rope thimbles of correct size. It is grooved to support the rope or cable and prevent kinking and deformation.
3. Inspection of Wire Rope:

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- a. Wire rope terminations within hoist must be able to be inspected for excessive wear and damage per ANSI E1.47. Hoists that prevent the visual inspection of terminations shall not be permitted.

F. Limit Switches:

1. Hoists shall have positively actuated limit switches for normal end of travel indication. These switches shall open the control circuit in the drive or starter to stop any further movement in the direction of travel.
2. Positively actuated limit switches shall be provided for over travel indication. These shall use a separate circuit that is redundant to the normal end of travel switches, and positively disconnects power from the hoist.
3. An override mechanism to allow resetting of the overtravel limits shall be included.
4. Limit switches shall be adjustable from the motor end of the hoist and set to match actual site conditions.
5. Computer controlled systems shall also have software limits utilizing solid state encoders, in addition to the two levels of mechanically actuated limit switches.

G. Emergency Stop:

1. The emergency stop system shall meet NFPA-79 (Electrical Standards for Industrial Machinery) and directly remove power either by means of electromechanical components, using a UL 508E Type 2, non-welding, positive break contactors or through the utilization of functional safety elements within the feature set of the VFD.
2. The emergency stop circuit shall be a normally closed circuit or a supervised circuit that provides the same or greater level of reliability and security. Its operation shall not depend on software or semiconductors.
3. Resetting the emergency stop circuit shall not initiate motion.
4. For hoists running at more than 25 fpm, a Category 1 controlled stop per NFPA-79 (Electrical Standards for Industrial Machinery) shall be provided. This provides a rapid ramp to a stop, and then removes power to reduce shock loading.

H. Load Sensing:

1. Load information shall be obtained from a load cell and located to sense the torque at the motor and the drum.
2. The load sensing system shall be able to accommodate changing loads, such as the weight of power and/or data control cables which change with elevation, without false tripping.
3. The load sensing system shall prevent the hoist from being operated while over the maximum capacity of the hoists. In the event of an overload while in travel the hoist shall be able to move down to resolve the overload.

I. Continuous Beam:

1. The hoist shall integrate with a rectangular, tubular-shaped, aluminum extrusion capable mitigating horizontal loads on the building structure
2. Continuous beam shall provide mounting capabilities for loft blocks to be positioned anywhere along the beam.

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- J. Hoist Controller:
1. Hoist shall be compatible with all JR Clancy control systems.
 2. Power and Control Wiring:
 - a. Integral power and control cables shall be provided with each hoist. Cables shall be eight feet long, with one end directly connected to the hoist assembly.
 - b. Power cables shall be a properly rated SO cable, with a NEMA L series locking connector. Control cables shall positive locking connectors.
 - c. Power and control raceways or boxes (configured as determined by the hoist manufacturer) shall be provided, complete with connectors that mate with those provided on the cables.
 3. Maintenance Pendant:
 - a. Provide one maintenance pendant to be used during installation and delivered to owner at project completion.
 - b. Maintenance pendant shall consist of up and down operators that illuminate when the hoist is on an end of travel limits, an indicator light for when an overtravel limit has been struck and an operator to bypass the end of travel limit.
 - c. Pendant shall be compatible with all PowerLift hoists in the system.
- K. Testing:
1. Hoist shall be tested to ensure proper operation of motor, limit switches and wiring prior to leaving the manufacturing facility.
 2. After hoist has been installed on site, and in accordance with ANSI E1.6-1 hoist shall undergo a static, dynamic and emergency stop test at 100% of the rated load. In addition, each load securing device shall be tested independently at 100% of the rated load.
- L. General:
1. Systems that do not comply with ANSI E1.6-1 shall not be considered acceptable.

2.05 CUSTOM LINE SHAFT HOIST (QUANTITY: 1)

- A. General: Each hoist unit shall have the capacity to raise and lower the specified load at the specified speed.
1. The hoist shaft shall incorporate a sturdy 12" x 12" box truss frame and field adjustable mounting clips for easy mounting.
 - a. Lift Line Diameter Cable Size: 3/16 inch (4.8 mm).
 2. Construction:
 - a. The integrated motor - brake - gear reducer unit and associated components, which may include a helical drum, shall be supported by a sturdy 12" x 12" box truss base, holding the elements of the winch in proper alignment.
 - b. Each helical drum shall be supported by a sturdy 12" x 12" box truss base, holding the elements of the drum assembly in proper alignment. Both ends of each drum shall be supported by a self-aligning flange bearing.
 - c. Alternate drums shall be threaded in opposite directions, to keep the batten from moving left and right as cables wrap on the drum.

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- d. Drums shall be interconnected by shafts with universal joints at each end.
- e. Side plates shall have three keepers designed to prevent cross winding of lift lines on the drums.
- 3. Gearmotor:
 - a. Motors, primary brakes, and gearboxes shall be an integrated unit, with the first stage pinion gear mounted directly on the motor's armature shaft. No couplings shall be permitted between the motor and gear reducer. Exceptions shall be permitted only when special gearing or torque requirements cannot be met with an integrated unit.
 - b. Motors shall be totally enclosed fan cooled (TEFC). The motor shall have a minimum NEMA service factor of 1.0 for constant operation.
 - c. The gear reducer shall be a combination helical/worm or helical/bevel reducer. The gear case shall be cast iron for protection against shock damage. The output shaft(s) shall have double lip oil seals to prevent leaks. The gearing service factor shall be a minimum of 1.0 with a mechanical strength service factor of 1.25.
- 4. Primary Brake:
 - a. The primary brake shall be an integral part of the motor, mounted directly on the motor's armature shaft. No couplings shall be permitted between the motor and primary brake.
 - b. Brakes shall be spring applied, direct acting, electrically released, and equipped with a manual release. The brake shall an AC / DC electro-magnetic unit with a minimum retarding torque equal to 200 percent of motor full load torque.
 - c. The brake shall be released by energizing the coil simultaneously with the motor winding to provide fail-safe braking in case of power failure.
- 5. Shafts, Keys, and Couplings:
 - a. Shafts shall be designed to accommodate the applied loads (including shock and bending loads) in accordance with ANSI B 106.1 m, "Design of Transmission Shafting",.
 - b. All connections shall be keyed, using keys designed to accommodate the applied loads. Keys shall be in accordance with ANSI B 17.1, "Keys and Key Seats".
 - c. Couplings shall be chosen to accommodate the applied loads, including shock and bending loads. Couplings shall accommodate the possible parallel and angular misalignments caused during manufacturing, assembly, and installation, as well as by structural tolerances and structural or equipment deflections.
 - d. In the case of line shaft hoists, the couplings in the shafts between the drums shall be universal joints in order to compensate for misalignment and deflections.
 - e. Only couplings made of steel and with steel to steel contact surfaces shall be used.
- 6. Bearings:
 - a. Bearings shall be selected to accommodate the applied loads and speeds.

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- b. The use of self-aligning flange bearings is preferred. The use of other bearing types shall be in accordance with good engineering practice. Pillow blocks may be used only where they are subject to compressive forces only.
- 7. Helical Drums:
 - a. Winding drums shall be designed to properly support the required loads.
 - b. Drums shall be helically grooved to accept a single layer of cable accommodating the entire travel distance plus three dead wraps. The drum diameter shall meet or exceed the wire rope manufacturer's minimum recommended D/d ratio.
 - c. Drum construction shall be of the all welded type. Cables shall enter the drum through holes drilled from root of the cable groove through the tubing wall at a 45 degree angle and shall be retained by a Copper swage stop sleeve. In order to prevent unbalanced operation, drum assemblies that exceed 20 rpm shall be straightened to a maximum total indicated run out (T.I.R.) of 0.005 inch (0.127 mm).
 - d. Each end of the drum shall be supported by either the output shaft of the gearbox or an appropriately properly sized self-aligning flange mounted in a steel plate that fully captures the drum shaft.
- 8. Fixed Speed Starters:
 - a. Each fixed speed hoist shall be controlled by a UL 508E listed, full voltage, self-protected, reversing starter. Enclosure shall be NEMA 12 with hinged, latching cover. The interior of the starter cabinet shall be "touch safe" per IEC 204-1 "Protection against direct contact" rules.
 - b. The NEMA/IEC mechanically and electrically interlocked, reversing starter shall be sized to match the hoist motor horsepower and shall be rated for plugging and jogging. Units shall incorporate UL 508E Type 2, non-welding, positive break contactors.
 - c. Overcurrent protection shall be provided by an IEC Class 10 overload. Short circuit protection shall be provided by a circuit breaker.
 - d. Starters shall be wired so that operation of the normal end of travel limit switches shall only allow movement away from the limit switch. Operation of an overtravel limit switch shall open the line contactor, and shall not allow further movement in either direction. A spring return toggle switch shall be housed inside the starter cabinet to allow override of the overtravel limits for resetting purposes.
 - e. Touch safe protection, a line contactor, and override spring return switch for overtravel limits are mandatory for safety.
- B. Limit Switch:
 - 1. Rotary Limit Switches.
 - a. Rotary limit switch assemblies shall have four gear-driven, independently adjustable switch/cam sets. Switches shall have snap acting contacts.
 - b. Rotary limit switches shall be driven directly or by roller chains. If roller chains are used, sprockets shall be pinned to prevent slipping and sized for maximum usable rotation of switch cams. The input shaft and drive chain shall be fully guarded.

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- c. Switches shall be mounted to the winch base to allow for easy adjustment of the switch settings.
 - C. Secondary Brake:
 - 1. Overspeed Brake:
 - a. A secondary overspeed load brake shall be supplied in addition to the primary brake on the motor. This brake shall be located on the low speed output shaft of the gearbox or directly fixed to the hoist drum.
 - b. This brake shall be factory set to apply itself at 125 percent of the maximum rated hoist speed (50 rpm minimum). The friction lining is mechanically set against the drum to grip when the arms extend to lock into the drum and bring the hoist to a halt.
 - c. The overspeed brake shall not require either electricity or pressure from an external source for operation.
 - D. Load Monitoring:
 - 1. Load information shall be obtained from solid state load cells mounted between the base of the hoist and the gear motor.
 - a. The cell shall accommodate total hoist loads or changing loads depending on the functions included in the supplied controls.
 - E. Slack Line Detection:
 - 1. Charged Bar:
 - 2. Provide an electrically isolated bar that grounds the control when a cable escapes from its groove. When a line touches and grounds the bar it activates a contact in the controller that does one of the following as wired or programmed:
 - a. Engages the emergency stop and halts all motion.
 - b. Stops motion and prevent further motion in the same direction.
 - c. Signals the PLC and waits for further instruction.
- 2.06 MOTORIZED RIGGING ACCESSORIES
- A. Pipe Batten.
 - 1. All battens shall be 1.5 inch (38.1 mm) nominal diameter, schedule 40 pipe in lengths as shown on the drawings or Bill of Materials. All joints shall be spliced with 18 inch (457.2 mm) long sleeves with 9 inch (228.6 mm) extending into each pipe and held by two 3/8 inch (9.52 mm) hex bolts and lock nuts on each side of the joint.
 - 2. Each end shall be covered with a bright yellow, closed end, soft vinyl safety cap at least 4 inch (101.6 mm) in length.
 - B. Turnbuckles and Pipe Clamp.
 - 1. Turnbuckles: Turnbuckles.
 - a. Turnbuckles shall be drop forged and galvanized, and conform to ASTM F-1145 Type 1, Grade 1 standard. Turnbuckles shall be moused after adjustment to prevent loosening.
 - 2. Pipe Clamps: Pipe Clamps.

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- a. Full Pipe Clamps:
- b. Pipe clamps shall be made of two strips of 12 Ga. (2.780 mm) by 2 inch (50.8 mm) hot rolled steel formed to encompass and clamp the pipe batten to prevent its rotation. Corners shall be rounded.
- c. There shall be a 3/8 inch x 1 inch (9.525 mm x 25.4 mm) hex bolt with lock nut above and below the batten. A 5/8 inch (15.875 mm) hole in the top of each clamp half allows the attachment of cable, chain, or other fittings.
- d. Full pipe clamps shall have a manufacturer's recommended load rating of at least 750 lbs (340.2 KG).

C. Lift Cables:

- 1. All lift cables shall be 7 x 19 construction, galvanized utility cable, sized as required, and with breaking strengths as follows:
 - a. 1/8 inch (3.17 mm) diameter - 2,000 lbs. (907 KG).
 - b. 3/16 inch (4.77 mm) diameter - 4,200 lbs. (1,905 KG).
 - c. 1/4 inch (6.35 mm) diameter - 7,000 lbs. (3,175 KG).
 - d. 5/16 inch (7.94 mm) diameter - 9,800 lbs. (4445 KG).
 - e. 3/8 inch (9.52 mm) diameter - 14,400 lbs. (6,532 KG).
- 2. Damaged or deformed cable shall not be used. All wire rope rigging shall be installed so as to prevent abrasion of the wire rope against any part of the building construction or other equipment.

D. Cable Fittings:

- 1. Cable clips shall conform to wire rope manufacturer's recommendations as to size, number, and method of installation. Clips shall be drop forged, made in the United States per Federal Specification FF-C-450, Type 1, Class 1. Under no circumstances may malleable cable clips be used in suspension or lifting lines.
- 2. Swaged sleeve fittings shall be copper Nicopress. Aluminum sleeves are not permitted. Swaged fittings shall be installed per the fitting manufacturer's instructions, using the appropriate tools, and checked with the appropriate Nicopress "Go - No go" gauge.
- 3. Eyes shall be formed over galvanized steel, wire rope thimbles of correct size. It is grooved to support the rope or cable and prevent kinking and deformation.
- 4. Anchor shackles are u-shaped fittings with holes at each end to accommodate a pin used to connect a rope, cable, or chain to another device or hanging point. The pin has a head at one end and a cotter pin at the other end, a thread that screws into the body of the shackle, or a thread, nut and cotter pin at the other end.

E. Emergency Stop Circuit:

- 1. The emergency stop system shall meet NFPA-79 (Electrical Standards for Industrial Machinery) and directly remove power by means of electromechanical components, using a UL 508E Type 2, non-welding, positive break contactors.
- 2. The emergency stop circuit shall be a normally closed circuit or a supervised circuit that provides the same or greater level of reliability and security. Its operations shall not depend on software or semiconductors.
- 3. Resetting the emergency stop circuit shall not initiate motion.

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4. Emergency Stop switches shall all look similar and operate in an identical manner. All fixed and portable control panels shall include an emergency stop operator. Additional switches shall be provided as shown or required for safety.

F. Pantograph Cable Management:

1. Pantograph shall accommodate up to (64) 12 Ga conductors and up to (2) data cables.
 - a. Up to (8) 8 conductor flat cables.
 - 1) Maximum capacity of (25) 120 Volt, 20 amp circuits utilizing (1) 12 Ga ground conductor for every (2) 20 amp circuits.
 - b. Data Cable:
 - 1) Data cable shall be CAT5 capable of being used for either DMX or network protocol.
2. Pantograph shall be constructed with a physical barrier between the power supply and data cables within the channel.
3. The pantograph shall consist of a series powder coated aluminum channels hinged to each other to allow the entire distance of travel required by the batten, up to a 52 feet (15.8 m) fully extended length.
4. The top arm shall be connected to a moving trolley.
5. Pantograph shall fit between lift lines spacing greater than 8 feet -6 inch (2591 mm) and less than 11 feet - 0 inch (3353 mm).
6. Pantograph fully retracted height shall be no greater than 25 inch (635 mm) vertical.
7. Pantograph shall mount to a 1.5 inch (38 mm) schedule 40 pipe batten.
8. Pantograph shall travel at a maximum speed of 30 feet per minute (9 meters per second).
9. System includes power and data strain reliefs for top and bottom.
10. System shall include grid junction box to be installed by electrical contractor.

2.07 THEATRICAL CURTAINS AND ACCESSORIES

A. Manual Cord Operated Traveling Curtain Track (Quantity: 3)

1. Provide curtain track complete with all necessary accessories for cord operation to be located in the Main Curtain, Midstage, and Upstage / Breeze Traveler Curtain positions. Tracks to be ~50' long. Refer to TEX.XX drawings.
2. Suspend track with two-piece clamp hanger. Provide 2' track overlap at center, rigidly separated by two overlap clamps. Install end stop with cord support at each track end. Where track lengths exceed 24', connect tracks with minimum 12" long, two-piece splicing clamp.
3. Provide single carriers, spaced on 12" centers, constructed of two polyethylene wheels fastened parallel to shielded ball bearing carrier body and supplied with heavy-duty hook, swivel eye and trim chain for attachment of curtain. Black Super Tough nylon shall be molded around shielded and greased ball bearing to form carrier body. Install round neoprene bumper between each carrier to reduce noise.
4. Master carriers shall be 4-wheel assemblies with press-fit shielded ball bearings. Connect to operating line with two formed steel cord clamps attached to each body.

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Supply each master carrier with two heavy-duty hooks, swivel eyes and trim chains for attachment of leading edge of curtain.

5. Single and double end pulleys shall clamp securely to the underside of the track channel and shall contain 4" diameter sheaves enclosed in steel housings to prevent operating line from escaping the grooves. Sheaves shall be Nylon moulded around shielded and greased ball bearings and grooved to accommodate up to 3/8" operating line.
 6. Provide floor block in 12 gauge steel housing containing 4" Nylon shielded ball bearing sheave. Sheave axle shall lock at any point within 9" vertical slots to allow tension adjustment of operating line. The floor block shall have a removable sand bag for floor stabilization when the curtain is at floor level.
 7. Black operating line shall be 3/8" diameter, stretch-resistant rope with spun polyester outer jacket braided over solid aramid core.
 8. Track shall be finished with a semi-gloss black powder coat. All other steel components shall be black oxide finished.
 9. Curtains per drapery schedule in paragraph 2.07, C, 3.
- B. Walk Along Operated Traveling Curtain Track (Quantity: 2)
1. Provide curtain track complete with all necessary accessories for walk along operation. Tracks to be ~52' long. Refer to TEX.XX drawings.
 2. Suspend track with two-piece clamp hanger. Install end stop at each track end. Where lengths exceed 24', connect tracks with minimum 12" long, two-piece splicing clamp.
 3. Provide single carriers, spaced on 12" centers, constructed of two polyethylene wheels fastened parallel to shielded ball bearing carrier body and supplied with heavy-duty hook, swivel eye and trim chain for attachment of curtain. Black nylon shall be molded around shielded and greased ball bearing to form carrier body. Install round neoprene bumper between each carrier to reduce noise.
 4. Track shall be finished with a semi-gloss black powder coat. All other steel components shall be black oxide finished.
 5. Curtains per drapery schedule in paragraph 2.07, C, 3.
- C. Stage Drapery and Drops
1. Stage Curtain Construction
 - a. Verify Drapery Measurements in Field before construction.
 - b. All draperies must be vat dyed and either inherently flameproof or flame retarded by an immersion process.
 - c. All fabric cuts must be full length with no splices. Any fabric sections with visible streaking or spotting must be cut from bolt and discarded.
 - d. All Stage curtains furnished with sewn fullness must be box-pleated on 12-inch centers.
 - e. All top hems must have a heavy-duty jute webbing double stitched at the top with machine set brass grommets one foot on center with tie lines or snap hooks as required.
 - f. All draperies must have, as a minimum, 50% fullness unless otherwise specified.
 - g. All hems must be double turned with no visible selvage edges.

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- h. On-stage and off-stage vertical hems of Main Curtain and Traveler Curtains must have 1/2 bolt width turned back hems. All other vertical hems must be 3 inches.
 - i. Floor length draperies must have a 6-inch bottom hem with a suspended inner canvas or muslin pocket containing #8 zinc plated chain weights.
 - j. Bottom hems of border curtains must be 4 inches.
 - k. All fabrics with pile ends must be sewn with pile running down unless otherwise specified.
 - l. Lining fabric (if required) shall be attached to the face fabric of the drape using short nylon webbing strips tacked along the bottom and sides of the curtain.
 - m. All fabrics must be either inherently flameproof or flame proofed using an immersion process. This process must be in accordance with the requirements of the NFPA 701 Large and Small scale test.
2. Scenery Drop Construction
- a. Verify Drapery Measurements in Field before construction.
 - b. All fabrics must be vat dyed unless specified as a natural color.
 - c. All fabrics must be either inherently flameproof or flame proofed by the immersion process, in accordance with the requirements of the NFPA 701 Large and Small scale test.
 - d. All fabric cuts must be full width with no splices.
 - e. Cuts must be sewn horizontally unless otherwise specified. Seamless fabrics as specified.
 - f. Top hem must be reinforced with heavy jute webbing double stitched with #4 machine set brass grommets one-foot on center with 36-inch tie lines.
 - g. Side hems must be 3 inch double turned and show no selvedge.
 - h. Bottom hem must have a bottom hem with a suspended inner 6-inch heavy canvas lined pipe pocket with reinforced openings spaced 10-foot on center for inserting pipe weight.
3. Drapery Schedule
- a. 1 each - Main Curtain from 25 oz IFR Polyester Velour with 100% fullness, in two sections, each section being ~24'0" high X 26'0" wide. Provide curtain with snap hooks at top. Coordinate Color with Architect and Client before construction.
 - b. 1 each - Main Border from 25 oz IFR Polyester Velour with 100% fullness, in one section ~8'0" high X 42'0" wide. Provide curtain with 18" tie lines at top. Color to be the same as the Main Curtain.
 - c. 1 each - Mid Stage Traveler from 21 oz IFR Polyester Velour with 50% fullness, in two sections, each section being 24'0" high by 26'0" wide. Provide curtain with snap hooks at top. Color to be black.
 - d. 1 each – Up Stage/Breeze Curtain Traveler from 21 oz IFR Polyester Velour with 50% fullness, in two sections, each section being 24'0" high by 26'0" wide. Provide curtain with snap hooks at top. Color to be black.
 - e. 4 each - Masking Leg Curtains from 21 oz IFR Polyester Velour with 50% fullness, in one section ~22'6" high X 8'0" wide. Provide curtain with 18" tie lines at top. Color to be black.

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- f. 1 each - Cyclorama Drop from Seamless natural Heavy Weight 100% Cotton muslin in one section 22'6" high by 48'0" wide. Provide Drop with 18" tie lines at top. Color to be bleached white.
 - g. 8 each – Variable Acoustic Side Curtains from 22 oz IFR Polyester Velour with 100% fullness, in one section ~27'0" high X 11'0" wide. Provide curtain with snap hooks at top. Coordinate Color with Architect and Client before construction.
 - h. 1 each – Variable Acoustic Rear Austrian/Braille Curtain from 22 oz IFR Polyester Velour with 100% horizontal fullness, in one section ~20'0" high X 40'0" wide with cutout for the followspot window. Provide curtain with 18" tie lines at top. Coordinate Color with Architect and Client before construction.
 - i. NOTE - For items "g" and "h" above the following additional criteria applies: Drapery fabric used for acoustical purposes shall perform to a minimum 0.35 absorption coefficient @ 125Hz band AND minimum NRC 0.95, when tested in accordance with ASTM C423 in Type G100 Mount by a laboratory accredited for specific acoustical testing under the National Voluntary Laboratory Accreditation Program (NVLAP).
- D. 10' long Intermediate Metal Conduit pipe weight (Quantity: 4)
- 1. Provide sections of intermediate metal conduit to serve as drop bottom pipe weight.
 - 2. Each section of conduit to have one (1) threaded coupler.
 - 3. Provide plastic thread protection end caps for each conduit section.
- E. 8' long Intermediate Metal Conduit pipe weight (Quantity: 1)
- 1. Provide sections of intermediate metal conduit to serve as drop bottom pipe weight.
 - 2. Each section of conduit to have one (1) threaded coupler.
 - 3. Provide plastic thread protection end caps for each conduit section.

PART 3 - EXECUTION

3.01 GENERAL

- A. Coordinate work with other trades to avoid causing delays in construction schedule.
- B. Mount equipment and enclosures plumb and square. Permanently installed equipment shall be firmly and safely held in place.
- C. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.
- D. Mount equipment in racks and enclosures and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Consultant in writing that racks will be fabricated on site and the reasons for the change.

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3.02 CONTRACTOR/THEATRICAL RIGGING CONTRACTOR INSTALLATION

- A. Confirm by site visit and by report from general and electrical contractor all field conditions, which may affect manufacture and installation of the Theatrical Rigging Systems equipment prior to fabrication. Provide any additional hardware, panels and back boxes to accommodate field conditions. Submit all changes to equipment and mounting details to Consultant for review prior to fabrication.
- B. Supply specific, detailed direction to electrical contractor as required for proper termination of all Theatrical Rigging System equipment, coordinated with actual site conditions.
- C. The Theatrical Rigging Contractor shall furnish all items required to properly install and secure Rigging System equipment in place.
- D. The electrical contractor shall connect all line voltage Theatrical Rigging System equipment with the following exceptions:
- E. Hoist control wire terminations.
- F. If any panel, distribution box, or other device requires relocation or change of mounting detail, and this fact is not known until after shipment due to sequence of work, modify equipment or provide new equipment to fit revised location or mounting detail. Notify Consultant of any such changes, and submit all changes to Consultant for review prior to fabrication.
- G. The Theatrical Rigging Contractor shall terminate all control wire in racks and at hoist locations.
- H. Provide a service loop for all control cables and harness in place where applicable. No splices shall be allowed inside of control panels or racks. Provide terminal strips secured to panel or rack frame for all connections.
- I. Supply GC with all paint and supplies to correct minor cosmetic damage to equipment. Ensure that all equipment is clean and in perfect condition at time of Completion Checkout.
- J. Repair or replace any equipment, which has suffered non-cosmetic damage prior to time of Completion Checkout. Claims arising from repair or replacement of such damage shall be considered only after final acceptance of system by Owner.
- K. The Theatrical Rigging Contractor in coordination with the Project General Contractor shall clean all racks, panels, and boxes of dirt, dust and debris, re-assemble all equipment, and replace all panels, covers and screws prior to time of Completion Checkout.

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- L. Theatrical Rigging Contractor shall not use any control equipment intended for installation for the purpose of checking out wiring or circuitry prior to an on-site factory trained technician testing the system (as specified above). Equipment may be used for such testing only in specific areas where proper conditions exist.

3.03 THEATRICAL RIGGING CONTRACTOR TESTS AND ADJUSTMENTS

- A. Test all hoists for proper operation. Set hoist limit switches to limit travel appropriately.
- B. Test hoist control system for proper operation.
- C. Test system Kill switch for proper operation.
- D. Test all cable management systems for proper operation.
- E. Verify that all termination hardware is installed to specification.

3.04 TEST EQUIPMENT

- A. The following equipment shall be available for field-testing. Submit for approval, as a portion of the tender, list of test equipment.
 - 1. Torque Wrench
 - 2. Compression sleeve test gage.
- B. Theatrical Rigging Contractor shall provide all appropriate hardware, adapters, extension cables and connectors necessary to interconnect test equipment to Theatrical Rigging system, and to perform all tests described below.
- C. Theatrical Rigging Contractor shall provide sufficient field service personnel (minimum of 2) to perform all tests specified below. The electrical contractor shall furnish sufficient workmen to operate all equipment and to assist in all tests specified below. The Theatrical Rigging Contractor shall provide ladders and other devices, including 4 walkie-talkies, to allow access to all devices to be tested and communication between parties.

3.05 TEST PROCEDURES

- A. Perform all following tests & provide a test report to the consultant:
 - 1. Inspect all device labels to ensure that devices are correctly and clearly labeled as specified and shown in specifying consultant approved submittal drawings.
 - 2. Measure Torque of all bolted connections to verify if they meet manufacturer's specification.
 - 3. Measure all Compression sleeve connections to verify if they meet manufacturer's specification.
 - 4. Inspect all hoist cabling and terminations for kinks, twists, and bends.
 - 5. Test all control panels for all functions.

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6. Test all functions of all remote devices and all control plug-in points. When remote devices are Not In Contract, but accommodation for these devices is included, provide identical devices for testing purposes.
7. Test all extension cables, adapters, etc. Test and adjust all spare parts.
8. Repair or replace any equipment that fails to conform to specification, and schedule second set of tests and adjustments. Repeat testing and repair or replacement as required to make the entire Theatrical Rigging System conform to specification.
9. Upon completion of testing, furnish Owner, Architect and Consultant a complete report on all field-testing and adjustment, certifying that system conforms to specification and that installation is complete and ready for inspection.

3.06 ACCEPTANCE

- A. Schedule inspection by Owner, Architect and Consultant no earlier than upon receipt of above specified report.
- B. Provide all test equipment and personnel specified in "Field Testing and Adjustment" above.
- C. Coordinate with GC to ensure that no other work shall be scheduled in audience chamber or stage areas, and that all temporary bracing and scaffolding has been removed to permit full operation of and access to all equipment.
- D. At request of Consultant, repeat any and all tests specified in "Field Testing and Adjustment" above in presence of Owner, Architect and Consultant.
- E. Should Owner, Architect or Consultant judge that any equipment fails to conform to specification, repair or replace that equipment within 30 days, and schedule second inspection. Should the Owner; Architect or Consultant judge that any work inspected is not substantially complete at time of Completion Checkout, schedule second inspection. Provide all equipment and personnel specified above.
- F. Schedule additional checkouts as required until Owner, Architect and Consultant judge entire Rigging System to conform to specification. After Completion Checkout, compensate Owner for any consulting and transportation costs incurred during subsequent checkouts. Final payment shall be withheld until systems have been thoroughly tested and adjusted and found to be in first class operating condition in every particular.

3.07 INSTRUCTION OF OWNER PERSONNEL

- A. Provide four hours instruction to Owner designated personnel on the use and operation of the System, scheduled as one session, by an instructor fully knowledgeable and qualified in system operation. This instruction should include familiarization with all system components and basic operation of the rigging system. The Owner may record

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the instruction session at their cost. The System Reference Manuals shall be complete and on site at the time of this instruction.

3.08 FOLLOW-UP INSPECTION

- A. One year after the completion of installation, the Rigging Contactor shall return to the site and provide the following services:
1. Perform a complete inspection of the rigging system in accordance with ANSI E1.6-1 Entertainment Technology - Powered Hoist Systems, and ANSI E1.47 - Recommended Guidelines for Entertainment Rigging System Inspections.
 2. Make all required adjustments.
 3. Correct all warranty items.
 4. Provide written recommendations for necessary repairs or changes not included in the warranty.
 5. Conduct a 1 hour rigging operation and safety class.
 6. Provide a written proposal for the next year's maintenance visit.

END OF SECTION

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SECTION 126100 - FIXED AUDIENCE SEATING

PART 1- GENERAL

1.01 SECTION INCLUDES

- A. Delivery and installation of approximately 250 fixed, padded and upholstered chairs as specified, floor mounted, with self-lifting seat that rises to a uniform 3/4-safety fold position.

1.02 SUBMITTALS

- A. Product data for each chair model specified, to include construction details, material descriptions and finish options
- B. Seating layout (shop drawings) developed from the contract drawings that show aisle widths, chair spacing for each row, row-lettering and chair-numbering scheme, chair dimensions, back pitch, and under-floor air diffuser locations. Layout drawings to also include locations for accessories, where specified, electrical devices, accessibility provisions and attachments to other work.
- C. Samples for verification & finish selection to include:
 - 1. Initial finish selections to be made from manufacturer's standard color and fabric guides.
 - 2. Final powder coat selection to be approved from manufacturers standard-sized samples not less than 1" x 3".
 - 3. Final laminate selection to be approved from manufacturers standard-sized samples not less than 2" x 2".
 - 4. Final plastic color selection to be approved from manufacturers standard-sized samples not less than 2" x 3".
 - 5. Final wood finish selection to be approved from manufacturers standard-sized samples not less than 4" x 3".
 - 6. Final upholstery fabric selection to be approved from fabric mills standard swatch size.
- D. Maintenance instructions and inspection guidelines furnished for each chair model specified.
- E. Manufacturers standard warranty.

1.03 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Obtain each type of fixed seating required, including accessories and mounting components, from a single manufacturer.

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2. Obtain fabric of a single dye lot for each color and pattern of fabric required except when yardage requirement exceeds maximum dye lot. Multiple dye lots shall be color matched for quality assurance.

B. Fire Performance Characteristics of Upholstered Seating:

1. Fabric shall be Class 1 according to DOC CS 191 and 16 CFR 1610.61, tested according to California Technical Bulletin 117.
2. Padding shall comply with California Technical Bulletin 117.

1.04 REFERENCES

- A. California Building Code (CBC) – 2022 Edition
- B. California Fire Code (CFC) – 2022 Edition
- C. California Technical Bulletin 117

1.05 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install seating until spaces are enclosed and weather tight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary or permanent HVAC system is operating and maintaining ambient temperature and humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements:

1. Take field measurements to verify or supplement dimensions indicated on contract drawings prior to manufacturing.

1.06 PROJECT COORDINATION

- A. Do not deliver or install seating until space is free of lifts and/or scaffolding used by other trades which may interfere with installation and/or damage seating.
- B. Coordinate layout and installation of electrical wiring and devices with electrical contractor to ensure that floor junction boxes for electrical devices are accurately located for final connection to the building's power supply by the electrical contractor.
- C. Coordinate layout and installation of seating with HVAC contractor to ensure that floor diffusers are located in a manner that will not interfere with seating installation and are as far to the rear of each seating tier as possible.

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- D. Coordinate layout and installation of seating with low voltage devices, such as AV floor boxes, to ensure devices are located in a manner that will not interfere with seating installation and will allow box lids to operate properly.
- E. Coordinate concrete requirements needed for proper installation.

1.07 WARRANTY

- A. Provide a manufacturer's warranty covering the material and workmanship for the specified warranty period from date of final acceptance.
- B. Minimum Warranty Periods:
 - 1. Structural Components: five years.
 - 2. Operating Mechanisms: five years.
 - 3. Plastic, Wood and Painted Components: five years.
 - 4. Upholstery Fabric: one year.
 - 5. Electrical Components: one year.

PART 2- PRODUCTS

2.01 Materials and Finishes

- A. Steel shall meet requirements for ASTM A 36/A 36M plates, shapes, and bars; ASTM A 513 mechanical tubing; ASTM A 1008/A 1008M cold-rolled sheet; and ASTM A 1011 hot-rolled sheet and strip.
- B. Cast Iron shall meet requirements for ASTM A 48/A 48M, Class 25, gray iron castings free of blow holes and hot checks with parting lines ground smooth.
- C. Cast Aluminum shall meet requirements for ASTM B 85 aluminum-alloy die castings.
- D. All exposed metal parts shall be powder coated with a polyester powder coat finish. The powder coat finish shall be applied by electrostatic means to a thickness of 2 - 5 mils and shall provide a durable coating having a 2H Pencil hardness. Prior to powder coating, metal parts shall be treated with a three-stage non-acidic, bonderizing process for superior finish adhesion, and after coating shall be oven baked to cause proper flow of the epoxy powder to result in a smooth, durable finish. Manufacturer's standard color range shall be used.
- E. Medium-density fiberboard shall meet requirements for ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
- F. Concealed plywood shall meet requirements for HPVA HP-1 hardwood plywood.

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- G. Exposed plywood shall meet requirements for HPVA HP-1, Face Grade A, hardwood veneer core with color-matched hardwood-veneer faces, made with adhesive containing no urea formaldehyde.
- H. Hardwood lumber and veneer faces shall be maple selected to be free of visible defects. Exposed wood shall be sanded smooth and stained to color selected with low-VOC water-based stain and top coat to provide with a high quality finish. Color to be chosen from manufacturer's standard offering.
- I. Upholstery fabric shall be selected by Architect. Fabric shall meet specifications AATCC 16 Option 3, AATCC 107 and AATCC 8 for color fastness and withstand 250,000 double rubs per ASTM D-4157. Fabric shall meet flammability resistance outlined in California Technical Bulletin 117; NFPA 260-1989, Class 1; UFAC, class 1.
- J. Upholstery padding shall be molded, custom cut or slab polyurethane foam complying with CMVSS-302.
- K. Molded Plastics:
 - 1. Structural components shall be mar and dent resistant high density glass-filled polypropylene with UV stabilizers.
 - 2. Decorative components shall be mar and dent resistant high density polyethylene (HDPE) with UV stabilizers.
 - 3. Plastic components shall be chosen from manufacturer's standard offering.

2.02 FIXED AUDIENCE SEATING

- A. Permanent arrangement of fixed audience seating as shown on seating layout drawings.
 - 1. Approved manufacturers subject to compliance with requirements outlined herein.
 - 2. Basis-of-design for fixed audience seating is Ducharme model Arte with customizations (contact Aleksandra Pietrzycka at Ducharme).
- B. Chair frame to be constructed of tube steel.
- C. Aisle end panels shall be solid plywood with veneer finish. Veneer species to be selected by Architect.
- D. Backs shall be padded and upholstered on their face, with a wood veneer rear panel. The face of the back shall be upholstered over a 3" thick polyurethane foam pad with horizontal lumbar support. Assembled chair shall have a nominal back height of 34". The back assembly shall be certified through routine ISO testing to withstand a 250 lb. static load test applied approximately 16" above the seat assembly and a 100,000 cycle 40 lb. swing impact test.

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- E. Seats shall be padded and upholstered on their top surface with a structural, injection molded polypropylene seat foundation. Seats shall self-rise to a uniform position when unoccupied utilizing a maintenance-free gravity counterweight system. Spring actuated seats are not acceptable. The mechanism shall be certified through routine ISO testing to exceed 300,000 cycles during ASTM Designation F851-87 Test Method for Self-Rising Seat Mechanism. In addition, the seat shall withstand a 600 lb. static load test applied approximately 3" from the front edge of the seat assembly and a 50,000 cycles 125 lb. vertical drop impact test.
1. Seat foundation shall be engineered glass-filled, injection molded polypropylene. Bottom surface of the foundation shall be wood veneer.
 2. When unoccupied, the seat shall rise automatically to a 3/4 safety fold position, and upon a slight rearward pressure, shall achieve full-fold, allowing the patron additional passing room. Seat-lift shall be accomplished by a maintenance-free counterweight (gravity lift) system.
- F. Chair width shall vary between 20" and 24" to accommodate sightlines and row lengths.
- G. Back height and pitch shall be fixed as shown on seating layout drawings.
- H. Center standards shall be provided with an armrest support structure capable of surpassing a 200 lb. vertical static load test applied 3" from the front edge of the armrest. Support structure is capped with a curved solid wood armrest attached with concealed hardware. Aisle end armrests are to be attached to the aisle panel bracket with concealed hardware.
- I. Chairs are to be provided with cupholders
- J. Row-lettering and chair-numbering shall be provided for identification of all chairs as shown on approved seating layout drawings. Number plates shall be 5/8" x 1-5/8" aluminum with a finish to be selected by the Architect, and black sans serif numerals. Row letter designators shall be numerals attached to the aisle standards. Finish to be selected by Architect. Attaching hardware shall have a finish compatible to designators.
- K. Aisle lights shall be furnished for aisle standards designated on the approved seating layout drawings. Aisle lights shall be LED fixtures. Fixtures shall be concealed under the armrest to provide illumination of the aisle panel and adjacent floor and/or steps. The aisle light standards are to be provided pre-wired with approximately 18" of wiring extending beyond the base of the standards. Wiring shall be encased within a black, rubber-coated flex steel conduit that exits the column just above the foot. Seating supplier shall furnish as part of the aisle light package a voltage reduction device suitable for conversion of 120 volt, A.C., facility power to 12 volt, D.C., or as required for aisle lights. The voltage reduction device shall be Underwriters' Laboratories listed as a Class II Power Unit for proper supply

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of power to the aisle lights. All wiring connections from the electric distribution system to the aisle light standards, as well as installation, proper safe mounting, and connection of the voltage reduction device, shall be the responsibility of the electrical contractor, including provision of suitable locking-style electrical disconnect device.

L. Accessible Seating:

1. Shall be designated on the seating layout drawings and designed to allow an individual to transfer from a wheelchair to the theatre chair. The aisle standard shall be equipped with an armrest capable of lifting to a position parallel with the support column, opening sideways access to the seat. Aisle standards so equipped shall be provided with a label, displaying an easily recognizable "handicapped" symbol. Decorative requirements of aisle standards are waived for the handicapped access standards.
2. Chairs located as shown in the contract drawings shall be mounted upon moveable steel bases. The steel bases shall be available for sections of one (1), two (2), or three (3) chairs. The bases shall be fabricated from 3/16" x 3-1/2" x 15-1/2" steel, with cross members securely fastened to the horizontal base members via Tec screws. Holes shall be provided for the attachment of the chair standards. Moveable bases are secured to the floor when the seating is in use with reverse anchors.

M. Furnish extra materials from the same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish complete seat and back assemblies equal to 1% of amount installed for each type and size of chair seat and back.
2. Furnish seat and back fabric covers equal to 2% of amount installed for each type and size of cushion.
3. Furnish armrests equal to 1% of amount installed for each type of armrest.

2.03 FABRICATION

- A. Manufacture fabric-covered cushions with molded padding beneath fabric and with fabric covering free of welts, creases, stretch lines, and wrinkles. For each upholstered component, install pile and pattern run in a consistent direction.
- B. Fabricate floor attachment plates to conform to floor slope, if any, so that standards are plumb, and chairs are maintained at same angular relationship to vertical throughout project.

PART 3- EXECUTION

3.01 EXAMINATION

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- A. Prior to layout and installation examine floors, risers, and other adjacent work and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the work including, but not limited to, plumb of riser faces and concrete conditions.
- B. Examine locations of electrical connections.
- C. Examine locations of HVAC supply ducts.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install seating in locations indicated and fastened securely to substrates according to manufacturer's written installation instructions.
- B. Use installation methods and fasteners that produce fixed audience seating assemblies with individual chairs capable of supporting an evenly distributed 600-lb static load applied 3" from front edge of the seat without failure or other conditions that might impair the chair's usefulness.
- C. Install seating with chair end standards aligned from first to last row and with backs and seats varied in width and spacing to optimize sightlines.
- D. Install riser-mounted attachments to maintain uniform chair heights above floor.
- E. Install chairs in curved rows at a smooth radius.
- F. Install seating so moving components operate smoothly and quietly.
- G. Install wiring conductors and cables concealed in components of seating and accessible for servicing.

3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Prepare test and inspection reports.

3.04 ADJUSTING

- A. Adjust chair backs so that they are properly aligned with each other.
- B. Adjust self-rising seat mechanisms so seats in each row are aligned when in upright position.
- C. Verify that all components and devices are operating properly.

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- D. Repair minor abrasions and imperfections in finishes with coating that matches factory-applied finish.
- E. Replace upholstery fabric damaged during installation.

END OF SECTION

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SECTION 14 42 00 - WHEELCHAIR LIFTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Vertical platform lifts.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each lift. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Manufacturer Certificates: Signed by lift manufacturer certifying that runway, ramp or pit, and dimensions as shown on Drawings and that electrical service as shown and specified are adequate for lift being provided.
- E. Inspection and acceptance certificates and operating permits.
- F. Operation and maintenance data.
- G. Warranty: Sample of special warranty.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Regulatory Requirements: In addition to requirements of authorities having jurisdiction, comply with ASME A18.1, "Safety Standard for Platform Lifts and Stairway Chairlifts."

1.04 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lifts that fail in materials or workmanship within specified warranty period.

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1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500.
- C. Steel Pipe: ASTM A 53/A 53M; standard weight (Schedule 40) unless otherwise indicated or required by structural loads.
- D. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel (CS), Type B, exposed, matte finish.
- E. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel (CS), Type B, pickled.
- F. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating.
- G. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- H. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required:
 1. Extruded Aluminum: ASTM B 221, Alloy 6063-T6.
 2. Aluminum Sheet: ASTM B 209, Alloy 5005-H15.
- I. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- J. Stainless-Steel Tubing: ASTM A 554, Grade MT-304.
- K. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
- L. Stainless-Steel Floor Plate: ASTM A 793.
- M. Glass: Comply with requirements in Division 08 Section "Glazing."
- N. Acrylic Glazing: ASTM D 4802, Category A-1 (cell-cast) or Category A-2 (continuous cast), Finish 1 (smooth or polished), clear or tinted as indicated.

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- O. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing structural members, guide rails, machines, and other lift components where installation of devices is specified in another Section.
- P. Expansion Anchors: Anchor-bolt-and-sleeve assembly of material indicated below with capability to sustain a load equal to 10 times the load imposed as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Group 1, Alloy 304 or Alloy 316, stainless-steel bolts and nuts complying with ASTM F 593 and ASTM F 594.
- Q. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

2.02 VERTICAL PLATFORM LIFTS

- A. Vertical Platform Lifts: Manufacturer's standard preengineered lift systems as indicated.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Savaria Corporation; V1504-STD, or comparable product by one of the following:
 - a. Garaventa Accessibility.
 - b. Lift-U; Division of Hogan Mfg., Inc.
 - c. National Wheel-O-Vator Co., Inc. (The).
 - d. Savaria Corporation.
 - e. ThyssenKrupp Access; a ThyssenKrupp company.
- B. Platform Size: 36 by 48 inches.
- C. Door Operation and Clear Opening Width: Low-energy, power-operated doors that remain open for 20 seconds minimum; end door with minimum 32-inch clear opening width.
- D. Rated Speed: 20 fpm.
- E. Power Supply: 110 V, 60 Hz, 1 phase, 20A.
- F. Emergency Operation: Provide connection to indicated standby (emergency) power to raise or lower units in case of malfunction or power loss.
- G. Self-Supporting Units: Support vertical loads of units only at base, with lateral support only at landing levels.
- H. Platform: Galvanized-steel sheet with black rubber flooring.

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- I. Platform Enclosure and Door: Rectangular steel-tube frame with flush steel-sheet panels.
- J. Platform Enclosure and Door: Extruded-aluminum frame with flush galvanized-steel-sheet panels.
- K. Fixed Ramp: Provide fixed ramp matching platform to provide transition from floor to lift platform at bottom landing.
- L. Retractable Ramp: Provide ramp matching platform to provide transition from lower floor to lift platform. Ramp lowers to floor automatically when lifts reach lower landing and door opens. Ramp rises automatically when lift control is activated for lift to leave lower landing.
 - 1. Ramp Size: End ramps a minimum of 32 inches wide; length as required for slope.
 - 2. Ramp Slope: As indicated on Drawings, but not more than 1:12.
 - 3. Ramp Finish: Finish ramps to match lift platform.

2.03 FINISHES

- A. Steel Factory Finish: Manufacturer's standard powder-coat finish.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.
- B. Aluminum Finishes:
 - 1. Powder-Coat Finish: Manufacturer's standard powder coating.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Comply with ASME A18.1 and manufacturer's written instructions for installation of lifts unless otherwise indicated.
- B. Minimum Headroom Clearance: Verify that installed lift will have a minimum headroom of 80 inches above any point on platform floor at any point of travel.
- C. Wiring Method: Conceal conductors and cables within housings of units or building construction. Do not install conduit exposed to view in finished spaces.
- D. Coordinate runway doors with platform travel and positioning, for accurate alignment and minimum clearance between platforms, runway doors, sills, and door frames.
- E. Position sills accurately and fill space under sills solidly with nonshrink, nonmetallic grout.

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- F. Coordinate platform doors with platform travel and positioning.
- G. Adjust stops for accurate stopping at each landing, within required tolerances.
- H. Adjust retractable ramps to meet maximum allowable slope and change-in-elevation requirements, and to lie fully against landing surfaces.
- I. Lubricate operating parts of lift, including drive mechanism, guide rails, hinges, safety devices, and hardware.

3.02 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of lift installation and before permitting use of lifts, perform acceptance tests as required and recommended by ASME A18.1 and authorities having jurisdiction.
- B. Operating Test: In addition to above testing, load lifts to rated capacity and operate continuously for 30 minutes between lowest and highest landings served. Readjust stops, signal equipment, and other devices for accurate stopping and operation of system.

3.03 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lifts. Include a review of emergency systems and emergency procedures to be followed at time of operational failure and other building emergencies.
- B. Check operation of lifts with Owner's personnel present and before date of Substantial Completion. Determine that operating systems and devices are functioning properly.
- C. Check operation of lifts with Owner's personnel present not more than one month before end of warranty period. Determine that operating systems and devices are functioning properly.

END OF SECTION

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SECTION 21 13 00 – FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.01 REFERENCES

- A. AMERICAN IRON AND STEEL INSTITUTE (AISI)
 - 1. AISC/AISI 121 (2007) Standard Definitions for Use in the Design of Steel Structures
- B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
 - 1. ASME A112.18.1 (2018) Plumbing Supply Fittings
 - 2. ASME B1.20.1 (2013) Pipe Threads, General Purpose (Inch)
 - 3. ASME/ANSI B16.1 (2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
 - 4. ASME/ANSI B16.3 (2016) Malleable Iron Threaded Fittings, Classes 150 and 300
 - 5. ASME/ANSI B16.4 (2016) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
- C. AMERICAN WATER WORKS ASSOCIATION (AWWA)
 - 1. AWWA C111/A21.11 (2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - 2. AWWA C151/A21.51 (2017) Ductile-Iron Pipe, Centrifugally Cast
 - 3. AWWA C900 (2016) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4-inch Through 60-inch
- D. ASTM INTERNATIONAL (ASTM)
 - 1. ASTM A47/A47M (1999) Standard Specification for Ferritic Malleable Iron Castings
 - 2. ASTM A53/A53M (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 3. ASTM A135/A135M (2009; R2014) Standard Specification for Electric-Resistance-Welded Steel Pipe
 - 4. ASTM A234/A234M (2019) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
 - 5. ASTM A536 (1984) Standard Specification for Ductile Iron Castings
 - 6. ASTM D1784 (2020) Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
- E. FM GLOBAL (FM)
 - 1. FM APP GUIDE (updated on-line) Approval Guide <http://www.approvalguide.com/>
- F. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
 - 1. NFPA 13 (2022) Standard for the Installation of Sprinkler Systems

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2. NFPA 24 (2019) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

G. UNDERWRITERS LABORATORIES (UL)

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Conduct a survey of the work area. Commencement of work constitutes acceptance of existing conditions.
- B. Convene one week before starting work of this section for preinstallation meeting.

1.03 SUBMITTALS

- A. Submit the following in accordance with DIVISION 01 – GENERAL REQUIREMENTS.

1. Shop Drawings

- a. Shop drawings prepared in accordance with NFPA 13, including hydraulic calculations that are approved by the Authority Having Jurisdiction. Drawings shall have the approval of a Professional Engineer registered in the state in which the project is located. Drawings to consist of the following, refer to NFPA 13 “Plans and Calculations” for a comprehensive list of items to be included:

- 1) Piping plan view and/or Reflected Ceiling Plan (RCP) drawing(s) indicating relationship of all other trades and approved sprinkler head locations.
- 2) Details and sections to clearly identify design intent.
- 3) Plans shall include: Seismic zones of influence, hydraulic remote areas, elevations of pipe, attachment locations and type, zones and associated coverage areas, volume of dry system(s) (if applicable), locations of seismic separation and expansion joints, hose cabinet locations, drain locations, primary fire pumps, secondary pumps, supply, pressure maintenance pumps, controllers, drivers and accessories.

2. Product Data

- a. Provide data on piping, valves, sprinklers, hangers/supports, hose cabinets, notification devices, specialties and accessories. Product data shall include manufacturers catalog information with performance ratings, rough-in details, finish, weights, and installation requirements.
- 1) Each product shall be referred to on submittals, drawings, and other documentation, by the identification or model number as specifically published in the appropriate agency listing or approval.

3. Design Data

- a. Provide detailed hydraulic calculations that clearly demonstrate that the water supply will meet the demand of the sprinkler system and hose streams. Calculations shall accompany design drawings and shall be based on a water flow test conducted at the site within six (6) months of the submittal of

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plans for approval. Flow test information and associated nodes shall be documented on shop drawings and include a site plan.

- b. Provide complete seismic calculations that clearly reflect seismic restraint with supporting site specific force factor and attachment details used, relative to an associated zone of influence.
- 4. Test Reports
 - a. Contractor's Material & Test Certificate Reports in accordance with NFPA for above ground piping, underground piping, pressure, system operation, air, valve and drain tests.

1.04 QUALITY ASSURANCE

- A. Fire protection system materials and components shall be Underwriter's Laboratories listed and labeled, or Factory Mutual approved.
- B. Company specializing in performing the work of this section shall have a minimum of five years experience and approved by manufacturer.
- C. Manufacturing Company shall be one specializing in manufacturing the products specified with a minimum three years documented experience.

1.05 COORDINATION

- A. The Contractor shall coordinate and reflect routing and location of equipment, devices, and materials with other disciplines, where not already indicated, on the design documents. Indicate required space for routine maintenance and inspection, including location and sizes of access doors.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. All fire protection system materials and equipment shall be Underwriters Laboratories (UL) listed or the Factory Mutual (FM) approved for its intended use.

2.02 EQUIPMENT

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- A. Aboveground Piping Materials
 - 1. BCS - Black Carbon Steel
 - a. All piping 2-inch and smaller: Schedule 40, black-carbon steel conforming to ASTM A53, or ASTM A135, threaded or roll grooved ends. All 1-inch pipe shall have threaded ends.
 - b. All Piping 2-1/2-inch through 8 inch: Schedule 10, black carbon steel conforming to ASTM A53 or ASTM A135, roll grooved ends.
 - 2. GCS - Galvanized Carbon Steel
 - a. All piping 1/2- inch through 8-inch: Schedule 40 seamless or electric resistant welded galvanized steel conforming to ASTM A53/A53M, Type E (electric-resistance welded) or Type S (seamless). Type F (furnace butt welded continuous welded) is acceptable for sizes less than 2 inches.
- B. Fittings and Couplings
 - 1. Cast-Iron Threaded Fittings:
 - a. ASME/ANSI B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
 - 2. Malleable-Iron Threaded Fittings:
 - a. ASME/ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.2.1.
 - 3. Steel Fittings:
 - a. ASTM A234/A234M, seamless or welded, for welded joints.
 - 4. Grooved Mechanical Fittings:
 - a. ASTM A536, Grade 65-45-12 ductile iron; ASTM A47 Grade 32510 malleable iron; or ASTM A53, Type F or Types E or S, Grade B fabricated steel fittings with grooves or shoulders designed to accept grooved end couplings.
 - 5. Grooved Mechanical Couplings:
 - a. consist of ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking in, locking toggle, or lugs to secure roll-grooved pipe and fittings. Grooved mechanical

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couplings including gaskets used on dry-pipe systems shall be listed for dry-pipe service.

6. Cast-Iron Flanges:
 - a. ASME/ANSI B16.1, Class 125, raised ground face, bolt holes spot faced.
7. Unions:
 - a. Malleable iron, Class 150 hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces, female threaded ends. Threads shall conform to ASME B1.20.1.
8. Dielectric Unions:
 - a. Threaded, solder, or grooved-end connections as required to suit application' constructed to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.

C. Pipe Hangers and Supports

1. Shall be UL listed and shall meet requirements of NFPA 13 for type, dimension and location.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
4. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
5. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
6. Vertical Support: Steel riser clamp.
7. Hanger Rods: Use only circular solid cross section rod hangers to connect building structure attachments to pipe-support devices. Use pipe, straps, or bars of equivalent strength for hangers.

D. Alarm Devices

1. General: Types and sizes shall mate and match piping and equipment connections.
2. Water Flow Indicators (Wet-pipe Systems): vane type waterflow detector, rated to 250 psi; designed for horizontal or vertical installation; have 2-SPDT circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere 125 volts AC and 0.25 ampere 24 Volts DC; completed with factory-set, field-adjustable retard element to prevent false signals, and tamperproof cover.
3. Electric Alarm Bell: UL listed 10" electric operated factory painted alarm bell with weatherproof bell kit and bell guard. Bell shall have minimum 90 decibel rating. Provided engraved plate under Bell lettered "Building Standpipe and Sprinkler System."
4. Supervisory Switches: SPST, normally closed contacts, designed to signal valve in other than full open position and tamperproof cover.

2.03 AUTOMATIC SPRINKLERS

- A. Sprinklers must comply with UL 199 and NFPA 13. Sprinklers with internal O-rings are not acceptable. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters must have temperature classification in accordance with NFPA 13.

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Extended coverage sprinklers are permitted for loading docks, residential occupancies and high-piled storage applications only.

1. Sprinkler Finishes: Provide sprinklers and matching escutcheons as indicated in the contract documents or as approved by Owner or Architect. All sprinklers are to be glass bulb type unless otherwise approved by Owner or Architect.
 2. Upright Sprinkler
 - a. Upright sprinkler must be quick-response type and have a nominal K-factor of 5.6.
 3. Concealed Sprinkler
 - a. Concealed sprinkler must be quick-response type and have a nominal K-factor of 5.6. Cover plate must match ceiling.
- B. Sprinkler Cabinet and Wrench: Provide spare sprinklers in accordance with NFPA 13 and must be placed in a suitable metal or plastic cabinet of sufficient size to accommodate all the spare sprinklers and wrenches in designated locations. Spare sprinklers must be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed as required by NFPA 13. At least one wrench of each type required must be provided.
- C. Head Protection
1. Protect heads with paper or plastic bags during painting operations. Remove protection immediately upon finishing painting operations.
 2. Provide head guards wherever mechanical damage could occur. Guard finish to be red enamel.
- D. Aboveground Valves
1. Ensure gate, globe, and check valves (all sizes) are FM approved or UL listed.
 2. Ensure ball valves, 2 inches and under, are FM approved, rated 300 psi, with provisions to wire or lock handle in place where critical alarm function may be isolated.
 3. Ensure butterfly valves, 6-inches and larger are FM approved, rated 175 psi, cast-iron bodied wafer type, with elastomer liners and seals.
- E. Paints and Coatings
1. Paints and coatings must comply with:
 - a. The California Department of Public Health (CDPH) Standard Method v1.1-2010 general testing and emissions evaluation requirements.
 - b. All paints/coatings wet-applied on site must meet the applicable VOC limits of the California Air Resources Board (2007), Suggested Control Measure

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(SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011.

- F. Adhesives, Sealants, and Sealant Primers
 - 1. Adhesives, sealants, and sealant primers must comply with:
 - a. The California Department of Public Health (CDPH) Standard Method v1.1-2010 general testing and emissions evaluation requirements.
 - b. All adhesives, sealants, and sealant primers wet-applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by methods specified in Rule 1168.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Painting
 - 1. If manufacturer's standard-finish equipment surfaces are damaged during construction, bring to as-new condition by touchup or repainting to the satisfaction of the Contracting Officer, or replaced with new undamaged equipment at no additional cost to the Owner.

3.02 INSTALLATION

- A. Ensure installation of system materials and equipment is in accordance with the recommendations and provisions of NFPA 13 and NFPA 24. Perform work in the presence of the Contracting Officer.
- B. Perform all installation work by licensed fire protection sprinkler contractors, licensed for such work in the state where the work is to be performed.

3.03 UNDERGROUND PIPING INSTALLATION

- A. The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 3-feet. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 6-inches above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line.
- B. Thrust Blocks
 - 1. Construct 3,000-psi cured-strength thrust blocks to absorb hydraulic thrust at caps, plugs, and at system change-of-direction fittings. Place concrete against undisturbed soil, with an area sufficient to provide load transmittal.

3.04 ABOVEGROUND PIPING INSTALLATION

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- A. Locations and Arrangements: Coordinate installation of horizontal piping with other components. Allow sufficient space above removable ceiling panels to allow for panel removal.
- B. Install system such that all piping is rigidly secured and supported. Cutting of structural members for passage of sprinkler pipes or hangers will not be permitted. Route all sprinkler piping and provide all offsets, bends and elbows around all mechanical, electrical, and structural members as required. In areas with ceilings, piping shall be routed concealed, above ceiling. In areas without ceilings, piping shall extend as high as possible.
- C. Deviations from approved "Working Plans" for sprinkler piping require written approval of the Authority Having Jurisdiction. Written approval shall be on file with the Engineer prior to deviating from the approved "Working Plans."
- D. Install sprinkler piping to provide for system drainage in accordance with NFPA 13.
- E. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- F. Hangers and Supports: Comply with the requirements of NFPA 13. Hanger support spacing and locations for piping joined with grooved mechanical couples shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Provide protection from damage where subject to earthquake if required by the applicable building code, designed in accordance with NFPA 13.
- G. Make connections between underground and aboveground piping using an approved transition piece strapped or fastened to prevent separation.
- H. Install mechanical sleeve seal at pipe penetrations in basement and foundation walls.
- I. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve. Test connections may also serve as drain pipes.
- J. Install pressure gauge on the riser or feed main at or near each test connection. Provide gauge with a connection not less than ¼ inch and having a soft metal seated globe valve arranged for draining pipe between gauge and valve. Install gauges to permit removal, and where they will not be subject to freezing.
- K. Install automatic air vent at high point of system(s) in accordance with NFPA 13.
- L. Sleeves
 - 1. Provide sleeves where piping passes through roofs, masonry or concrete walls, or floors.
 - 2. Continuously weld or braze sleeves to the deck when passing through steel decks.
 - 3. Install sleeves that are continuous when extending through floors, roofs, or load-bearing walls, and sleeves through fire barriers. Fabricate sleeves from Schedule 40 steel pipe with welded anchor lugs. Form other sleeves by molded linear

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polyethylene liners or similar materials that are removable. Ensure diameter of sleeves is large enough to accommodate pipe, insulation, and jacketing without touching the sleeve, and additionally provides a minimum 3/8-inch clearance. Install sleeve to accommodate mechanical and thermal motion of pipe and to preclude transmission of vibration to walls and generation of noise.

4. Pack solid the space between a pipe and the inside of a pipe sleeve or a construction surface penetration or wherever the piping passes through firewalls, equipment-room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Use a mineral fiber. Where sleeves or construction-surface penetrations occur between conditioned and unconditioned spaces, fill the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction-surface penetration with an elastomer caulk to a depth of 1/2 inch. Ensure surfaces are oil- and grease-free before caulking.
5. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

M. Escutcheons

1. Install escutcheons at penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, provide escutcheons on both sides of the partition. Where suspended ceilings are installed, attach plates at the underside only of such ceilings. Use chrome plated escutcheons in occupied spaces and conceal openings in building construction. Ensure escutcheons are firmly attached.

3.05 FIELD QUALITY CONTROL

A. System Testing

1. Prior to acceptance of the work, test completed systems in the presence of the Contracting Officer. Upon approval, provide certificates of testing.
2. Conduct a hydrostatic test, unless otherwise specified. Use only potable water for testing.
3. Perform air tests, valve-operating tests, and drainage tests for dry-pipe systems.
4. Perform full-flow system operating tests for standpipe systems.
5. Prepare and maintain test records of piping-system tests. Ensure records show personnel responsibilities, dates, test-gage identification numbers, ambient and

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test-water temperatures, pressure ranges, rates of pressure drops, and leakage rates. Each test acceptance requires the signature of the Contracting Officer.

B. Test Gauges

1. Acceptable test gages have 4-1/2-inch dials or larger with accuracy of plus or minus 1/2 of 1 percent of full-scale range and dial graduations and pointer width compatible with readability to within one-half of the accuracy extremes.

C. Pneumatic Testing

1. Perform pneumatic Pressure Tests when freezing conditions may occur and upon prior approval by the Contracting Officer. Use oil-free compressed air used for testing.

D. Test and Acceptable Criteria

1. Perform above ground systems pressure tests at 200 psi and maintain the applied pressure without further addition of test media for not less than 2 hours. No pressure drop is allowed.
2. Test underground rubber-jointed ferrous-pipe water systems at 200 psi, and maintain the applied test pressure for not less than 2 hours. Maximum allowable pressure drop is 2 psi. After satisfactory hydrostatic testing, test piping for leakage as follows:
 - a. Duration of each leakage test is not less than 2 hours; during the test, subject the main to 200 psi pressure based on the elevation of the lowest section under test and corrected to the elevation of the test gage.
 - b. Leakage is defined as the quantity of water supplied into the laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
 - c. Amount of leakage at the joints cannot exceed 2 quarts per 100 joints regardless of pipe diameter.
 - d. Apply hydrostatic tests to piping with concrete thrust blocking only after the concrete has cured for more than 7 calendar days.
3. Test backflow prevention into connected potable-water systems and system devices for proper functioning under conditions normal to their application. Repair dripping or weeping joints.

3.06 ADJUSTING AND CLEANING

- A. At the completion of the work, clean all parts of the installation. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system. Adjust automatic control devices for proper operation.

3.07 PROTECTION

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A. Flushing

1. Before overhead sprinkler piping can be connected to the underground piping, verification of an approved hydrostatic test and flush must be furnished.

END OF SECTION

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SECTION 21 13 16 - DRY PIPE SPRINKLER SYSTEMS, FIRE PROTECTION

PART 1 GENERAL

1.1 REFERENCES

- A. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
 - 1. ASME B16.1 (2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
 - 2. ASME B16.3 (2016) Malleable Iron Threaded Fittings, Classes 150 and 300
 - 3. ASME B16.4 (2016) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
 - 4. ASME B16.21 (2016) Nonmetallic Flat Gaskets for Pipe Flanges
- B. AMERICAN WATER WORKS ASSOCIATION (AWWA)
 - 1. AWWA C203 (2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
- C. ASTM INTERNATIONAL (ASTM)
 - 1. ASTM A47 (1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings
 - 2. ASTM A53 (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 3. ASTM A135 (2009; R2014) Standard Specification for Electric-Resistance-Welded Steel Pipe
 - 4. ASTM A153 (2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 5. ASTM A536 (1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
- D. FM GLOBAL (FM)
 - 1. FM APP GUIDE (updated on-line) Approval Guide <http://www.approvalguide.com/>
- E. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
 - 1. MSS SP-71 (2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends
- F. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
 - 1. NFPA 13 (2022) Standard for the Installation of Sprinkler Systems
 - 2. NFPA 24 (2019; TIA 19-1) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
 - 3. NFPA 101 (2021) Life Safety Code
 - 4. NFPA 291 (2016) Recommended Practice for Fire Flow Testing and Marking of Hydrants
- G. UNDERWRITERS LABORATORIES (UL)

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1.2 SYSTEM DESCRIPTION

- A. Provide dry pipe sprinkler systems in area indicated on the drawings. Except as modified herein, the system must meet the requirement NFPA 13. Pipe sizes which are not indicated on the Contract drawings must be determined by hydraulic calculations.
- B. Hydraulic Design
 - 1. Basis for Calculations
 - a. Hydraulic calculations must be based upon the Hazen-Williams formula with a "C" value noted in NFPA 13 for piping.
 - 2. Hydraulic Calculations
 - a. Water supply curves and system requirements must be plotted on semi-logarithmic graph (NA1.85) paper so as to present a summary of the complete hydraulic calculation.
 - b. Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, minimum discharge pressures and minimum flows. Elevations of hydraulic reference points (nodes) must be indicated.
 - c. Documentation must identify each pipe individually and the nodes connected thereto. Indicate the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient for each pipe.
 - 3. Design Criteria
 - a. Hydraulically design the system to discharge a minimum density as indicated on the drawings. Hydraulic calculations must be in accordance with the Area/Density Method of NFPA 13. Add an allowance for exterior hose streams of 100 gpm to the sprinkler system demand.
- C. Sprinkler Coverage
 - 1. Sprinklers must be uniformly spaced on branch lines. Provide coverage throughout 100 percent of the scope of work. Coverage per sprinkler must be in accordance with NFPA 13. Provide sprinklers below all obstructions in accordance with NFPA 13.
- D. System Volume Limitations
 - 1. Where the volume of an individual system piping exceeds 500 gallons, provide the dry pipe valve with a quick-opening device. The maximum system capacity

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controlled by one dry pipe valve must not exceed 750 gallons, unless it complies with the dry pipe system water delivery calculations noted in NFPA 13.

- E. Qualified Fire Sprinkler Designer
 - 1. An individual who is a licensed professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveying (NCEES) and has relevant fire protection engineering experience, or an individual who is NICET Level III in Water-Based Systems Layout, certified with National Institute for Certification in Engineering Technologies (NICET) and has a minimum of five (5) years of fire sprinkler design experience.

1.3 SUBMITTALS

- A. Partial submittals and submittals not fully complying with NFPA 13 and this Product Data for each type of sprinkler, piping, valve, piping specialty, and fire protections specialty specified. Include rated capacities, certified pump performance curves with each selection point indicated, operating characteristics, and furnished accessories and specialties for each fire pump and pressure-maintenance pump.
- B. Shop drawings prepared in accordance with NFPA 13 identified as "Working Plans," including hydraulic calculations where applicable, and which have been approved by the

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Authority Having Jurisdiction. Shop drawings consisting of the following shall be furnished. Refer to NFPA 13 for additional requirements.

1. Layout drawings of complete overhead sprinkler system indicating relationship of all other trades. Shall include a reflected ceiling plan indicating sprinkler location.
 2. Complete details and sections as required to clearly define and clarify the design indicated.
 3. Include plans, elevations, sections, and details
- C. Upon completion of the work, provide Record Drawings as required by other sections of these specifications showing location of all fire sprinkler system piping, valves, etc., as finally installed.
- D. Maintenance Data for each type of sprinkler, valve, piping specialty, fire protection specialty, fire department connection, fire pump and driver, pressure-maintenance pump and controllers, for inclusion in operating and maintenance manual.
- E. Test Reports and Certificates include "Contractor's Material & Test Certificate for Aboveground Piping" and "Contractor's Material & Test Certificate for Underground Piping" as described in NFPA 13.

1.4 QUALITY ASSURANCE

- A. Preconstruction Submittals
1. Electronic copy of AHJ approved drawings. Drawings must include the following:
 - a. Floor plans clearly showing locations of devices, equipment, risers, and other details required to clearly describe the proposed arrangement.
 - b. Details of each type of pipe hanger, seismic bracing/restraint and related components.
 - c. Include fire pump curve with shop drawings and hydraulic calculations.
 - d. The calculated volume of each system.
 2. Product Data
 - a. Electronic copies of annotated catalog data to show the specific model, type, and size of each item. The data must be highlighted to show model, size, options, and other pertinent information, that are intended for consideration. Product data for all equipment must be combined into a single submittal.
 3. Hydraulic Calculations
 - a. Calculations must be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings.
 4. Operating and Maintenance (O&M) Instructions
 - a. Provide six manuals and one pdf version on electronic media. The manuals must include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance, simplified wiring and controls diagrams, troubleshooting guide, and

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recommended service organization (including address and telephone number) for each item of equipment.

B. Regulatory Requirements

1. Equipment and material must be listed or approved. Listed or approved, as used in this Section, means listed, labeled or approved by a Nationally Recognized Testing Laboratory (NRTL). All listings or approvals by testing laboratories must be from an existing ANSI or UL published standard.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants.

1.6 EXTRA MATERIALS

- A. Spare sprinklers and wrench(es) must be provided as spare parts in accordance with NFPA 13.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Standard Products

1. Provide materials, equipment, and devices listed for fire protection service when so required by NFPA 13 or this specification. Select material from one manufacturer, where possible, and not a combination of manufacturers, for a particular classification of materials. Material and equipment must be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid.

B. Pressure Ratings

1. Valves, fittings, couplings, alarm switches, and similar devices must be rated for the maximum working pressures that can be experienced in the system, but in no case less than 175psi.

2.2 ABOVEGROUND PIPING COMPONENTS

A. Steel Piping Components

1. Steel Pipe
 - a. Except as modified herein, steel pipe must be black as permitted by NFPA 13 and conform to the applicable provisions of ASTM A53, ASTM A135 or ASTM A153.

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SP-71, for Type 3 or 4. Inspection plate must be provided on valves larger than 6 inches.

2.3 DRY PIPE VALVE ASSEMBLY

- A. The dry pipe valve must be a listed, latching differential type be complete with trim piping, valves, fittings, pressure gauges, priming water fill cup, velocity drip check, drip cup, and other ancillary components as required for proper operation. The assembly must include a quick-opening device by the same manufacturer as the dry pipe valve for systems over 500 gallons in capacity.

2.4 ALARM INITIATING AND SUPERVISORY DEVICES

- A. Sprinkler Alarm Switch
 - 1. Pressure-type flow switch(es). Connection of switch must be by the fire alarm installer.
- B. Valve Supervisory (Tamper) Switch
 - 1. Switch must be integral to the control valve or suitable for mounting to the type of control valve to be supervised open. The switch must be tamper resistant and contain SPOT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.5 SPRINKLERS

- A. Upright Sprinklers
 - 1. Upright sprinkler must be of architect approved finish, intermediate temperature, quick-response type with a nominal K-factor of 5.6 or as required by application.
- B. Pendent Sprinklers
 - 1. Pendent sprinkler must be the quick-response type. Pendent sprinkler must have a nominal K-factor of 5.6 or as required by application. Pendent sprinkler must have an architect approved finish.

2.6 ACCESSORIES

- A. Sprinkler Cabinet
 - 1. Provide spare sprinklers in accordance with NFPA 13 and must be placed in a suitable metal or plastic cabinet of sufficient size to accommodate all the spare sprinklers and wrenches in designated locations. Spare sprinklers must be representative of, and in proportion to, the number of each type and temperature

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rating of the sprinklers installed as required by NFPA 13. At least one wrench of each type required must be provided.

- B. Sprinkler Guard
 - 1. Listed guard must be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards must be provided on sprinklers located where sprinklers are subject to damage.
- C. Identification Sign
 - 1. Valve identification sign must be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gage steel or 0.024-inch aluminum with red letters on a white background or white letters on red background. Wording of sign must include, but not be limited to "main drain", "auxiliary drain", "inspector's test", "alarm test", "alarm line", and similar wording as required to identify operational components. Where there is more than one sprinkler system, signage must include specific details as to the respective system.

PART 3 EXECUTION

3.1 VERIFYING ACTUAL FIELD CONDITIONS

- A. Before commencing work, examine all adjoining work on which the contractor's work that is dependent for perfect workmanship according to the intent of this specification section.

3.2 INSTALLATION

- A. The installation must be in accordance with the applicable provisions of NFPA 13 and publications referenced therein. Locate sprinklers in a consistent pattern. Install sprinkler system over and under ducts, piping, and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.
 - 1. Piping offsets, fittings, and other accessories required must be furnished to provide a complete installation and to eliminate interference with other construction.
 - 2. Wherever the contractor's work interconnects with work of other trades the Contractor must coordinate with other Contractors to ensure all Contractors have the information necessary so that they may properly install all necessary connections and equipment. Identify all work items needing access.
 - 3. Provide required supports and hangers for piping, conduit, and equipment so that loading will not exceed allowable loadings of structure. Submittal of a bid must be a deemed representation that the contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required supports.
- B. Waste Removal
 - 1. At the conclusion of each day's work, clean up and stockpile on site all waste, debris, and trash which may have accumulated during the day as a result of work by the contractor and of his presence on the job. Sidewalks and streets adjoining

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the property must be kept broom clean and free of waste, debris, trash and obstructions caused by work of the contractor, which will affect the condition and safety of streets, walks, utilities, and property.

3.3 ABOVEGROUND PIPING INSTALLATION

- A. The methods of fabrication and installation of the aboveground piping must fully comply with the requirements and recommended practices of NFPA 13 and this specification section.
- B. Protection of Piping Against Earthquake Damage
 - 1. Seismic restraint is required.
- C. Piping in Exposed Areas
 - 1. Install exposed piping without diminishing exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, must be installed to provide maximum headroom.
- D. Pipe Joints
 - 1. Pipe joints must conform to NFPA 13, except as modified herein. Not more than four threads must show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints must be provided where indicated or required by NFPA 13. Grooved pipe and fittings must be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools must be products of the same manufacturer.
- E. Pipe Penetrations
 - 1. Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors must be core-drilled and provided with pipe sleeves. Each sleeve must be Schedule 40 galvanized steel, ductile-iron or cast-iron pipe and extend through its respective wall or floor and be cut flush with each wall surface. Sleeves must provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe must be firmly packed with mineral wool insulation.
 - 2. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe must be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.
- F. Inspector's Test Connection
 - 1. Unless otherwise indicated, the test connection must consist of 1-inch pipe connected to the remote branch line; a test valve located approximately 7 feet above the floor; a smooth bore brass outlet equivalent to the smallest orifice

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sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test".

2. Provide concrete splash blocks at all exterior drain and inspector's test connection discharge locations if not discharging to a concrete surface. Splash blocks must be large enough to mitigate erosion and not become dislodged during a full flow of the drain. Ensure all discharged water drains away from the facility and does not cause property damage.

G. Drains

1. Main drain piping must be provided to discharge at the location indicated. Provide a concrete splash block at drain outlet. Discharge to the exterior must not interfere with exiting from the facility. Water discharge or runoff must not cross the path of egress from the building.
2. Auxiliary drains must be provided as required by NFPA 13. Auxiliary drains are permitted to discharge to a floor drain if the drain is sized to accommodate full flow (min 40 gpm). Discharge to service sinks or similar plumbing fixtures is not permitted.

H. Identification Signs

1. Signs must be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Main drain test results must be etched into main drain identification sign. Hydraulic design data must be etched into the nameplates and permanently affixed to each sprinkler riser as specified in NFPA 13.

3.4 ELECTRICAL

- A. Alarm signal wiring connected to the building fire alarm control system must be by the fire alarm installer.

3.5 FIELD QUALITY CONTROL

A. Test Procedures

1. Submit detailed test procedures, prepared and signed by the NICET Level III Fire Sprinkler Technician, and the representative of the installing company.

B. Correction of Deficiencies

1. If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests must be

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conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.6 MINIMUM SYSTEM TESTS

- A. Aboveground Piping
 - 1. Hydrostatic Test
 - a. Aboveground piping must be hydrostatically tested in accordance with NFPA 13. There must be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure must be read from a gauge located at the low elevation point of the system or portion being tested.
 - 2. Air Pressure Test
 - a. As specified in NFPA 13, an air pressure leakage test at 50 psi must be conducted for 24 hours. There must be no drop in gauge pressure in excess of 1.5 psi for the 24 hours. This air pressure test is in addition to the required hydrostatic test.
- B. Dry Pipe Valve Trip Test
 - 1. Each dry pipe valve must be trip-tested by reducing normal system air pressure through operation of the inspector's test connection. Systems equipped with quick-opening devices must first be tested without the operation of the quick-opening device and then with it in operation. Test results will be witnessed and recorded. Test results must include the number of seconds elapsed between the time the test valve is opened and tripping of the dry valve; trip-point air pressure of the dry pipe valve; water pressure prior to valve tripping; and number of seconds elapsed between time the inspector's test valve is opened and water reaches the orifice.

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The delivery of water from the dry pipe valve to the system test connection be in accordance with NFPA 13.

- C. Main Drain Flow Test
 - 1. Following flushing of the underground piping, a main drain test must be made to verify the adequacy of the water supply.

3.7 SYSTEM ACCEPTANCE

- A. Following acceptance of the system, as-built drawings. The drawings must show the system as installed, including deviations from both the project drawings and the approved shop drawings.
- B. Provide one set of full size electronic as-built drawings and schematics.
- C. Provide operating and maintenance (O&M) instructions.

3.8 ONSITE TRAINING

- A. Conduct a training course for the responding fire department and operating and maintenance personnel. Training must be performed on two separate days (to accommodate different shifts of Fire Department personnel) for a period of 4 hours of normal working time and must start after the system is functionally complete and after the final acceptance test. The on-site training must cover all of the items contained in the approved Operating and Maintenance Instructions.

END OF SECTION

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SECTION 22 00 10 - BASIC PLUMBING REQUIREMENTS

PART 1. GENERAL

1.01 SECTION INCLUDES

- A. Basic Plumbing Requirements specifically applicable to Division 22 Sections, in addition to Division 01 - General Requirements.

1.02 DESCRIPTION

- A. Furnish materials and perform labor required to execute this work as indicated on the drawings, as specified and as required to complete the work of this section, except as otherwise herein specifically excluded.

1.03 WORK INCLUDED

- A. The complete Plumbing systems (including Fire Protection systems), including but not limited to these major items.
 - 1. Coordinate work of this Section with related trades.
 - 2. Verify applicable dimensions at the jobsite.
 - 3. Furnishing and installation of miscellaneous hangers, supports, sleeves, inserts, anchors and other auxiliary equipment for systems under this Division.
 - 4. Soil waste and vent system inside and 5 feet to outside of the building including connections to fixtures, equipment, sewer connections, clean-outs.
 - 5. Roof drains and overflow drains along with piping inside and 5 feet to outside of building.
 - 6. Water piping systems inside and to 5 feet outside of the building, including connections to fixtures and equipment.
 - 6. Plumbing hose bibs, wall hydrants, and accessories.
 - 7. Drains and floor sink.
 - 8. Trap primers.
 - 9. Backflow Preventors.
 - 9. Shop drawings.
 - 10. Water systems testing, adjusting and balancing.
 - 11. Written operating and maintenance instructions.
 - 12. Record drawings.
 - 13. Guarantee

1.04 WORK SPECIFIED ELSEWHERE

- A. Concrete, Architectural Sheet Metal, Door and Exterior Wall Louvers, Painting and Electrical.

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SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.02 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Advance Products & Systems, Inc
 - 2. CALPICO, Inc
 - 3. Metraflex Company
 - 4. Pipeline Seal and Insulator, Inc
 - 5. Proco Products, Inc

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SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.02 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for 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.

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SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Fastener systems.
 - 5. Pipe positioning systems.
 - 6. Equipment supports.

1.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7
 - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

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SECTION 22 05 33 - HEAT TRACING FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Self-regulating parallel resistance electric heating cable.
- B. Plastic insulated series resistance electric heating cable.
- C. Constant wattage resistance electric heating cable.
- D. Cable outer jacket markings.
- E. Connection kits.
- F. Accessories.
- G. Controls.

1.2 REFERENCE STANDARDS

- A. IEEE 515.1 - IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications; 2022.
- B. ITS (DIR) - Directory of Listed Products; Current Edition.
- 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.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for electric heat tracing.

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PART 2 PRODUCTS

2.1 SELF-REGULATING PARALLEL RESISTANCE ELECTRIC HEATING CABLE

- A. Manufacturers:
 - 1. Chromalox, Inc: www.chromalox.com/#sle.
 - 2. Pentair: www.pentairthermal.com.
 - 3. Thermon Manufacturing Company: www.thermon.com.
- B. Provide products listed, classified, and labeled by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction (AHJ).
- C. Factory Rating and Testing: Comply with IEEE 515.1.
- D. Heating Element:
 - 1. Provide pair of parallel No.16 tinned or nickel coated stranded copper bus wires embedded in cross linked conductive polymer core with varying heat output in response to temperature along its length.
 - 2. Terminations: Waterproof, factory assembled, non-heating leads with connector at one end and water-tight seal at opposite end.
 - 3. Capable of crossing over itself without overheating.
- E. Insulated Jacket: Flame retardant polyolefin.
- F. Cable Cover: Provide tinned copper and polyolefin outer jacket with UV inhibitor.
- G. Maximum Power-On Operating Temperature: 150 degrees F.
- H. Maximum Power-Off Exposure Temperature: 185 degrees F.
- I. Electrical Characteristics:

2.2 PLASTIC INSULATED SERIES RESISTANCE ELECTRIC HEATING CABLE

- A. Manufacturers:
 - 1. Emerson Electric Co: www.emerson.com.
 - 2. Pentair: www.pentairthermal.com.

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- B. Provide products listed, classified, and labeled by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction (AHJ).
- C. Factory Rating and Testing: Comply with IEEE 515.1.
- D. Heating Element:
 - 1. Resistor Wire: Provide single or dual stranded.
 - 2. Terminations: Waterproof, factory assembled, non-heating leads with connectors at both ends.
- E. Insulated Jacket: Minimum 4.0 mil polyimide film with silicon jacket or fluoropolymer resin.
- F. Cable Cover: Provide aluminum braid and silicon or thermoplastic fluoropolymer outer jacket.
- G. Maximum Operating Temperature: 300 degrees F.
- H. Electrical Characteristics:

2.3 CONSTANT WATTAGE RESISTANCE ELECTRIC HEATING CABLE

- A. Manufacturers:
 - 1. Briskheat Corporation: www.briskheat.com.
 - 2. Chromalox, Inc: www.chromalox.com.
 - 3. Omega Engineering Inc: www.omega.com.
- B. Provide products listed, classified, and labeled by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction (AHJ).
- C. Factory Rating and Testing: Comply with IEEE 515.1.
- D. Heating Element:
 - 1. Provide pair of parallel No.12 tinned or nickel-coated stranded copper bus wires with single stranded resistor wire connected between bus wires.
 - 2. Terminations: Waterproof, factory assembled, non-heating leads with connector at one end and water-tight seal at opposite end.
- E. Insulated Jacket: Flame retardant fluoropolymer.

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- F. Cable Cover: Provide tinned copper and polyolefin outer jacket with UV inhibitor.
- G. Maximum Operating Temperature: 392 degrees F.
- H. Electrical Characteristics:

2.4 CABLE OUTER JACKET MARKINGS

- A. Name of manufacturer, trademark, or other recognized symbol of identification.
- B. Catalog number, reference number, or model.
- C. Month and year of manufacture, date coding, applicable serial number, or equivalent.
- D. Agency listing or approval.

2.5 CONNECTION KITS

- A. Provide power connection, splice/tee, and end seal kits compatible with the heating cable and without requiring cutting of the cable core to expose bus wires.
- B. Provide with NEMA 4X rating for prevention of corrosion and water ingress.

2.6 ACCESSORIES

- A. Provide Accessories As Indicated or As Required for Complete Installation, Including but Not Limited To:

2.7 CONTROLS

- A. Pipe Mounted Thermostats:
 - 1. Remote bulb on capillary, resistance temperature device (RTD) or thermistor for direct sensing of pipe wall temperature.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's written installation instructions.
- B. Comply with installation requirements of IEEE 515.1 and NFPA 70, Article 427.
- C. Apply heating cable linearly on pipe with fiberglass tape only after piping has successfully completed any required pressure testing.

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- D. Comply with applicable local building codes and requirements of authorities having jurisdiction.
- E. Identification:
 - 1. After thermal insulation installation, apply external pipeline decals to indicate presence of the thermal insulation cladding at intervals not to exceed 20 ft including cladding over each valve or other equipment that may require maintenance.

END OF SECTION

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SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers.
- E. Ceiling tacks.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

PART 2 - PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Control Panels: Nameplates.
- B. Piping: Tags.
- C. Pumps: Nameplates.
- D. Small-sized Equipment: Tags.
- E. Tanks: Nameplates.
- F. Valves: Tags and ceiling tacks where located above lay-in ceiling.

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SECTION 22 10 05 - PLUMBING PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pipe, pipe fittings, specialties, and connections for piping systems.
 - 1. Sanitary sewer and vent.
 - 2. Domestic water.
 - 3. Storm Water.
 - 4. Radon.
 - 5. Flanges, unions, and couplings.
 - 6. Pipe hangers and supports.
 - 7. Valves.

1.02 REFERENCE STANDARDS

- A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 1999, and addenda A&B (R2004).
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- E. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV; 2011.
- F. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; 2012.
- G. ASME B31.1 - Power Piping; 2016.
- H. ASME B31.9 - Building Services Piping; 2014.
- I. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
- J. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- K. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2017.
- L. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

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SECTION 22 10 06 - PLUMBING PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Hydrants.
- E. Trap Primers.
- F. Air Vents.
- G. Backflow Preventer.

1.02 REFERENCE STANDARDS

- A. ASME A112.6.3 - Floor and Trench Drains; 2001 (R2007).
- B. ASSE 1011 - Hose Connection Vacuum Breakers; 2004.
- C. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent; 2009.
- D. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.
- E. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011.
- F. NSF 61 - Drinking Water System Components - Health Effects; 2016.
- G. NSF 372 - Drinking Water System Components - Lead Content; 2016.
- H. PDI-WH 201 - Water Hammer Arresters; 2010.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

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SECTION 23 00 10 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Basic Mechanical Requirements specifically applicable to Division 23 Sections, in addition to Division 01 - General Requirements.

1.02 DESCRIPTION

- A. Furnish materials and perform labor required to execute this work as indicated on the drawings, as specified and as required to complete the work of this section, except as otherwise herein specifically excluded.

1.03 WORK INCLUDED

- A. The complete Heating, Ventilating and Air Conditioning (HVAC) systems, including but not limited to these major items.
 - 1. Coordinate work of this Section with related trades.
 - 2. Verify applicable dimensions at the jobsite.
 - 3. Duct systems; supply, return and exhaust complete with combination fire-smoke dampers, and manual dampers.
 - 4. Diffusers, grilles and registers.
 - 5. Split fan coil with heat pump units.
 - 6. Split air handling unit with heat pump units.
 - 9. Exhaust fans.
 - 10. Furnishing and installation of miscellaneous hangers, supports, sleeves, inserts, anchors and other auxiliary equipment for systems under this Division.
 - 11. Duct lining and insulation.
 - 12. Refrigerant piping.
 - 13. Piping insulation.
 - 14. Automatic Controls.
 - 15. Shop drawings.
 - 16. Equipment identification.
 - 17. Equipment and systems adjustments and balancing.
 - 18. Air and water systems testing, adjusting, and balancing.
 - 19. Written operating and maintenance instructions.
 - 20. Record drawings.
 - 21. Guarantee.

1.04 WORK SPECIFIED ELSEWHERE

- A. Concrete, Architectural Sheet Metal, Door and Exterior Wall Louvers, Painting and Electrical.

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SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Flexible pipe connectors.

1.02 REFERENCE STANDARDS

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a.
- B. EJMA (STDS) - EJMA Standards; Tenth Edition.

PART 2 - PRODUCTS

2.01 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com.
 - 2. fh Flex-Hose Co. Inc.: www.flexhose.com.
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Single braided, stainless steel.
- D. Pressure Rating: 125 psi and 450 degrees F.
- E. Size: Use pipe sized units.

2.02 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Manufacturer:
 - 1. Mercer Rubber Company: www.mercer-rubber.com.
 - 2. The Metraflex Company: www.metraflex.com.
 - 3. fh Flex-Hose Co. Inc.: www.flexhose.com.
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 psi and 450 degrees F.
- E. Size: Use pipe sized units.

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SECTION 23 05 29 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following hangers and supports for mechanical system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Equipment supports.

1.02 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.03 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems. Not allowed for this project.
 - 4. Pipe positioning systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Pipe stands. Include Product Data for components.

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SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Vibration-isolated equipment support bases.
- B. Vibration isolators.
- B. Seismic snubber assemblies.
- C. Seismic restraints for suspended components and equipment.
- D. Curbs.

1.02 REFERENCE STANDARDS

- A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.03 DESIGN REQUIREMENTS

- A. It is the intent of this Specification to provide the necessary design for the avoidance of excessive noise or vibration in the building due to the operation of machinery or equipment, or due to interconnected piping, ductwork, or conduit and to seismically restraint piping, ductwork and equipment per the applicable codes against seismic forces in any direction.
- B. All isolators shall:
 - 1. Be provided by a single manufacturer.
 - 2. Be designed or treated for resistance to corrosion. Structural steel bases shall be cleaned of welding slag and coated with an SCAQMD compliant primer.
 - 3. Be selected to perform their function without undue stress or overloading.
 - 4. All isolators shall have a method for leveling and have a 1/4" thick ribbed neoprene acoustical pad under the spring baseplate
 - 5. Be installed in a manner to prevent the transmission of vibration to the structure. No rigid connections between rotating or oscillating equipment or piping and the building will be permitted.
 - 6. Be designed to be non-resonant with equipment forcing frequencies or support structure natural frequencies.

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SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers.
- E. Ceiling tacks.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.

PART 2 - PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplate.
- B. Automatic Controls: Tags. Key to control schematic.
- C. Control Panels: Nameplates.
- D. Dampers: Ceiling tacks, where located above lay-in ceiling.
- E. Piping: Stencils or pipe markers.
- F. Thermostats: Nameplates.
- G. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.02 NAMEPLATES

- A. Manufacturers:
 - 1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com.
 - 2. Brimar Industries, Inc: www.pipemarker.com/#sle.

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SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Measurement of final operating condition of HVAC systems.
- C. Sound measurement of equipment operating conditions.
- D. Vibration measurement of equipment operating conditions.

1.02 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008.
- C. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

1.03 SUBMITTALS

- A. The contractor shall procure the services of an independent Air Balance and Testing Agency, approved by the Engineer, which specializes in the balancing and testing of heating, ventilating, and air conditioning systems. The independent agency shall be certified and in good standing with the AABC.
- B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. 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. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with Architect and other installers to sufficiently understand the design intent for each system.
 - 3. 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.

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SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Duct insulation.
- B. Duct liner.
- C. Insulation jackets

1.02 RELATED REQUIREMENTS

- A. Section 23 31 00 - HVAC Ducts and Casings: Glass fiber ducts.

1.03 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2015.
- D. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2012.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- G. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).
- H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

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SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Jackets and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 23 23 00 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.
- D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2016.
- E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2015.
- F. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

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SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Filter-driers.
- F. Solenoid valves.
- G. Expansion valves.

1.02 REFERENCE STANDARDS

- A. AHRI 710 - Performance Rating of Liquid-Line Driers; 2009.
- B. AHRI 750 - Thermostatic Refrigerant Expansion Valves; 2007.
- C. AHRI 760 - Performance Rating of Solenoid Valves for Use With Volatile Refrigerants; 2007.
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.
- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- F. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2013.
- G. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2013.
- H. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2016.
- I. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2016.
- J. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2016.

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SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Metal ductwork.
- B. Casing and plenums
- C. Duct cleaning.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- B. Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- C. Section 23 33 00 - Air Duct Accessories.
- D. Section 23 37 00 - Air Outlets and Inlets.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- D. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.
- E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).
- F. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; 2003.
- G. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.

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SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers.
- C. Combination fire and smoke dampers.
- D. Duct access doors.
- E. Duct test holes.
- F. Volume control dampers.
- G. Flexible duct connections.

1.02 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- B. NFPA 92 - Standard for Smoke Control Systems; 2015.
- C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).
- 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, and hardware used. Include electrical characteristics and connection requirements.
- B. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.

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SECTION 23 34 23 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Inline/Ceiling centrifugal fans.

1.02 REFERENCE STANDARDS

- A. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.
- B. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- B. Manufacturer's Instructions: Indicate installation instructions.

1.04 FIELD CONDITIONS

- A. Permanent ventilators may not be used for ventilation during construction.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Greenheck Fan Corporation: www.greenheck.com.
- B. Loren Cook Company: www.lorencook.com.

2.02 INLINE CENTRIFUGAL FANS

- A. Manufacturers:
 - 1. Greenheck Fan Corporation: www.greenheck.com.
 - 2. Loren Cook Company: www.lorencook.com.
- B. Centrifugal Fan Unit:
 - 1. Direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.

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SECTION 23 37 00 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Rectangular Diffusers.
- B. Registers/grilles.
- C. Gravity Ventilators.

1.02 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2012.
- B. ARI 890 - Standard for Air Diffusers and Air Diffuser Assemblies; Air-Conditioning and Refrigeration Institute; 2008.
- C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; 2006 (R2011).
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).

1.03 SUBMITTALS

- A. 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.

1.04 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Krueger: www.krueger-hvac.com.
- B. Titus: www.titus-hvac.com.
- C. Tuttle and Bailey: www.tuttleandbailey.com/#sle.

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SECTION 23 40 00 - HVAC AIR CLEANING DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Disposable, extended area panel filters.

1.02 REFERENCE STANDARDS

- A. AHRI 850 - Performance Rating of Commercial and Industrial Air Filter Equipment; 2004.
- B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2012, with 2015 amendments.
- C. UL 900 - Standard for Air Filter Units; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.

PART 2 - PRODUCTS

2.01 FILTER MANUFACTURERS

- A. American Filtration Inc: www.americanfiltration.com.
- B. AAF International/American Air Filter: www.aafintl.com.
- C. The Camfil Group: www.camfilfarr.com.
- D. CLARCOR Air Filtration Products: www.airguard.com

2.02 DISPOSABLE, EXTENDED AREA PANEL FILTERS

- A. Media: UL 900 Class 1, pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to welded wire grid by corrugated aluminum separators.
 - 1. Frame: Non-flammable.
 - 2. Nominal size: 24 by 24 inches.
 - 3. Nominal thickness: 2 inches.

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SECTION 23 74 81 - INDOOR AIR HANDLER UNITS

PART 1 - GENERAL

1.01 QUALITY ASSURANCE

A. Manufacturer Qualifications:

Company specializing in manufacturing the products specified in this section with minimum of five years documented experience.

B. The management system governing the manufacture of this product is ISO (International Organization for Standardization) 9001:2015 certified.

C. Air-handling unit assembly shall have UL (Underwriters Laboratories) 1995 certification for safety, including use with electric heat.

D. Products requiring electric connection shall be listed and classified by ETL and CSA (Canadian Standards Association) as suitable for the purpose specified and indicated.

E. All coils shall be rated in accordance with AHRI Standard 410, latest edition.

F. Direct expansion coils shall be designed and tested in accordance with ANSI/ASHRAE (American National Standard Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers) 15 Safety Code for Mechanical Refrigeration.

G. Unit performance shall be rated in accordance with AHRI Standard 430 for Central Station Air Handling Unit Supply Fans and subject to verification of rating accuracy by AHRI-sponsored, third party testing.

H. Units shall meet NFPA (National Fire Protection Association) 90A requirements.

1.02 DELIVERY, STORAGE AND PROTECTION

A. All indoor units, painted or unpainted, shall be completely shrink-wrapped from the factory for protection during shipment. Tarping of bare units is unacceptable.

B. Inspect for transportation damage and store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

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SECTION 23 81 26.13 - SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Air cooled heat pump units.
- B. Indoor air handler (fan & coil) units for ducted systems.
- C. Variable outdoor units.
- D. Controls.

1.02 RELATED REQUIREMENTS

- A. Section 22 10 05 - Plumbing Piping: Includes indoor coil condensate drain.
- B. Section 23 31 00 - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.
- D. ASHRAE Std 23.1 - Methods of Testing for Rating the Performance of Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Temperatures of the Refrigerant; 2010.
- E. ASHRAE Std 90.2 - Energy-Efficient Design of Low-Rise Residential Buildings; 2007, Including All Addenda.
- F. NFPA 54 - National Fuel Gas Code; 2015.
- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.
- I. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

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SECTION 26 00 10 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SCOPE

- A. This section supplements all sections of this division and shall apply to all phases of work hereinafter specified, shown on the drawings, or required to provide a complete installation of electrical systems for the Project. The work required under this division is not limited to the electrical specifications and drawings. Refer to all bid documents including Civil, Architectural, Structural, and Mechanical documents which may designate Work to be accomplished. The intent of the Specifications is to provide a complete and operable electrical system, which shall include all documents that are a part of the entire Project Contract.
 - 1. Work included: Furnish all labor, material, tools, equipment, facilities, transportation, skilled supervision necessary for, and incidental to, performing operations in connection with furnishing, delivery, and installation of the work in this division complete as shown or noted on the Drawings and specified herein.
- B. Related Work Specified Elsewhere:
 - 1. Refer to all sections in the general contract conditions, Contract Requirements and Division 1, General Requirements.
- C. Work Installed but Furnished by Others:
 - 1. The electrical work includes the installation or connection of certain materials and equipment furnished by others. Verify installation details. Foundations for apparatus and equipment will be furnished by others unless otherwise noted or detailed.

1.02 GENERAL REQUIREMENTS

- A. Guarantee See General Conditions:
 - 1. Except as may be specified under other Sections in the specification, guarantee equipment furnished under the specifications for a period of one year, except for equipment required to have a longer guarantee period, from date of final completion. Guarantee all work against defective workmanship, material, and improper installation. Upon notification of failure, correct deficiency immediately and without additional cost to the Owner.
 - 2. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner or his service agency as approved. Furnish to the Owner, through the Architect, printed manufacturer's warranties complete with material included and expiration dates, upon completion of project. Conform to Division 01.

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- B. Equipment Safety: All electrical materials and equipment shall be new and shall be listed by Underwriter's Laboratories and bear their label, or listed and certified by a nationally recognized testing authority where UL does not have an approval. Custom made equipment must have complete test data submitted by the manufacturer attesting to its safety.
- C. Codes and Regulations:
1. Design, manufacturer, testing and method of installation of all apparatus and materials furnished under the requirements of these specifications shall conform to the latest publications or standard rules of the following:
 - a. Institute of Electrical and Electronic Engineers - IEEE
 - b. National Electrical Manufacturers' Association - NEMA
 - c. Underwriters' Laboratories, Inc. - UL
 - d. National Fire Protection Association - NFPA
 - e. American Society for Testing and Materials - ASTM
 - f. American National Standards Institute - ANSI
 - g. California Electrical Code - CEC, Title 24, Part 3
 - h. California Code of Regulations, Title 8, Subchapter 5
 - i. California Building Code-CBC, Title 24 Parts 1 &2
 - j. State & Municipal Codes in Force in the Specific Project Area
 - k. Occupational Safety & Health Administration - OSHA
 - l. California State Fire Marshal
 - m. California Fire Code- CFC, Title 24 Part 9
 - n. National Electrical Testing Association - NETA
 2. The term "Code", when used within the specifications, shall refer to the Publications, Standards, ordinances and codes, listed above. In the case where the codes have different levels of requirements the most stringent rules shall apply.
- D. Requirements of Regulatory Agencies:
1. Codes, Permits, and Fees: Where the Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where code conflicts occur, the most stringent shall apply. The most stringent condition shall be as interpreted by the Engineer.
 - a. Comply with all requirements for permits, licenses, fees and Code. Permits, licenses, fees, inspections and arrangements required for the Contractor at his expense shall obtain the Work, unless otherwise specified.

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- b. Comply with the requirements of the applicable utility companies serving the Project. Make all arrangements with the utility companies for proper coordination of the Work.

E. Shop Drawings:

1. See Division 01 for additional requirements.
2. Time Schedules for Submission and Ordering: The Contractor shall prepare, review and coordinate his schedule of submissions carefully, determining the necessary lead time for preparing, submitting, checking, ordering and delivery of materials and equipment for timely arrival. The Contractor shall be responsible for conformance with the overall construction schedule.
3. Submittals will be checked for general compliance with specifications only. The Contractor shall be responsible for deviations from the drawings or specifications and for errors or omissions of any sort in submittals.
4. Submit a complete list of materials and equipment proposed for the job, including manufacturers names and catalog numbers.
5. Shop drawings shall be submitted in completed groups of materials (i.e., lighting fixtures or switchgear). The Contractor shall add and sign the following paragraph on equipment and materials submitted for review. "It is hereby certified that the (equipment) (material) shown and marked in this submittal is that proposed to be incorporated into the project; is in compliance with the Contract Drawings and specifications and can be installed in the allocated spaces". Failure to add the above written statement for compliance will result in return of submittals without review.
 - a. Bind catalog cuts, plate numbers, descriptive bulletins and drawings, 11" x 17" (275 mm x 435 mm) or smaller, in sets with covers neatly showing titles.
 - b. The Contractor shall verify dimensions of equipment and be satisfied as to Code compliance for fit prior to submitting shop drawings for approval.
 - c. Where current limiting devices are specified, submit technical data to substantiate adequate protection of equipment cascaded downstream. Submittals shall not be reviewed unless supporting calculations and data are submitted therewith.
 - d. Include complete catalog information such as construction, ratings, insulation systems, as applicable.
 - e. For any material specified to meet UL or trade standards, furnish the manufacturers or vendor's certification that the material furnished for the work does in fact equal or exceed such specifications.
 - f. Reference listings to the specifications' Sections and Article to which each is applicable.

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- g. Equipment Floor Plans: After approval of material is secured prepare a floor plan of each electrical and communication equipment space, room or yard, drawn to scale at 1/2 inch equals 1 foot and submit for approval in the same manner as for shop drawings. The layout drawings shall be exact scale.
 - 6. Contractor shall prepare coordinated drawings when required by Division 01 or where noted otherwise.
- F. Interpretations: The Contractor through the Architect must make Requests for interpretations of drawings and specifications. Any such requests made by equipment manufacturers or suppliers will be referred to the Contractor.
- G. Standard of Quality
 - 1. The contract Drawings and Specifications establish the "MINIMUM STANDARD OF QUALITY" each product and/or system must meet to be considered acceptable. Products of other manufactures will be considered if the product and/or system meet or exceed the "MINIMUM STANDARD OF QUALITY" established by this Contract Document.
 - 2. Items for similar application shall be of the same manufacturer.
 - 3. The label of listing by UL shall appear on all materials and equipment for which standards have been established by the agency.
 - 4. Where codes as listed in Section General Requirement Section of the Specifications that establish label or approved requirements, furnish all materials and equipment with either the required labels affixed or the necessary written approval.
 - 5. Provide the type and quantity of electrical materials and equipment necessary to complete Work and all systems in operation, tested and ready for use.
 - 6. Provide and install all incidental items that belong to the Work described and which are required for complete systems.
 - 7. All switchboards, distribution boards, panel boards and circuit breakers shall be of the same manufacturer.
 - 8. All wiring devices such as switches and receptacles shall be of the same manufacturer.
- H. Substitutions: Refer to Division 01
- I. Submit comprehensive material list, shop drawings and complete technical data for the following equipment and materials:
 - 1. General Requirements:
 - a. Panelboards.
 - b. Conduits
 - c. Conductors, include all selected insulation types.

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- d. Fuses
 - e. Disconnect switches and Starters.
 - f. Pullboxes, manholes and handholes.
 - g. Standard lighting fixtures, specially fabricated fixtures, ballasts and lamps, with samples and sample of standard finish available (where requested).
 - h. Control devices, standard and special receptacles, switches, outlets and finish device plates.
 - i. Cabinets for signal and telephone system, special terminals and cabinets. Include all cabinet dimensions.
 - j. Fire alarm system.
- J. Utility Service:
- 1. Contractor shall verify the locations shown on the drawings and shall include extensions of lines to building service from locations which are acceptable to the Owner.
 - 2. Verify electrical, civil, architectural and structural, dimensional and other requirements with the Owner.
 - 3. Should any major modifications to the work indicated be necessary to comply with the Owner requirements, notify the Architect.
- K. Record Drawings: Refer to Division 01, Contract Closeout.
- L. Work Responsibilities:
- 1. The drawings indicate diagrammatically the desired locations or arrangement of conduit runs, outlets, junction boxes and equipment and are to be followed. Execute the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations. The Contractor is responsible for the correct placing of his work. Where conflicts occur in plans and/or specifications, the most stringent application shall apply and shall be part of the base bid.
 - 2. Locations shown on architectural plan or on wall elevations shall take precedence over electrical plan locations, but where a major conflict is evident, notify the Architect.
 - 3. In the event minor changes in the indicated locations or arrangement are necessary due to developed conditions in the building construction or rearrangement of furnishings or equipment or due to interference with other trades, such changes shall be made without extra cost.
 - 4. Verify dimensions and the correct location of Owner-Furnished equipment before proceeding with the roughing-in of connections.
 - 5. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with work carefully check and verify

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dimensions and sizes with the drawings to see that the furnished equipment will fit into the spaces provided without violation of applicable Codes.

6. Should any changes to the work indicated on the drawings or described in the specifications be necessary in order to comply with the above requirements, notify the Architect.
7. Contractor shall be responsible for coordination of coordinated drawings when required by the Architect.
8. Replace or repair, without additional compensation any work which does not comply with or which is installed in violation of any of these requirements.

M. Installation General: For special requirements, refer to specific equipment under these requirements.

1. Unless otherwise specified elsewhere in the specifications, do all excavating necessary for the proper installation of the electrical work.
2. Locations of Openings: Locate chases, shafts and openings required for the installation of the electrical work during framing of the structure. Do any additional cutting and patching required. Cutting or drilling in any structural member is prohibited without approval of the Architect. Furnish all access panels to make all boxes, connections and devices accessible as required by CEC.
3. Location of Sleeves: Where conduits pass through concrete walls, suspended slabs or metal deck floors, install sleeves of adequate size to permit installation of conduit. Sleeves shall be installed prior to pouring of concrete and shall have ends flush with the wall or extend 2 inches above floor surfaces. Verify locations.
4. Wherever conduit extends through roof, install flashings in accordance with drawings and details.
5. Contractor shall be responsible for cutting and patching which may be required for the proper installation of the electrical work.
6. Protect work, materials and equipment and provide adequate and proper storage facilities during the progress of the work. Storage outdoors shall be weather protected and shall include space heaters to prevent condensation. Provide for the safety and good condition of all work until final acceptance of the work. Replace all damaged or defective work, materials and equipment before requesting final acceptance.
7. Conduit and Equipment to be Installed: Clean thoroughly to remove plaster, spattered paint, cement and dirt on both exterior and interior. All underground conduits shall be mandrelled prior to pulling wire.
8. Conduit and Equipment to be Painted: Clean conduit exposed to view in completed structure by removing plaster and dirt. Remove grease, oil and

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similar material from conduit and equipment by wiping with clean rags and suitable solvents in preparation for paint.

9. Items with Factory Finish: Remove cement, plaster, grease and oil, and leave surfaces, including cracks and corners, clean and polished. Touch up scratched or bare spots to match finish.
10. Site Cleaning: Remove from site all packing cartons, scrap materials and other rubbish on a weekly basis. Vacuum out all cabinets, switchgear and panels and junction boxes prior to pulling any conductors.
11. Electrical equipment and materials exposed to public and in finished areas shall be finish-painted after installation in accordance with the Painting Section. All exposed screw-type fasteners, exterior, or interior in restrooms, shall be vandal-resistant spanner type; include tool.

N. Excavation, Cutting and Patching:

1. Excavating, trenching and backfilling required for the work of this Division in accordance with the applicable requirements of Division 2. Excavating and backfilling connected with electrical work, repaving cuts and providing and maintaining protective measures for the electrical work excavation required by the governing authorities having jurisdiction shall be performed as a part of the work of this Division.
2. Verify openings indicated on the drawings. Provide all cutting, patching and reinforcement of the construction of the building as required to install electrical work.

O. Tests

1. Equipment and systems for which the National Electrical Testing Association (NETA) has an approved or recommended procedure, shall be tested in accordance with that procedure. Test values shall equal values recommended by NETA. Copies of test reports shall be submitted as required under shop drawing submittals.
2. Resistance to ground tests shall be accomplished by a qualified independent testing firm to measure resistance to ground at grounding electrodes. Make tests before slabs or affected areas are poured in order that corrective measures, if required, may be taken. Submit a report showing the results of these measurements. If the resistances exceed values specified elsewhere or NETA test procedure recommendations, perform corrective measures required to reduce resistance to acceptable values.
3. Prior to energizing any motor, measure the service voltage for phase balance and report if unbalance exceeds 1% from mean.
4. Measure the three-phase voltage at no load and at maximum load conditions and submit to the engineer a report showing the results of these measurements.

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5. Upon completion of the work and adjustment of all equipment, conduct an operating test. Conduct the test in the presence of an authorized representative of the Owner's Representative. Demonstrate system and equipment to operate in accordance with requirements of the Contract Documents and to be free from electrical and mechanical defects. Provide systems free from short circuits and grounds and show an insulation resistance between phase conductors and ground not less than the requirements of the governing electric code. Test circuits for proper neutral connection.
 6. Complete tests prior to final inspection of project, including corrective work based on the results of the tests.
 7. Perform special tests on systems and equipment as specified herein using personnel qualified to perform such tests.
- P. Protection: Protect finish parts of the materials and equipment against damage during the progress of the work and until final completion and acceptance. Cover materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred. Keep moving parts clean, dry and lubricated.
- Q. Cleaning Up:
1. Upon completion of the work and at various time during the progress of the work, remove from the building all surplus materials, rubbish and debris resulting from the work of this Division.
 2. Thoroughly clean switchgear including busses, apparatus, exposed conduit, metal work including the exterior and interior, and accessories for the work of this Division, of cement, plaster and other deleterious materials; remove grease and oil spots with cleaning solvent; carefully wipe surfaces and scrape cracks and corners clean.
 3. Thoroughly polish chromium or plated work. Remove dirt and stains from lighting fixtures.
 4. Leave the entire installation in a clean condition.
- R. Completion:
1. The work will not be reviewed for final acceptance until operating and maintenance data, manufacturer's literature, panel directories and nameplates specified herein have been approved and properly posted or installed and final cleaning of equipment and premises has been completed.
 2. When the installation is complete and adjustments have been made, operate the system for a period of one week, during which time demonstrate that systems are completed and operating in conformance with the specifications.
- S. Operating and Maintenance Data: Submit complete and at one time, prior to acceptance of the installation, 4 copies of manufacturer's instructions for operation

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and maintenance of electrical equipment, including replacement parts lists. As specified in Division 01

- T. Inspection and Acceptance Procedures: The Architect will submit observation reports periodically during the construction phase detailing Contract deficiencies. The Contractor is responsible for making corrections immediately. Notice of Completion of the project will not be made until all items have been corrected.
- U. Final Completion of Electrical Systems:
1. Prior to Final Completion of operating electrical systems, the Contractor shall:
 - a. Provide materials of the type and quality specified and as necessary for proper operation, tested and ready for use.
 - b. Furnish the required Operating and Maintenance Data/Manuals.
 - c. Clean up of the project pertaining to this Division of the work.
 - d. After installation has been completed and adjustments made, operate the system for a period of one week, during which time, demonstrate to the Architect that systems are complete and operating in conformance with Contract Documents.
 - e. Conduct tests required and as specified in this Division and submit test reports and corrective actions taken.
 - f. Submission of warranties and guarantees.
 2. Final Completion of Work Shall be Contingent On:
 - a. Contractor replacing defective materials and workmanship.
 - b. Upon completion of work and adjustments made, Contractor shall conduct an operating test for each system for approval at such time as Architect directs. Conduct test in presence of authorized representative of Architect and demonstrate that systems and equipment do operate in accordance with requirements of the Contract Documents and are free from electrical and mechanical defects.
 - c. Contractor shall provide the necessary training programs and instructions to the Owner's representative. Number of hours shall be a minimum of four (4) hours for each system or days as required under separate Sections of these Specifications. Complete operation and maintenance manuals shall be provided at least two (2) weeks prior to training.
 - d. Submit copies of manufacturer's instructions and maintenance of electrical equipment including replacement parts lists. Each set shall include one set of shop drawings of equipment installed.

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- V. Submittals for Change Orders: When changes are made during the construction phase, deletions and additions shall be presented in a manner that will indicate the cost of each item of material and corresponding labor. Markup shall be then added in accordance with the requirements of the General Conditions as modified by the Supplementary Conditions.
- W. The Contractor at a time convenient to the Owner shall provide instruction to the Owner's operating personnel in the proper operation and maintenance of all equipment and systems. The instructors shall have received factory training and shall be thoroughly familiar with the equipment installed. The operating personnel shall receive the number of days instruction as indicated in other sections.

1.03 PROJECT RECORD DOCUMENTS

- A. Record Drawings: CAD: Use a computer aided drafting (CAD) system in the preparation of record drawings for this Project. Acceptable CAD systems shall be capable of producing files in AutoCAD Version 2012 compatible DWG or DXF format. Owner's consultant will furnish CAD backgrounds for use by the Contractor after construction is 85% complete except where prohibited by Contract.
- B. Record Set During the Work: At site, maintain at least one set of Drawings as a Field Record Set. Also maintain at least one copy of all Addenda, Modifications, approved submittals, correspondence, and transmittals at site. Keep Drawings and data in good order and readily available to Architect and Owner.
- C. Changes: Clearly and correctly mark Record Drawings to show changes made during the construction process at the time the changed work is installed. No such changes shall be made in the work unless authorized by the Architect.
- D. Final Record Drawings: Conform to Division 01 requirements.
- E. Preparation of Final Record Drawings: Contractor shall transfer recorded changes in the work indicated on the Field Record Set to the record set. Changes shall be neatly and clearly drawn and noted by skilled draftsmen, and shown technically correct.
- F. Approval: Prior to Architect's inspection for Substantial Completion, submit the Final Record Drawings to the Architect for review, and make such revisions as may be necessary for Final Record Drawings to be a true, complete, and accurate record of the work.
- G. Manuals: Obtain data from the various manufacturers and submit instruction, operation, and maintenance manuals as required and to the extent required under other Sections.
- H. At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies, a complete separate, clean, undamaged set of the latest stamped, actioned submittals. As work progresses, maintain records of "as installed" conditions on this set in suitable ink or chemical fluid. Update the set daily. After successful completion of Project Site testing specified herein, and after completion of Punch List corrections, copy all records of "as installed" conditions on to originals.

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- I. Quantity:
 - 1. Review sets: As for Shop and Field Drawings.
 - 2. Record set: Refer to Division 01.
- J. Content: All drawings required under "Field and Shop Drawings". Show "as installed" condition. Where room designations according to Project permanent signage differ from construction designations in the Contract Documents, show both designations.
- K. Warranty Certificates: Comply with Division 01.

PART 2 - COMMISSIONING

2.01 Commissioning of Electrical Systems

- A. Include cost for commissioning requirements in the contract price.
- B. Attend commissioning meetings scheduled by the CxA.
- C. Prepare preliminary schedule for indoor lighting system inspections, O&M manual submission, training sessions, lighting controls testing, system verification, performance testing, and system completion for use by the CxA. Update schedule as appropriate throughout the construction period and provide updated schedule to the commissioning team.
- D. Verify proper installation and performance of all electrical services provided.
- E. Complete Title 24 Certificate(s) of Installation and manufacturer's pre-start checklists prior to scheduling startup of HVAC and electrical equipment.
 - 1. Retain Certificate(s) of Installation in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - 2. Make Certificate(s) of Installation available for CxA review upon request.
 - 3. Retain calibration records for equipment provided with manufacturer calibrated sensors in the Certificate(s) of Installation binder.
- F. Where applicable, complete the Certificate(s) of Acceptance per the contract documents.
 - 1. Retain Certificate(s) of Acceptance in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - 2. Provide copies of all Certificate(s) of Acceptance to the CxA.
 - 3. Certificate(s) of Acceptance shall be conducted by companies who are certified as California Advanced Lighting Controls Training Program Acceptance Technician (CALCTP-AT) employer and only completed by those employees of said company who are certified to complete the respective acceptance test.
- G. Monitor and respond to Resolution Tracking Forms distributed by the CxA in order to expedite corrective actions necessary to achieve design intent.

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- H. Participate in the Certificate(s) of Acceptance and Functional Performance Tests as required to achieve design intent.
- I. Participate in the opposite-season testing as required to achieve design intent.
- J. Participate in O&M Training as required by project specifications.
- K. Ensure participation of major equipment manufacturers and their representatives as applicable.
- L. Obtain O&M data on all equipment and assemble in binders using tabs as required.
- M. Conduct a maintenance orientation and inspection with hands on training per the contract documents.
- N. Provide written certification and completed Certificate(s) of Installation forms and checklists documenting that the following work has been completed in accordance with the plans and specifications and that they are functioning as designed.
 - 1. Correct labeling of all circuits with connected equipment.
 - 2. Lighting system controls operations, including occupancy sensors, automatic time controls or Energy Management control, override timers, manual dimming controls, exterior lighting controls, multi-level switching, as applicable to the Work.

END OF SECTION

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SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Single conductor building wire.
- B. Wiring connectors.
- C. Electrical tape.
- D. Heat shrink tubing.
- E. Wire pulling lubricant.
- F. Cable ties.

1.02 RELATED REQUIREMENTS

- A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

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 2011 (Reapproved 2017).
- 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 D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.
- F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes 2020.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2021.
- 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.

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- K. UL 44 - Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.
- L. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.
- M. UL 267 - Outline of Investigation for Wire-Pulling Compounds Most Recent Edition, Including All Revisions.
- N. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.
- O. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.
- P. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.
- Q. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables Current Edition, Including All Revisions.
- R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape 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 Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. 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.
- B. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

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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.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is not permitted.

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. Provide new conductors and cables manufactured not more than one year prior to installation.
- D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- E. Comply with NEMA WC 70.
- F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- H. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
 - 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.
- I. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.
 - a. Exceptions:

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- 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.
- 4) 20A exterior circuits: 10 AWG..

2. Control Circuits: 14 AWG.

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. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
 - b. Equipment Ground, All Systems: Green.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:

1. Copper Building Wire:
 - a. Cerro Wire LLC: www.cerrowire.com/#sle.
 - b. Encore Wire Corporation: www.encorewire.com/#sle.
 - c. Southwire Company: www.southwire.com/#sle.
 - d. Rome Wire and Cable.
 - e. Okonite Wire
 - f. Pirelli Wire and Cable
 - g. Carol Cable

B. Description: Single conductor insulated wire.

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- C. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN-2, except as indicated below.
 - a. Size 4 AWG and Larger: Type XHHW-2.
 - b. Installed Underground: Type XHHW-2.

2.04 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. 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.
- C. 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. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
- D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

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- F. 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.
- G. Mechanical Connectors: Provide bolted type or set-screw type.
- H. Compression Connectors: Provide circumferential type or hex type crimp configuration.

2.05 ACCESSORIES

- A. Electrical Tape:
 - 1. 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.
 - 2. 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.
 - 3. 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.
 - 4. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
 - 5. 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.
- C. Wire Pulling Lubricant:
 - 1. Listed and labeled as complying with UL 267.
 - 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 - 3. Suitable for use at installation temperature.
- D. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 - EXECUTION

3.01 EXAMINATION

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- 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 and mandrel 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 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.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. 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.

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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.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. 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.
1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
 2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
- G. Install conductors with a minimum of 12 inches of slack at each outlet.
- H. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- K. 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.
- L. 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.

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1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
 3. Wet Locations: Use heat shrink tubing.
- M. Insulate ends of spare conductors using vinyl insulating electrical tape.
- N. 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.
- O. Identify conductors and cables in accordance with Section 260553.
- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section Firestopping.
- Q. 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. Inspect and test in accordance with NETA ATS, except Section 4.
 - B. 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.
 - C. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

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SECTION 26 05 26 - 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. Ground access wells.

1.02 RELATED REQUIREMENTS

- A. Section 096500 - Resilient Flooring: Static control flooring.
- B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

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 2017.
- 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 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.

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3. Notify Architect of any conflicts with or deviations from 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. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- B. Field quality control test reports.
- C. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

- A. Comply with 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.

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:

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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 25 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
- 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 two electrodes unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - c. Provide ground access well for each electrode.
 6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.

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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.
- 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. 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.

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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.
- J. 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.

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.

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- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 260526:
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).
- 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.
 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
- 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.
- F. 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".

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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 install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.
- D. 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.
- E. Identify grounding and bonding system components in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.13.
- C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

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END OF SECTION

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SECTION 26 05 29 - 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 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 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.
- D. MFMA-4 - Metal Framing Standards Publication 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
 - 2. Coordinate work to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
 - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
 - 5. Notify Architect of 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 cured; see Section 033000.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

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- B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- 1.05 QUALITY ASSURANCE
- 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. Comply with the following. Where requirements differ, comply with most stringent.
 - a. NFPA 70.
 - b. Requirements of authorities having jurisdiction.
 - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
 - 3. Provide products listed, classified, and labeled as suitable for purpose intended, 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 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. Conduit and Cable Supports: Straps and clamps suitable for 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.

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- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
- D. Metal Channel/Strut Framing Systems:
 - 1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 - 2. Comply with MFMA-4.
 - 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.
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
- F. Anchors and Fasteners:
 - 1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
 - 2. New Concrete: Use preset concrete inserts.
 - 3. Existing Concrete: Use expansion anchors.
 - 4. Solid or Grout-Filled Masonry: Use expansion anchors.
 - 5. Hollow Masonry: Use toggle bolts.
 - 6. Hollow Stud Walls: Use toggle bolts.
 - 7. Steel: Use welded threaded studs complying with AWS D1.1/D1.1M with lock washers and nuts or Beam clamps (MSS Type 19 21 23 25 or 27) complying with MSS SP-69.
 - 8. Sheet Metal: Use sheet metal screws.
 - 9. Wood: Fasten with lag screws or through bolts.
 - 10. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
 - 11. Plastic and lead anchors 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. Manufacturer: Same as manufacturer of metal channel/strut framing system.
 - b. Comply with MFMA-4.
 - c. Channel Material: Use galvanized steel.

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13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

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 hangers and supports in accordance with NECA 1.
- 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.
 - 1. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
 - 2. Equipment Support and Attachment:
 - 3. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
 - 4. 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.
 - 5. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 6. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- G. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

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- H. Secure fasteners in accordance with manufacturer's recommended torque settings.
- I. Remove temporary supports.

3.03 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete or Cast-in-Place Concrete (Limited Applications)" as applicable.
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturers written instructions.

3.04 FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

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SECTION 26 05 33.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. PVC-coated galvanized steel rigid metal conduit (RMC).
- C. Flexible metal conduit (FMC).
- D. Liquidtight flexible metal conduit (LFMC).
- E. Galvanized steel electrical metallic tubing (EMT).
- F. Rigid polyvinyl chloride (PVC) conduit.
- G. Reinforced thermosetting resin conduit (RTRC).

1.02 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. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2020.
- E. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- F. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit 2018.
- G. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2020.
- H. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series 2015.
- I. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 1 - Flexible Metal Conduit Current Edition, Including All Revisions.
- K. UL 6 - Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.
- L. UL 360 - Liquid-Tight Flexible Metal Conduit Current Edition, Including All Revisions.
- M. UL 514B - Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.
- N. UL 797 - Electrical Metallic Tubing-Steel Current Edition, Including All Revisions.

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- O. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- B. Project Record Documents: Record actual routing for conduits installed underground and conduits 2 inch (53 mm) trade size and larger.

1.05 QUALITY ASSURANCE

- A. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:

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1. Under Slab on Grade: Use rigid PVC conduit.
 2. Exterior, Direct-Buried: Use rigid PVC conduit.
 3. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or schedule 80 rigid PVC conduit where emerging from underground.
 4. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use PVC-coated galvanized steel rigid metal conduit elbows for bends.
 5. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
 6. Where galvanized rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) emerges from concrete into soil, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches on either side of where conduit emerges.
- D. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).
- E. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT).
- F. Concealed Above Accessible Ceilings: Use 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 or electrical metallic tubing (EMT).
- I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
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.
- K. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit.

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- L. Corrosive Locations Above Ground: Use stainless steel rigid metal conduit (RMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), stainless steel electrical metallic tubing (EMT), or reinforced thermosetting resin conduit (RTRC).
- M. Hazardous/Classified Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit (RMC).
- N. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
 - 1. Maximum Length: 6 feet.
- O. Flexible Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit (FMC).
 - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
 - 3. Maximum Length: 6 feet unless otherwise indicated.
 - 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.
- P. Fished in Existing Walls, Where Necessary: Use flexible metal conduit (FMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

2.02 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.
- B. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- C. Provide products listed, classified, and labeled as suitable for purpose intended.
- D. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4 inch (21 mm) trade size.
 - 2. Branch Circuit Homeruns: 3/4-inch trade size.
 - 3. Control Circuits: 1/2-inch trade size.
 - 4. Flexible Connections to Luminaires: 3/8-inch trade size.
 - 5. Underground, Exterior: 1-inch trade size.
- E. 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)

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- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
 - B. Fittings:
 - 1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
 - 2. Material: Use steel or malleable iron.
 - 3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.
- 2.04 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)
- A. 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.
 - B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch.
 - C. PVC-Coated Boxes and Fittings:
 - 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 - 2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
 - 3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
 - 4. Material: Use steel or malleable iron.
 - 5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch.
 - D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch.
- 2.05 FLEXIBLE METAL CONDUIT (FMC)
- A. 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.
 - B. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
- 2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)
- A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

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- B. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
- 2.07 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)
 - A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
 - B. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - 3. Connectors and Couplings: Use compression/gland or set-screw type.
 - a. Do not use indenter type connectors and couplings.
- 2.08 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)
 - A. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).
 - B. Supports: As recommended by manufacturer.
 - C. Fittings: Same type and manufacturer as conduit to be connected.
- 2.09 ACCESSORIES
 - A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch.
 - B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
 - C. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
 - D. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.

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.

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- B. Install conduit in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by manufacturer.
- E. 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 conduits unless specifically indicated to be exposed.
 - 4. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 - 5. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 6. Arrange conduit to provide no more than equivalent of three 90-degree bends between pull points.
 - 7. Arrange conduit to provide no more than 150 feet between pull points.
 - 8. Route conduits above water and drain piping where possible.
 - 9. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 - 10. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
 - 11. 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.
 - 12. Group parallel conduits in same area on common rack.
- F. Conduit Support:
 - 1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 260529.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 - 3. 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.

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4. 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.
5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
9. Use of spring steel conduit clips for support of conduits is not permitted.
10. Use of wire for support of conduits is not permitted.

G. 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. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
7. Secure joints and connections to provide mechanical strength and electrical continuity.

H. 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.

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5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 6. 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.
 7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 078400.
- I. Underground Installation:
1. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 18 inches.
 - b. Under Slab on Grade: 12 inches to bottom of slab.
 2. Provide underground warning tape in accordance with Section 260553 along entire conduit length.
- J. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section Concrete with minimum concrete cover of 3 inches on all sides unless otherwise indicated.
- K. 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 conduits are subject to earth movement by settlement or frost.
- L. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
 2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
 - a. Where conduits pass from outdoors into conditioned interior spaces.
 - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- M. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 24 inches at each end.
- N. Provide grounding and bonding; see Section 260526.

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- O. Identify conduits; see Section 260553.

3.03 FIELD QUALITY CONTROL

- A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- B. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- C. 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 05 33.16 - 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.

1.02 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 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports 2013 (Reaffirmed 2020).
- F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- I. UL 508A - Industrial Control Panels Current Edition, Including All Revisions.
- J. UL 514A - Metallic Outlet Boxes Current Edition, Including All Revisions.

1.03 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.

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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 Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for floor boxes and underground boxes/enclosures.
- B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 016000 - Product Requirements, for additional provisions.
 2. Keys for Lockable Enclosures: Two of each different key.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

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.

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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 suitable concrete type boxes where flush-mounted in concrete.
 4. Use suitable masonry type boxes where flush-mounted in masonry walls.
 5. Use raised covers suitable for the type of wall construction and device configuration where required.
 6. Use shallow boxes where required by the type of wall construction.
 7. Do not use "through-wall" boxes designed for access from both sides of wall.
 8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 10. 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.
 11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
 12. 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: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
 - c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
 13. Wall Plates: Comply with Section 262726.
- 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. 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.

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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.

PART 3 - EXECUTION

3.01 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. Box Locations:
 1. Locate boxes to be accessible. Provide access panels in accordance with Section Access Panels 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 262726.
 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.

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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 260533.13.
 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.
- H. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
 2. 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.
- I. Install boxes plumb and level.
- J. 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.

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- 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.
- K. Install boxes as required to preserve insulation integrity.
 - L. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
 - M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
 - N. Close unused box openings.
 - O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
 - P. Provide grounding and bonding in accordance with Section 260526.
- 3.02 CLEANING
- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.
- 3.03 PROTECTION
- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

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SECTION 26 05 53 - 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. Warning signs and labels.

1.02 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- B. Section 262726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.

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 2021.
- 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.

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1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- B. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

1.06 QUALITY ASSURANCE

- A. Comply with 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. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Panelboards:
 - 1) Identify ampere rating, name and source.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - 5) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.
 - 2. 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. Industrial control panels.
 - c. Motor control centers.
 - d. Elevator control panels.

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- e. Industrial machinery.
- 3. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Minimum Size: 3.5 by 5 inches.
 - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
- B. Identification for Conductors and Cables:
 - 1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
 - 2. 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.
 - 3. 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.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
 - 4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
- C. Identification for Raceways:
 - 1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
 - 2. 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.
 - 3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.

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4. Use underground warning tape to identify underground raceways.

D. Identification for Boxes:

1. Use voltage markers to identify highest voltage present.
2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
 - a. For exposed boxes in public areas, use only identification labels.

E. Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 262726.
2. 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.
3. 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.

F. Identification for Luminaires:

1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
2. 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.
 - a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
5. 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:

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1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 2. 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. Equipment designation or other approved description.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height:
 - a. Equipment Designation: 1/2 inch.
 - b. Other Information: 1/4 inch.
 5. Color:
 - a. Normal Power System: White text on black background.
- D. 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.
- E. 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.
- F. 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.

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2.03 WIRE AND CABLE MARKERS

- A. 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.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- E. Minimum Text Height: 1/8 inch.
- F. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

- A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- C. Minimum Size:
 - 1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 - 2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
 - 3. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- D. Legend:
 - 1. Markers for Voltage Identification: Highest voltage present.
- E. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

- A. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color:

2.06 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 - 1. Materials:

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2. Minimum Size: 7 by 10 inches unless otherwise indicated.
- C. 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: Enclosure front.
 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.

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- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

- A. 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 05 73- POWER SYSTEM STUDIES

PART 1 - GENERAL

1.01 REFERENCE STANDARDS

- A. NEMA MG 1 - Motors and Generators 2021.
- B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
 - 2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. 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.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Study reports, stamped or sealed and signed by study preparer.

1.04 POWER SYSTEM STUDIES

- A. Scope of Studies:
 - 1. 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).
 - 2. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
- B. General Study Requirements:
 - 1. Comply with NFPA 70, NFPA 70E.
 - 2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.
- C. Data Collection:

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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.
 - 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.
- D. 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.

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f. Include conclusions and recommendations.

1.05 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 preparation of studies of similar type and complexity using specified computer software.
- B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.

END OF SECTION

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SECTION 26 08 02 - INSTALLATION & ACCEPTANCE TESTING OF ELECTRICAL SYSTEMS

INTRODUCTION

1.01 Title 24 requires the completion of all applicable Certificates of Installation and Certificates of Acceptance for lighting systems. This shall include indoor and outdoor lighting systems.

1.02 RELATED DOCUMENTS

- A. Contract drawings and specifications, general provisions of the contract, including general and supplementary conditions, electrical provisions and Division-1 Specification sections apply to work of this section.

1.03 DESCRIPTION OF WORK

- A. Complete all Title 24 required Certificate(s) of Installation (NRCI) and Certificate(s) of Acceptance (NRCA) to be completed per the contract documents.

1.04 RESPONSIBILITIES OF INSTALLING CONTRACTORS

A. General Contractor (GC)

1. Ensure that all contractors identified as the contractor responsible for acceptance testing and completion of the Title 24 Certificate(s) of Acceptance are certified by the State of California or its designated body to conduct each respective test.

B. Electrical Contractor (EC)

1. Verify proper installation and performance of all electrical services provided.
2. Meet with acceptance tester at beginning of construction to review project requirements.
3. Complete Title 24 Certificate(s) of Installation and manufacturer's pre-start checklists prior to scheduling startup/programming of lighting control equipment.
 - a. Retain Certificate(s) of Installation in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - b. Make Certificate(s) of Installation available for building inspector's review.
 - c. Retain calibration records for equipment provided with manufacturer calibrated sensors in the Certificate(s) of Installation binder.
 - d. Correct labeling of all circuits with connected equipment.
4. Complete the Certificate(s) of Acceptance per the contract documents.

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- a. The company installing the lighting systems must be an authorized Lighting Controls Acceptance Test Employer certified by a Lighting Controls Acceptance Test Technician Certification Provider or include in their bid the cost of retaining and overseeing a contractor who is an authorized Lighting Controls Acceptance Test Employer to complete the acceptance testing.
 - b. All required acceptance testing must be completed by a Lighting Controls Acceptance Test Technician employed by the Lighting Controls Acceptance Test Employer. The acceptance tester shall be present for all commissioning efforts.
 - c. Retain Certificate(s) of Acceptance in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - d. Upload all Certificate(s) of Acceptance to the California Title 24 Certificates of Acceptance database, if, at the time of project completion, the database is available to the public.
5. Successful completion of the required Acceptance Tests is the responsibility of the installing contractor. Any costs associated with modifications necessary to obtain compliance and re-testing of systems shall be included in the base bid of this project.

END OF SECTION

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SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Occupancy sensors.
- B. Daylighting controls.

1.02 RELATED REQUIREMENTS

- A. Section 260529 - Hangers and Supports for Electrical Systems
- B. Section 260533.16 - Boxes for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches.

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 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- D. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts 2020.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 1472 - Solid-State Dimming Controls 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

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other potential obstructions to light level measurement installed under other sections or by others.

5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. 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.
- B. 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.
- C. Field Quality Control Reports.
- D. 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.
- E. Operation and Maintenance Data: Include detailed information on device programming and setup.
- F. Project Record Documents: Record actual installed locations and settings for lighting control devices.

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.

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

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- A. Provide five year manufacturer warranty for all occupancy sensors.
- B. Provide five 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.

2.02 OCCUPANCY SENSORS

- A. 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.
 - 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.

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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.
- B. 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.
- C. 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.

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- 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. Finish: Coordinate with architectural plans<>.
 - D. 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. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
 - d. Finish: White unless otherwise indicated.
 - 2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 1000 at a mounting height of 9 feet, with a field of view of 360 degrees.
 - E. 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.
- 2.03 DAYLIGHTING CONTROLS
 - A. 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.

PART 3 - EXECUTION

3.01 EXAMINATION

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- 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 260533.16 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.
 - 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 262726.
- G. Provide required supports in accordance with Section 260529.

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- 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 260553.
 - J. Occupancy Sensor Locations:
 - 1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
 - 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
 - K. Daylighting Control Photo Sensor Locations:
 - 1. 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.
 - 2. 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.
 - L. 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.
 - M. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.
 - N. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.
 - O. 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. Inspect each lighting control device for damage and defects.
 - B. 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.

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- C. 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.
- D. 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. 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.
- D. 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 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- B. 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

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SECTION 26 09 43 - NETWORK LIGHTING CONTROLS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes a networked lighting control system comprised of the following components:
 - 1. System Software Interfaces
 - a. Management and Visualization Interface
 - b. Historical Database and Analytics Interface
 - c. Personal Control Applications
 - d. Smartphone Programming Interface for wired devices
 - 2. System Backbone and Integration Equipment
 - a. System Controller
 - b. OpenADR Interface
 - 3. Wired Networked Devices
 - a. Wall Switches, Dimmers and Scene Controllers
 - b. Graphic Wall Stations
 - c. Auxiliary Input/Output Devices
 - d. Occupancy and Photocell Sensors
 - e. Power Packs and Secondary Packs
 - f. Networked Luminaires
 - g. Relay and Dimming Panel
 - 4. Wireless Networked Devices
 - a. Sensor Interface
 - b. Light Controllers
 - c. Digital Sensor Attachments
 - d. Networked Luminaires
 - e. Communication Bridge
- B. The networked lighting control system shall meet all of the characteristics and performance requirements specified herein.
- C. The contractor shall provide, install and verify proper operation of all equipment necessary for proper operation of the system as specified herein and as shown on applicable drawings.

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1.02 RELATED DOCUMENTS

- A. Section 262726 Wiring Devices
- B. Section 260923 Lighting Control Devices
- C. Section 265113 Interior Lighting Fixtures

1.03 SUBMITTALS

- A. Submittal shall be provided including the following items.
 - 1. Bill of Materials necessary to install the networked lighting control system.
 - 2. Product Specification Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.
 - 3. Riser Diagrams showing device wiring connections of system backbone and also typical per room/area type.
 - 4. Information Technology (IT) connection information pertaining to interconnection with facility IT networking equipment and third-party systems.
 - 5. Other Diagrams and Operational Descriptions – as needed to indicate system operation or interaction with other system(s).
 - 6. Contractor Startup/Commissioning Worksheet (must be completed prior to factory start-up).
 - 7. Service Specification Sheets indicating general service descriptions, including startup, training, post-startup support, and service contract terms.
 - 8. Hardware and Software Operation Manuals.

1.04 APPROVALS

- A. Prior approval from owner's representative is required for products or systems manufactured by companies not specified in the Network Lighting Controls section of this specification.
- B. Any alternate product or system that has not received prior approval from the owner's representative at least 10 days prior to submission of a proposal package shall be rejected.
- C. Alternate products or systems require submission of catalog datasheets, system overview documents and installation manuals to owner's representative.
- D. For any alternate system that does not support any form of wireless communication to networked luminaires, networked control devices, networked sensors, or networked input devices, bidders shall provide a total installed cost including itemized labor costs for installing network wiring to luminaires, control devices, sensors, input devices and other required system peripherals.

1.05 QUALITY ASSURANCE

- A. Product Qualifications

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1. System electrical components shall be listed or recognized by a nationally recognized testing laboratory (e.g., UL, ETL, or CSA) and shall be labeled with required markings as applicable.
 2. System shall be listed as qualified under DesignLights Consortium Networked Lighting Control System Specification V2.0.
 3. System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.
 4. All components shall be subjected to 100% end of line testing prior to shipment to the project site to ensure proper device operation.
 5. All components and the manufacturing facility where product was manufactured must be RoHS compliant.
- B. Installation and Startup Qualifications
1. System startup shall be performed by qualified personnel approved or certified by the manufacturer.
- C. Service and Support Requirements
1. Phone Support: Toll free technical support shall be available.
 2. Remote Support: The bidder shall offer a remote support capability.
 3. Onsite Support: The bidder shall offer onsite support that is billable at whole day rates.
 4. Service Contract: The bidder shall offer a Service Contract that packages phone, remote, and onsite support calls for the project. Response times for each type of support call shall be indicated in the terms of the service contract included in the bid package.
- 1.06 WARRANTY
- A. The manufacturer shall provide a minimum five-year warranty on all hardware devices supplied and installed. Warranty coverage shall begin on the date of shipment.
 - B. The hardware warranty shall cover repair or replacement any defective products within the warranty period.
- 1.07 MAINTENANCE & SUSTAINABILITY
- A. The manufacturer shall make available to the owner new parts, upgrades, and/or replacements available for a minimum of 5 years following installation.

PART 2 – EQUIPMENT

2.01 MANUFACTURERS

- A. Manufacturers that are listed with DesignLights Consortium Networked Lighting Control System Specification V2.0.

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2.02 SYSTEM PERFORMANCE REQUIREMENTS

A. System Architecture

1. System shall have an architecture that is based upon three main concepts: (a) networkable intelligent lighting control devices, (b) standalone lighting control zones using distributed intelligence, (c) optional system backbone for remote, time based and global operation between control zones.
 - a. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible so as to minimize overall device count of system.
 - b. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wallstations without requiring connection to a higher level system backbone; this capability is referred to as "distributed intelligence."
 - c. System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system backbone (see Control Zone Characteristics sections for each type of network connection, wired or wireless).
2. The system shall be capable of providing individually addressable switching and dimming control of the following: networked luminaires, control zones to include multiple switch legs or circuits, and relay and dimming outputs from centralized panels to provide design flexibility appropriate with sequence of operations required in each project area or typical space type. A single platform shall be used for both indoor and outdoor lighting controls.
3. Lighting control zones shall be capable of being networked with a higher level system backbone to provide time based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software.
4. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality at a later date.
5. System shall be capable of "out of box" sequence of operation for each control zone.

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a. Standard sequence is:

- 1) All switches control all fixtures in a zone
- 2) All occupancy sensors automatically control all fixtures in the control zone with a default timeout.

B. Wired Networked Control Zone Characteristics

1. Following proper installation and provision of power, all networked devices connected together with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The “out of box” default sequence of operation is intended to provide typical sequence of operation so as to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
2. System shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.
3. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
 - a. Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
 - b. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard, and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss of power sensed via line voltage connections.
 - c. Emergency egress devices shall be provided and UL labeled by the lighting control manufacturer.

C. Wireless Networked Control Zone Characteristics

1. Following proper installation and provision of power, all wireless networked devices paired, meshed or grouped together shall automatically follow the “out of box” default sequence of operations.
2. Wireless network communication shall support uniform and instant response such that all luminaires in a lighting control zone respond immediately and synchronously in response to a sensor or wallstation signal.
3. To support the system architecture requirement for distributed intelligence, wireless network communication shall support communication of control signals from sensors and wallstations to networked luminaires and wireless load control devices, without requiring any communication, interpretation,

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or translation of information through a backbone device such as a wireless access point, communication bridge or gateway.

4. All wireless communication shall be encrypted using at least 128-bit Advanced Encryption Standard (AES).
5. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
 - a. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard, and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss or interruption of power sensed via line voltage connections.

D. System Integration Capabilities

1. The system shall interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet/MSTP protocols.

2.03 SYSTEM SOFTWARE INTERFACES

A. Management Interface

1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
2. Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.
3. All system software updates must be available for automatic download and installation via the internet.

B. Historical Database and Analytics Interface

1. System shall provide a browser-based trending and monitoring interface that stores historical data for all occupancy/daylight sensors and lighting loads. Additionally, the system shall optionally upload that data to a cloud based server.

C. Visualization Interfaces

1. System shall provide an optional web-based visualization interface that displays a graphical floorplan. System data, to include status of occupancy sensors, daylight sensors and light output shall be overlaid to the floorplan to provide a graphical status page.

D. Portable Programming Interface for Standalone Control Zones

1. Portable handheld application interface for standalone control zones shall be provided for systems that allows configuration of lighting control settings.

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2. Programming capabilities through the application shall include, but not be limited to, the following:
 - a. Switch/occupancy/photosensor group configuration
 - b. Manual/automatic on modes
 - c. Turn-on dim level
 - d. Occupancy sensor time delays
 - e. Dual technology occupancy sensors sensitivity
 - f. Photosensor calibration adjustment and auto-setpoint
 - g. Trim level settings

2.04 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

A. System Controller

1. System Controller shall be a multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
2. System Controller shall perform the following functions:
 - a. Facilitation of global network communication between different areas and control zones.
 - b. Time-based control of downstream wired and wireless network devices.
 - c. Linking into an Ethernet network.
 - d. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
 - e. Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.
3. System Controller shall not require a dedicated PC or a dedicated cloud connection.
4. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.
5. Device shall have a standard and astronomical internal time clock.
6. Shall be capable of connecting to the customers Local Area Network (LAN) via IEEE 802.11.x Wireless and IEEE 802.3 Wired connection.
7. System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.
 - a. BACnet/MSTP shall support a minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.

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- b. BACnet/MSTP shall support 9600 to 115200 baud.
- c. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
- d. System controller must support BACnet/IP Broadcast Management Device (BBMD) and Foreign Device Registration (FDR).

B. OpenADR Interface

- 1. System shall provide an interface to OpenADR protocol Demand Response Automation Servers (DRAS) typically provided by local electrical utility.
- 2. OpenADR interface shall meet all of the requirements of Open ADR 2.0a Virtual End Nodes (VEN), including:
 - a. Programmable with the account information of the end-user's electrical utility DRAS account credentials.

2.05 WIRED NETWORKED DEVICES

A. Wired Networked Wall Switches, Dimmers, Scene Controllers

- 1. Wall switches & dimmers shall support the following device options:
 - a. Number of control zones: 1, 2 or 4
 - b. Control Types Supported: On/Off or On/Off/Dimming
- 2. Scene controllers shall support the following device options:
 - a. Number of scenes: 1, 2 or 4
 - b. Control Types Supported:
 - 1) On/Off or On/Off/Dimming
 - 2) Preset Level Scene Type
 - 3) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene
 - 4) Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones

B. Wired Networked Graphic Wall Stations

- 1. Device shall have a full color touch screen.
- 2. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
- 3. Graphic wall stations shall support the following device options:
 - a. Number of control zones: Minimum of 16
 - b. Number of scenes: Minimum of 16

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- c. Optional password protection for setup screens.
- C. Wired Networked Auxiliary Input / Output (I/O) Devices
 - 1. Auxiliary Input/Output Devices shall be specified as an input or output device with the following options:
 - a. Contact closure input
 - 1) Input shall be programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.
 - b. 0-10V analog input
 - 1) Input shall be programmable to function as a daylight sensor.
 - c. RS-232/RS-485 digital input
 - 1) Input supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
 - d. 0-10V dimming control output, capable of sinking a minimum of 20mA of current
- D. Wired Networked Occupancy and Photosensors
 - 1. Sensors shall utilize passive infrared (PIR) or passive dual technology (PDT) to detect both major and minor motion as defined by NEMA WD-7 standard.
 - 2. Sensing technologies that are acoustically passive, meaning they do not transmit sound waves of any frequency do not require additional commissioning. Ultrasonic or Microwave based sensing technologies may require commissioning due to the active nature of their technology, if factory required.
 - 3. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device.
 - 4. Sensor mounting type shall match project design requirements as shown on plans.
 - a. Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.
 - 5. The system shall support the following types of photocell-based control:
 - a. On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. A time delay or

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adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.

- b. Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.

E. Wired Networked Wall Switch Sensors

- 1. Wall switches sensors shall support the following device options:
 - a. User Input Control Types Supported: On/Off or On/Off/Dimming
 - b. Occupancy Sensing Technology: PIR only or Dual Tech
 - c. Daylight Sensing Option: Inhibit Photosensor

F. Wired Networked Embedded Sensors

- 1. Embedded sensors shall support the following device options:
 - a. Occupancy Sensing technology: PIR only or Dual Tech
 - b. Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor

G. Distributed System Power, Switching and Dimming Controls

- 1. Devices shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
- 2. Device programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
- 3. Device shall be plenum rated.
- 4. Devices shall be UL Listed for load and load type as specified on the plans.

H. Wired Networked Luminaires

- 1. Networked luminaire shall have a factory installed mechanically integrated control device and carry a UL Listing as required.
- 2. Networked LED luminaire shall provide low voltage power to other networked control devices.
- 3. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by automatically varying the dimming control signal to account for lumen depreciation.
- 4. System shall be able to provide control of network luminaire intensity, in addition to correlated color temperature of specific LED luminaires.

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5. Controls manufacturer is responsible for primary troubleshooting and tech support of complete fixture.

I. Wired Networked Relay and Dimming Panel

1. Relay and dimming panel(s) shall be capable of providing the required amount of relay capacity, as required per panel schedules shown on drawings, with an equal number of individual 0-10V dimming outputs.
2. Standard relays used shall have the following required properties:
 - a. Configurable in the field to operate with normally closed or normally open behavior.
 - b. Provides visual status of current state and manual override control of each relay.
 - c. Be individually programmable
3. 0-10 dimming outputs shall support a minimum of 100mA sink current per output.
4. Panel shall be UL924 listed for control of emergency lighting circuits.
5. Panel shall provide a contact closure input that acts as a panel override to activate the normally configured state of all relays (i.e., normally open or normally closed) in the panel.

2.06 WIRELESS NETWORKED DEVICES

A. Wireless Networked Sensor Interface

1. The device shall be capable of broadcasting the following manual wall control commands: on, off, and adjust dim level.

B. Wireless Networked Light Controllers (No Sensor)

1. The wireless light controller shall be capable of providing continuous dimming and on/off control of one commercial light fixture including fluorescent, HID, induction and LEDs.
2. An external antenna attached to the luminaire shall not be allowed.
 - a. Each wireless light controller shall provide measurement capability of the amperage, voltage, wattage, and watt-hours of its controlled lighting.

C. Wireless Networked Digital Sensors

1. In addition to providing Wireless Networked Light Controllers functionality, also provides:
 - a. Integrated digital occupancy sensing and digital photocell sensor.
 - b. Sensor shall connect directly to the wireless light controller and shall be suitable for embedding into the enclosure of a luminaire.
 - c. Sensor shall have software-adjustable settings

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- d. Photocell shall be suitable for closed and open loop applications.
- D. Wireless Network Communication Bridge
 - 1. A communication bridge device shall be provided that interfaces with the System Controller via Owner's LAN connection and interfaces with wireless network.
 - 2. Device shall be capable of communicating with a group of a minimum of 250 wireless networked devices and luminaires, so as to reduce the amount of communication bridges required in the system.

PART 3 – EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. Installation Procedures and Verification
 - 1. The successful bidder shall review all required installation and pre-startup procedures with
 - a. the manufacturer's representative through pre-construction meetings.
 - 2. The successful bidder shall install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals and plans specifications.
 - 3. The successful bidder shall be responsible for testing of all low voltage network cable included in the bid. Bidder is responsible for verification of the following minimum parameters:
 - a. Wire Map (continuity, pin termination, shorts and open connections, etc.)
 - b. Length
 - c. Insertion Loss
- B. Coordination with Owner's IT Network Infrastructure
 - 1. The successful bidder is required to coordinate with the owner's representative to secure all
 - a. required network connections to the owner's IT network infrastructure.
 - b. The bidder shall provide to the owner's representative all network infrastructure requirements of the networked lighting control system.
 - c. The bidder shall provide, to the manufacturer's representative, all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.
- C. Coordination with Mechanical Division

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1. The successful bidder shall provide all integration equipment detailed in Division 260943.
2. The successful bidder to verify integration scope with the Mechanical Contractor prior to submittal phase and provide all necessary schedules to the Lighting Control manufacturer.

D. Documentation and Deliverables

1. The installing contractor shall be responsible for documenting installed location of all networked devices, including networked luminaires. This includes responsibility to provide as-built plan drawing showing device addresses corresponding to locations of installed equipment.
2. The installing contractor is also responsible for the following additional documentation to the manufacturer's representative if visualization / graphical floorplan software is provided as part of bid package:
 - a. As-Built floor plan drawings showing wired network control zones outlined, in addition to device address locations required above. All documentation shall remain legible when reproducing\scanning drawing files for electronic submission.
 - b. As-Built electrical lighting drawings (reflected ceiling plan) in PDF and CAD format. Architectural floor plans shall be based on as-built conditions.
 - 1) CAD files shall have layers already turned on/off as desired to be shown in the graphical floorplan background images. The following CAD elements are recommended to be hidden to produce an ideal background graphical image:
 - (a) Titleblock
 - (b) Text- Inclusive of room names and numbers, fixture tags and drawings notes Fixture wiring and homeruns
 - (c) Control devices
 - (d) Hatching or poché of light fixtures or architectural elements
 - 2) CAD files shall be of AutoCAD 2013 or earlier. Revit file overall floor plan views shall be exported to AutoCAD 2013.

3.02 SYSTEM STARTUP

- A. Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer.
1. Low voltage network cable testing shall be performed prior to system startup at the discretion of the manufacturer.

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- B. System start-up and programming shall include:
 - 1. Verifying operational communication to all system devices.
 - 2. Programming the network devices into functional control zones to meet the required sequence of operation.
 - 3. Programming and verifying all sequence of operations.
 - 4. Customization of owner's software interfaces and applications.
- C. Initial start-up and programming is to occur on-site. Additional programming may occur on-site or remotely over the Internet as necessary.

3.03 PROJECT TURNOVER

- A. System Documentation
 - 1. Submit software database file with desired device labels and notes completed.
- B. Owner Training
 - 1. Provisions for onsite training for owner and designated attendees to be included in submittal package.

END OF SECTION

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SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General purpose transformers.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 33.13 - Conduit for Electrical Systems: Flexible conduit connections.

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 2014.
- 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.

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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 Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. 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.

- B. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.

1.06 QUALITY ASSURANCE

- A. Comply with 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.

1.07 DELIVERY, STORAGE, AND HANDLING

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- 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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton Corporation: www.eaton.com.
- B. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- C. Siemens Industry, Inc: www.usa.siemens.com.
- D. Source Limitations: Furnish transformers produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

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.
- 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.

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- 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. 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.
- C. Coil Conductors: Continuous copper windings with terminations brazed or welded.
- D. 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.
- E. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- F. Sound Levels: Standard sound levels complying with NEMA ST 20
- G. Mounting Provisions:

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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.
- H. 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.

2.04 SOURCE QUALITY CONTROL

- A. Factory test transformers according to NEMA ST 20.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install transformers in accordance with NECA 409 and IEEE C57.94.
- D. Use flexible conduit, under the provisions of Section 26 05 33.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.
- F. Install transformers plumb and level.
- G. Transformer Support:
 1. Provide required support and attachment in accordance with Section 26 05 29, where not furnished by transformer manufacturer.

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- 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 30 00.
 - 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.
- H. Provide grounding and bonding in accordance with Section 26 05 26.
- I. 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.
- J. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.
- 3.02 FIELD QUALITY CONTROL
- A. Inspect and test in accordance with NETA ATS, except Section 4.
 - B. 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.
- 3.03 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.
- 3.04 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 26 22 00

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SECTION 26 24 13 - 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 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 260573 - 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 Amendment (2017).
- 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 PB 2 - Deadfront Distribution Switchboards 2011.
- G. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less 2013.
- H. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.

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- I. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures Current Edition, Including All Revisions.
- K. UL 869A - Reference Standard for Service Equipment Current Edition, Including All Revisions.
- L. UL 891 - Switchboards Current Edition, Including All Revisions.
- M. UL 1053 - Ground-Fault Sensing and Relaying Equipment 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 from 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. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- B. 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.

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1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.
 2. Identify mounting conditions required for equipment seismic qualification.
- C. Manufacturer's equipment seismic qualification certification.
- D. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.
- 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, and installation of product.
- F. Project Record Documents: Record actual installed locations of switchboards 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. Enclosure Keys: Two of each different key.
- 1.06 QUALITY ASSURANCE
- A. Comply with requirements of NFPA 70.
- B. 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.

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1.08 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Switchboards - Basis of Design: Square D.
- B. Switchboards- Other Acceptable Manufacturers:
 - 1. ABB/GE: www.electrification.us.abb.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. 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 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. Provide switchboards 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 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.
- D. 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

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Company. Include hinged sealable door and provisions for Utility Company current transformers (CTs), potential transformers (PTs), or potential taps as required.

- E. Service Conditions:
 - 1. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- F. 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. Minimum Rating: 65,000 rms symmetrical amperes.
 - 3. Listed series ratings are not acceptable.
- G. 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.
- H. 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: Copper.
 - 5. Ground Bus Material: Copper.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
 - 1. Line Conductor Terminations:
 - a. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
 - b. Main and Neutral Lug Type: Mechanical.
 - 2. Load Conductor Terminations:
 - a. Lug Material: Copper, suitable for terminating copper conductors only.
 - b. Lug Type:
 - 1) Provide mechanical lugs.
- J. 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.

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- K. 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.
 3. Where designated spaces for future device provisions are not indicated, include provisions for minimum of 6 device(s) rated at 25 percent of rating of switchboard main or incoming feed.
 4. Arrange and equip through bus and ground bus to accommodate future installation of additional switchboard sections where indicated.
- L. 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.
- M. 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.
- N. 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.
 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. Remote monitoring capability via PC.
- O. Instrument Transformers:

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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. 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.
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.
 - 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.

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- e. 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.

2.04 SOURCE QUALITY CONTROL

- A. 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 260529.
- F. Install switchboards plumb and level.

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- G. Provide grounding and bonding in accordance with Section 260526.
- 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 directed.
- K. Set field-adjustable ground fault protection pickup and time delay settings as directed.
- L. Provide filler plates to cover unused spaces in switchboards.

3.03 FIELD QUALITY CONTROL

- A. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.1.
- D. 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 200 amperes. Tests listed as optional are not required.
- E. 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.
- F. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
- G. 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.
- H. Test shunt trips to verify proper operation.
- I. Correct deficiencies and replace damaged or defective switchboards or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

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- B. Adjust alignment of switchboard covers and doors.

3.05 CLEANING

- A. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred surfaces to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

- A. 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

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SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Lighting and appliance panelboards.
- B. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NECA 407 - Standard for Installing and Maintaining Panelboards 2015.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- D. NEMA PB 1 - Panelboards 2011.
- E. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less 2013.
- F. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- J. UL 67 - Panelboards 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.

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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. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- B. 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.
- C. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- D. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. Panelboard Keys: Two of each different key.

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 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.

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PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. ABB/GE: www.electrification.us.abb.com/#sle.
- B. Eaton Corporation: www.eaton.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.
- D. Siemens Industry, Inc: www.usa.siemens.com.
- E. 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. 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.
- C. 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.
- D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- F. 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 solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. 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:

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- a. Indoor Clean, Dry Locations: Type 1.
 - 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - 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.
 - 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
 - I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
 - J. Load centers are not acceptable.
- 2.03 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: Copper.
 - 3. Ground Bus Material: Copper.
 - 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 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.
 - 3. Provide clear plastic circuit directory holder mounted on inside of door.
- 2.04 OVERCURRENT PROTECTIVE DEVICES

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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 260529.
- 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. Provide minimum of 3 spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- J. Provide grounding and bonding in accordance with Section 260526.
- K. Install all field-installed branch devices, components, and accessories.
- L. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- M. Provide filler plates to cover unused spaces in panelboards.

3.03 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. 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.

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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

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SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates.

1.02 RELATED REQUIREMENTS

- A. Section 260533.16 - Boxes for Electrical Systems.
- B. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for 2014h, with Amendments (2017).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification) 2014g, with Amendment (2017).
- 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-Interruption 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.

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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. Notify Architect of any conflicts or deviations from 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. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
1. Wall Dimmers: Include derating information for ganged multiple devices.
- 1.06 QUALITY ASSURANCE
- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS
- A. Hubbell Incorporated: www.hubbell-wiring.com.
 - B. Leviton Manufacturing Company, Inc: www.leviton.com.
 - C. Lutron Electronics Company, Inc: www.lutron.com.
 - D. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
- 2.02 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.
 - E. Provide GFCI protection for receptacles installed within 6 feet of sinks.
 - F. Provide GFCI protection for receptacles serving electric drinking fountains.

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- G. Unless noted otherwise, do not use combination switch/receptacle devices.
- 2.03 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.
- 2.04 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 20 and 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.
- 2.05 RECEPTACLES
- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell-wiring.com.
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com.
 - 3. Lutron Electronics Company, Inc; Designer Style: www.lutron.com/#sle.
 - 4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
 - 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.

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2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:

1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. 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.
3. 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 SD suitable for installation in damp or wet locations; 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 SD suitable for installation in damp or wet locations.

2.06 WALL PLATES

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell-wiring.com.
2. Leviton Manufacturing Company, Inc: www.leviton.com.
3. Lutron Electronics Company, Inc: www.lutron.com.
4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us

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.

C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

E. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet

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locations while in use with attachment plugs connected and identified as extra-duty type.

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 branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. 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 260533.16 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. 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.

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- 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. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
 - I. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
 - J. Install wiring devices plumb and level with mounting yoke held rigidly in place.
 - K. Install wall switches with OFF position down.
 - L. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
 - M. 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.
 - N. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
 - O. Identify wiring devices in accordance with Section 260553.
- 3.04 FIELD QUALITY CONTROL
- A. Inspect each wiring device for damage and defects.
 - B. Operate each wall switch with circuit energized to verify proper operation.
 - C. Test each receptacle to verify operation and proper polarity.
 - D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
 - E. Correct wiring deficiencies and replace damaged or defective wiring devices.
- 3.05 ADJUSTING
- A. Adjust devices and wall plates to be flush and level.

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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 28 13 - FUSES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Fuses.

1.02 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 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - 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.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com.
- B. Littelfuse, Inc: www.littelfuse.com.

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- C. Mersen: ep-us.mersen.com.

2.02 APPLICATIONS

- A. Individual Motor Branch Circuits: Class RK1, 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.

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 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.

END OF SECTION

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SECTION 26 28 16.16 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 262813 - Fuses.

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.

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.

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4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- B. 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.
- C. Project Record Documents: Record actual locations of enclosed switches.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

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.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. ABB/GE: www.geindustrial.com/#sle.
- B. Eaton Corporation: www.eaton.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.
- D. Siemens Industry, Inc: www.usa.siemens.com.
- E. 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.

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- 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: Between -22 degrees F and 104 degrees F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. 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. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
- G. Provide with switch blade contact position that is visible when the cover is open.
- H. 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.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- K. 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.
- L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- M. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:
 - a. 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.

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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 260529.
- 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 260526.
- H. Provide fuses complying with Section 262813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

3.03 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- C. 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

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SECTION 26 33 23 – CENTRAL BATTERY EQUIPMENT

PART 1 - PRODUCTS

1.01 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:

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- 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.

END OF SECTION

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SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.

1.02 RELATED REQUIREMENTS

- A. Section 260529 - Hangers and Supports for Electrical Systems.
- B. Section 260533.16 - Boxes for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information 2019.
- B. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information 2002 (Reaffirmed 2008).
- C. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products 2019.
- D. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources 2021.
- E. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems 2006.
- F. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems 1999 (Reaffirmed 2006).
- G. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility 2012 (Reaffirmed 2018).
- 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 924 - Emergency Lighting and Power Equipment Current Edition, Including All Revisions.
- K. UL 1598 - Luminaires Current Edition, Including All Revisions.
- L. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

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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 Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. 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.

B. 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.
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. Ballasts: Include wiring diagrams and list of compatible lamp configurations.
4. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.

C. Samples:

1. Provide one sample(s) of each luminaire proposed for substitution upon request.

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- D. Certificates for Dimming Ballasts: Manufacturer's documentation of compatibility with dimming controls to be installed.
- E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
 - 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.
- G. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

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. Provide five year manufacturer warranty for all LED luminaires, including drivers.
- B. Provide 5-year pro-rata warranty for batteries for emergency lighting units.

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.

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- 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, 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. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
 - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
- 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.

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:
- D. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- E. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- F. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.04 EXIT SIGNS

- A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.

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1. Number of Faces: Single- or double-face as indicated or as required for installed location.
 2. Directional Arrows: As indicated or as required for installed location.
 - B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.
- 2.05 BALLASTS AND 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 one 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 260533.16 as required for installation of luminaires provided under this section.
- B. Install products in accordance with manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

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- D. Provide required support and attachment in accordance with Section 260529.
- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. 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. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- G. 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.
- H. 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.
- I. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- J. Install accessories furnished with each luminaire.
- K. Bond products and metal accessories to branch circuit equipment grounding conductor.
- L. Emergency Lighting Units:

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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.

M. Exit Signs:

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.

N. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- D. 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), NECA 502 (industrial 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. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.
- B. 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

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SECTION 26 51 20 - AUTOMATIC LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Provide and design an automatic lighting control system as described in this specification and as called for on the drawings.

1.02 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of 10 years experience in manufacturing and installing this type of system.
- B. The Contractor shall provide a list of recent jobs completed during the last 5 years with the name and phone number of a contact person.
- C. All components and assemblies are to be pre-tested and assembled at the factory prior to installation.
- D. Provide a factory-trained technician on site. The technician shall functionally test each component in the system after installation to verify proper operation and confirm that the panel wiring and addressing conform to the wiring documentation.

1.03 SUBMITTALS

- A. The following list includes the required shop drawings and product data information that shall be submitted.
 - 1. Underwriters Laboratories, Inc. (UL) listing and factory test reports.
 - 2. Internal and system wiring diagrams.
 - 3. Single line diagram of the system configuration. Typical riser diagrams are not acceptable.
 - 4. Dimensions of the equipment layout.
 - 5. Control wiring and conduits layout and connections.
 - 6. Floor plans to scale showing the location of each device and equipment.
 - 7. Product data of all the components including but not limited to programmable central controllers, transceivers panels, input relays, switches and other ancillary equipment.

1.04 REFERENCES

- A. UL 916 Energy Management Equipment.
- B. FCC Emissions Standards specified in Part 15, subpart J for Class A, Applications.

PART 2 - PRODUCTS

2.01 MATERIALS

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- A. Provide and microprocessor controlled relay panels for the Lighting Control System. The system shall include programmable standalone master panel, switch inputs, wiring, power supplies, relays and ancillary relays.
- B. Panels shall be capable of standing alone or operating as part of a network.
 - 1. The system shall provide intelligence to operate as follows:
 - a. Store all user operating data.
 - b. Initiate all relay output commands based on:
 - 1) Operator inputs
 - 2) Automatic operating schedule
 - 3) Binary type field sensors
 - 4) Universal override switch inputs
 - 5) Internal 56K Baud modem
 - c. Provide automatic system diagnostics and alarming based on detected faults in the controller, transceiver panels, relays, and data line.
 - 2. System shall include a memory back up to be able to survive an indefinite length of power failure.
- C. Lighting Control Panel (LCP): Microprocessor based, complete prewired assemblies consisting of the following:
 - 1. Stand alone panel controller capable of receiving and acting upon programs downloaded from the central computer. Programs downloaded from the network shall be capable of continuing to operate even if the network should fail. Battery Back up provides 8 days of memory retention. Panel shall be part of a system that can control up to 750 relays and receive up to 500 switch inputs. Panel shall have an USB input for local programming and trouble shooting from a laptop computer.
 - 2. Internal digital clock with self control power.
 - 3. Output modules: Plug in type to receive coded digital commands from the panel controller and pulse output relays to the appropriate state. Actual status feedback of the relays are to be fed back to the panel controller and from there to the central computer. Actual status of each relay is to be indicated by a pilot LED on the control board. Each Module controls 8 or 16 relays.
 - 4. Switch input modules: Plug-in type, actuated by remote external contact closures. These contact closures may be either momentary or maintained. The action of the contact is noted by the panel controller and acted upon as programmed by software. The action of the contact can command any group of output relays to the desired state. Either 8 or 24-input channels as shown on the plans.

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5. Output Relays
 - a. Type: Momentary pulsed, mechanically latched with pilot light contact.
 - b. Rating: 20 Ampere, 277VAC
 - c. Number per panel: 16,32 or 48 as required to satisfy this project scope.
6. The low voltage and high voltage sections of the lighting control cabinet shall be separated by a 14 gage steel barrier in which the relays are mounted. In areas where both 120 volt and 277 volt loads are present the high voltage compartment shall have a 14 gage steel barrier between the relays that carry 120 VAC and the relays that carry 277VAC. Each section shall be clearly labeled as to the voltage in that compartment.
7. Panel power supply shall be dual primary 115/277 volts AC, 60 Hz. \pm 10%. Low voltage side shall be protected from power line surges and spikes on the input power. The low voltage section shall be protected against short circuit faults and relay failures.
8. Panels shall be UL approved and shall have a short circuit withstand current rating at 14,000 AIC.
9. Manufacturer: Lighting Control and Design, or G.E. or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The Lighting Control System shall be installed and wired completely as required by the equipment manufacturer by the contractor, who shall make all necessary wiring connections to the lighting fixtures, override switches, photo cells and equipment.
- B. The Contractor shall provide on-site programming time with factory-trained personnel for the system set-up. The Contractor shall set up the software program and program the entire system in accordance with the Owner's instructions.
- C. Documentation
 1. Accurate "as-built" drawings shall be provided by the Contractor. These shall indicate the load controlled by each relay and the identification number for that switch connected to an input and the identification number of that input. Three sets of space plans or reflected ceiling plans shall be provided by the contractor indicating which fixtures are controlled by each relay.
 2. A separate data grade private line with RJ45 jack shall be furnished for each modem.

3.02 SERVICE AND SUPPORT

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- A. Startup: After the system has been installed, the Contractor shall provide the services of a factory trained representative of the manufacturer to verify correct operation of all system components. The contractor shall guarantee all material and workmanship involving the system for three years after startup.
- B. Training: After system startup and after all the programming is completed, the Contractor shall arrange for a factory trained representative to train the Owner's personnel. The trainer shall instruct the Owner's personnel in how to program the system and demonstrate a typical operating program for an area. The Contractor shall allow for 24 hours' instruction time for the Owner's training.
- C. Factory Support: Factory support shall be available free of charge during the three-year warranty period to answer programming and application questions. The manufacturer, or his representative, shall have a remote terminal capable of programming the system to support the Owner's personnel during this period. The Contractor shall include a modem, necessary cabling and telephone extension to support this telecommunications operation. The Contractor shall provide a three-year maintenance service contract as part of the cost.
- D. The Contractor shall also provide a software site licensing so that the Owner will be able to transfer the software program from the main computer to the other computers. This transfer shall not be an extra cost to the Owner.

END OF SECTION

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SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Exterior luminaires.

1.02 RELATED REQUIREMENTS

- A. Section 260529 - Hangers and Supports for Electrical Systems.
- B. Section 260533.16 - Boxes for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products 2019.
- B. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources 2021.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- D. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems 2000 (Reaffirmed 2006).
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 1598 - Luminaires Current Edition, Including All Revisions.
- G. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. 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.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings,

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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.

C. Samples:

- 1. Provide one sample(s) of each luminaire proposed for substitution upon request.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

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. Provide five 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.

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- 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. 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.

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 260533.16 as required for installation of luminaires provided under this section.
- B. Install products in accordance with manufacturer's instructions.
- C. Install luminaires in accordance with NECA/IESNA 501.
- D. Provide required support and attachment in accordance with Section 260529.
- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. Install accessories furnished with each luminaire.

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- G. Bond products and metal accessories to branch circuit equipment grounding conductor.
- H. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. 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.

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. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.
- B. 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

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SECTION 26 55 61 - THEATRICAL LIGHTING & RIGGING SYSTEMS REFERENCE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Theatrical Lighting and Rigging Systems.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Construction Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.
- B. Theatrical lighting and rigging system drawings (TLX.XX and TEX.XX).

1.03 RESPONSIBILITY AND RELATED WORK

- A. Coordinate scheduling of work with the Owner and Owner's Architect.
- B. Refer to TL0.00 and TE0.00 for division of responsibilities related to the theatrical lighting and rigging systems.

1.04 DEFINITION OF TERMS & ABBREVIATIONS:

- A. Provide: to supply and install.
- B. Furnish: to supply to another contractor for installation.
- C. Supply: to supply but not install.
- D. Install: to install but not supply.
- E. OFE: Owner furnished (supplied) equipment. Equipment will be provided to contractor for installation.
- F. NIC: Not In Contract. Refers to items that are not included in the scope of work outlined in this section but may be shown for coordination purposes or reference.
- G. Future: Equipment that will be provided by owner later. Accommodation shall be provided for future equipment as shown on the drawings.

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PART 2 - PRODUCTS

2.01 NOT APPLICABLE

END OF SECTION

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SECTION 27 00 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section specifies the basic requirements for communications installations as indicated or required and includes requirements common to more than one specification section of this division (such as related documents, related sections, definitions, governing requirements, contractor requirements, warranty requirements, submittal requirements/procedures, and project closeout requirements/procedures, as well as other requirements). This section may expand upon and/or supplement the requirements specified in Division 01.
- B. Examine the contract documents in their entirety (including drawings and specification sections in the other divisions) for requirements or work which may affect work under this section, regardless of whether such requirements or work are specifically indicated in this section.
- C. Errors or Omissions in Drawings or Documentation
 - 1. If any errors or omissions appear in Drawings, Specifications, or other documents, the bidding Contractor shall notify the Engineer no later than ten (10) days prior to submitting the bid.
 - 2. Should conflict occur in or between Drawings and Specifications, the bidding Contractor is deemed to have estimated the more expensive way of doing the work, unless the bidding Contractor has asked for and obtained written decision (addendum) before submission of the bid as to which method or materials will be required.
- D. Related Sections:
 - 1. Section 000000 – Procurement and Contracting Requirements
 - 2. Section 010000 – General Requirements
 - 3. Section 260526 – Grounding and Bonding for Electrical System
 - 4. Section 270526 – Grounding and Bonding for Communications Systems
 - 5. Section 270528 – Pathways for Communications Systems
 - 6. Section 270539 – Surface Raceway for Communications Systems
 - 7. Section 270553 – Identification for Communications Systems

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8. Section 270628 – Pathways for Communications Systems
9. Section 271116 – Communications Room Equipment
10. Section 271119 – Communications Termination Blocks and Patch Panels
11. Section 271323 – Backbone Cabling
12. Section 271513 – Horizontal Cabling
13. Section 271619 – Patch Cords
14. Section 271700 – Testing of Structured Cabling Systems
15. Section 272133 – Wireless Access Points

1.2 Definitions

- A. ANSI – American Northern Standards Institute
- B. AWG – American Wire Gauge
- C. BICSI – Building Industry Consulting Service International
- D. BCT – Bonding Conductor for Telecommunications
- E. EIA – Electronics Industry Alliance
- F. ETL – Intertek Certification Services
- G. IEC – International Electrotechnical Commission
- H. IEEE – Institute of Electrical and Electronic Engineers
- I. IDC – Insulation displacement contact
- J. ISO – International Standards Organization
- K. NECA – National Electrical Contractors Association
- L. NFPA – National Fire Protection Agency
- M. NRTL – Nationally Recognized Testing Laboratory
- N. TIA – Telecommunications Industry Association
- O. UL – Underwriters Laboratory

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- P. Provide: Furnish, install, terminate, label, test and certify a complete operating cabling system.
- Q. Contract Documents (CD): Design drawings, specifications, sketches and schedules provided by the Engineer as they directly relate to this scope of work and this project.
- R. Structured Cabling Systems (SCS) wiring is defined as all required equipment and cabling including hardware, termination blocks, cross connect wire or cordage, patch panels, patch cords, telecommunication outlets, work area cords, UTP and fiber cable installed and configured to provide computer data and voice connectivity.
- S. Point-of-Entry (POE): Unmarked Manholes/Vaults at property line
- T. NET-POP Rooms/MPOE (Main Point of Entry): The area where the outside plant media/carrier services appear in the facility. The NET-POP contains equipment used by owner or carrier to hand-off/transition cable from outside plant into inside plant type.
- U. Network Center/Main Distribution Frame (MDF) Areas: This technology space houses Layer 2/3 network switching gear and other main network distribution equipment and acts as the mid-connection point between the Core/Network and the TR/IDF/access zones for all connections.
- V. Telecommunications Room (TR)/Intermediate Distribution Frame (IDF): is the location for the termination of backbone cables and for termination of horizontal cables, and for the interconnection of each. The space also hosts access-layer switches and user network connections within each floor.
- W. Active Equipment: electronic equipment used to develop various WAN, LAN, and voice services, e.g., digital multiplexers, RS-232 controllers, Ethernet hubs, switches, routers, PBX, etc.
- X. Campus Backbone: cabling system consisting of media and termination hardware interconnecting POE, Net-Pop's and Future onsite buildings.
- Y. Building Backbone: cabling system consisting of media and termination hardware interconnecting MDFs to IDFs.
- Z. Horizontal: cabling system consisting of media and termination hardware interconnecting the Telecommunication Outlets (TOs) and the TRs.
- AA. Bonding: permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to conduct safely any current likely to be imposed on it.
- BB. Basket Cable Tray: A cable support and management system fabricated of continuous, rigid, welded steel wire mesh and available in many sizes with attachment hardware suiting multiple installation methods

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- CC. Cable Tray: vertical or horizontal open supports, usually made of aluminum or steel, which are fastened to the building structure. Cables are laid in and fastened to the trays.
- DD. Cabinet: free standing, floor-mounted or wall-mounted modular enclosure designed to house and protect rack-mounted electronic equipment and passive terminations.
- EE. Channel: The end-to-end transmission path between two points at which application specific equipment is connected; encompasses all the elements of the horizontal cabling link, plus the equipment cords in the telecommunications spaces and work area.
- FF. Cross-Connect: equipment used to terminate and tie together communications circuits.
- GG. Cross-Connect Jumper: a cluster of twisted-pair conductors without connectors used to establish a circuit by linking two cross-connect termination points.
- HH. Grounding: a conducting connection to earth, or to some conducting body that serves in place of earth.
- II. Jack: receptacle used in conjunction with a plug to make electrical contact between communications circuits, e.g., eight-position/eight-contact modular jacks.
- JJ. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- KK. LAN: Local area network.
- LL. Link: Horizontal cabling link encompassing all components of the horizontal cabling (TO, patch panels, blocks, jumpers and patch cords that join them in the horizontal cross-connect). It is distinguished from a channel because it does not include the equipment cables/cords at the telecom spaces or work area.
- MM. Media: twisted-pair, and fiber optic cable or cables used to provide signal transmission paths.
- NN. Mounting Frame: rectangular steel framework, which can be equipment rack or wall mounted to support wiring blocks, patch panels, and other communications equipment.
- OO. Outside Plant (OSP): generally, any and all portions of the cable system that runs outside of an environmentally enclosed structure and/or building with each end terminated at different buildings. This specifically includes inter-building cables, conduits, manholes, hand-holes, and innerduct.
- PP. UTP: Unshielded Twisted Pair.

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- QQ. FO: Fiber Optic
- RR. Passive Equipment: non–electronic hardware and apparatus, e.g., equipment racks, cable trays, electrical protection, patch panels, wiring blocks, fiber optic shelves, etc.
- SS. Patch Cords: a length of wire or fiber cable with connectors on one or both ends used to join communications circuits at a cross–connect.
- TT. Patch Panel: system of terminal blocks or connectors used with patch cords that facilitate administration of cross–connect fields.
- UU. Pathway: facility for the placement of communications cable. A pathway facility can be composed of several components including conduit, wireway, cable tray, surface raceway, under floor systems, overhead systems, raised floor, ceiling support wires, etc.
- VV. Protectors: electrical protection devices used to limit foreign voltages on metallic communications circuits.
- WW. Raceway: an enclosed channel designed expressly for holding wires or cables; may be of metal or insulating material. The term includes conduit, tubing, wire ways, under floor raceways, overhead raceways and surface raceways; does not include cable tray.
- XX. Racks: An open, freestanding, floor–mounted structure, typically made of aluminum or steel, used to mount equipment; usually referred to as an equipment rack.
- YY. Riser Backbone: The Riser Backbone subsystem links the main cross connect (MDF) in the equipment room to the distribution rooms (TRs).
- ZZ. Structured Cabling System (SCS): A SCS is defined as all required cabling including hardware, termination blocks, cross connect wire or cordage, patch panels, patch cords, telecommunication outlets, work area cords, UTP and fiber optic cable installed and configured to provide computer data and voice connectivity from each data or voice device to the network file server or voice network/switch designated as the service point of the local area network.
- AAA. Telecommunication Outlet (TO): Connecting device mounted in a work area used to terminate horizontal cable and interconnect cabling with station equipment.
- BBB. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- CCC. Work Area Subsystem: The connection between the telecommunications outlet and the station equipment in the work area is provided by the Work Area Subsystem. It consists of cords, adapters, and other transmission electronics.

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DDD. Wireless Access Point (WAP): Telecom outlet designated for use with wireless network devices. Such outlet shall be mounted above ceiling.

EEE. Contractor – The successful bidder engaged to provide the work of this specification

1.3 REFERENCES

A. Most recent editions and addenda of the following documents:

1. ANSI/TIA 568 series
2. ANSI/TIA–569 Telecommunications Pathways and Spaces
3. ANSI/TIA–606 Administration Standard for Telecommunications Infrastructure
4. ANSI/TIA–607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
5. ANSI/TIA–862 Structured Cabling Infrastructure Standard for Intelligent Building Systems
6. ANSI/TIA–4966 Telecommunications Infrastructure Standard for Educational Facilities
7. TIA–TSB–162 Telecommunications Cabling Guidelines for Wireless Access Points
8. Telecommunications Distribution Methods Manual
9. Information Transport Systems Installation Methods Manual (ITSIMM)

B. California Electric Codes (CEC)

C. Local Codes and Standards – all applicable

D. UL444 – Standard for Safety of Communications Cable

E. UL 1666 – Standard for Safety of Flame Propagation Height

F. Local Authority Having Jurisdiction (AHJ)

G. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either

H. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense

1.4 QUALIFICATIONS

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- A. The contractor shall hold a valid State of California C7 and C10 Contractor's license.
- B. Contractor shall have a proven track record in the field of specified cabling and system installations, with at least (3) previous installations of comparable size and complexity undertaken within the last (5) years.
- C. Contractor shall be a Certified CommScope Installer, and have completed Commscope's training - ACTs I, II, and III.
- D. Contractor shall be qualified in the installation and termination of copper and fiber cabling as described in this Division.
- E. Contractor shall have BICSI Registered Communication Distribution Designer (RCDD) to sign-off on all designs offered, including stamping the design with their current BICSI/RCDD stamp.
- F. Contractor shall be a manufacturer's authorized distributor and warrantee station for the equipment offered, and shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment.

1.5 SUBMITTALS

- A. Make submittals in accordance with:
 - 1. Section 00 00 00 – Procurement and Contracting Requirements
 - 2. Section 01 33 00 – Submittal Procedures.
- B. Action Submittals:
 - 1. Shop Drawings
 - a. Owner will provide electronic files in CAD or Revit format, containing the contract document drawing files, for use in the preparing of the shop drawings, by the RCDD.
 - b. Drawings will be to scale.
 - c. Submit the following sheets:
 - 1) Titlesheet and Cover Page: indicate project name and location; include sheet index
 - 2) Site Plan
 - 3) Overall Floor Plans: floor plans showing the locations of devices and cable routing paths with cable types, quantity called out, and device IDs; telecommunications room locations; backbone cable routes; new pathways/conduits/boxes/etc.
 - 4) Enlarged Plans: Communications rooms with equipment types and quantity called out; coordinated wall elevations with space allocated for trades not covered under Division 27; rack elevations with CFCI and OFCI equipment called out.

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- 5) Sheets for the entire structured cabling system and grounding and bonding system, identifying such items as PBB, SBB, TBB, rack fills, cabling pathways and pathway fills, ladder and other cable raceways, coordination with other trades, etc.
 - 6) Rough-in and wiring details.
 - 7) Topology diagrams, indicating Contractor and Owner scopes of work, as well as interconnecting media (i.e. cross-connections between ISP and Owner's network).
2. Product submittal
 - a. Contractor shall furnish products for a complete, turnkey system. Submit major components and ancillary accessories required for complete system. Minor accessories like screws and nuts are not required for submission, unless specified in other Specifications sections.
 - b. Product submittal shall be a single complete submittal. Incomplete submittals will be rejected without review.
 - c. Partial submittals will be allowed for short lead items only with documentation on lead time included at the front of the submittal.
 - d. Catalog cut sheets and data sheets containing physical and dimensional information, performance data, electrical characteristics, materials used in fabrication, material finish, and licenses. Clearly indicate on each sheet what is being submitted on.
 3. Qualification Data: Submit at least three references for telecommunications cabling jobs already completed, involving both fiber optics and twisted pair cabling, similar in scope to the project described herein. Include, for each customer reference, the following information: Company name, address, phone number, name and email address of contact and type of job completed.
 - a. Provide copies of the Contractor's certification.
 - b. Provide written guarantees from manufacturers of major equipment, that a service representative has been assigned.
 - c. Provide copies of technician training certificates.

1.6 CLOSEOUT DOCUMENTS

- A. Final close out documents including, but not limited to, test results on in digital PDF and physical CD-ROM or USB drive, in native tester format, project manual that includes manufacturer and contractor warranties, product cut sheets, material submittals, etc. Also, include the following:
 1. Provide "As-Built" Drawings in AutoCAD or Revit.
 - a. "As-Built" drawings indicating location of all equipment including but not limited to work area outlets, patch panels, cross connect blocks, on each segment and cable routing outlet and identifiers. Indicate labeling for each piece of equipment.
 - b. As-Built drawings will contain all installed cabling and materials. Outlets will be numbered with each cable associated with the work area outlet.

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- c. Red-lined shop drawings submitted as As-built drawings will be rejected without review.
 - d. (1) printed, hard copy of final approved as-built drawings in native sheet size will be provided to Owner. Unapproved sheet sizes will be rejected.
- 2. Place a laminated full-size, minimum "C" sized, floor plan of these drawings (coordinate with Owner) on the wall of each communications room, showing area covered, data locations, and cable label.
 - 3. Provide network schematics when appropriate.
 - 4. Print (2) printed copies of full-sized as-built drawings, and submit to Owner.
 - 5. Provide printed cable test reports in 3-ring binder and submit to Owner.
 - 6. Provide pricing and contact information for emergency service work not covered by warranty.

1.7 QUALITY ASSURANCE

A. Standards for Materials and Equipment

- 1. The Contractor shall provide all materials, equipment, and installation in compliance with the latest applicable standards from ANSI, FCC, ASTM, EIA/TIA, IEEE, CEC, NFPA, NEMA, OSHA, REA, and UL.

B. Manufacturer's Warranty

- 1. Contractor shall provide a 25-year warranty on all copper links and/or channels.
- 2. Warranty shall meet the following criteria:
 - a. A guarantee that the installed cabling system will pass the Commercial Building Telecommunications Standards cited in this document.
 - b. This warranty will cover all registered links and/or channels.
 - c. Contractor shall indicate in warranty documentation whether registered links are to be "link" or "channel" type.
 - 1) If links are covered, this warranty may be invoked only if the links are comprised entirely of a single manufacturer's cable and terminations.
 - 2) If channels are covered, this warranty may be invoked only if entire channel links are comprised of single manufacturer's cable, terminations, and patch cords.
 - d. The Contractor will correct any problems and malfunctions that are warranty-related issues without charge for the entire warranty period. Corrections shall start within 48-hours of notification from Owner.
 - e. If the warranty is needed by the Owner within the warranted period and the original installer is no longer in business, System manufacturer shall find a substitute certified contractor and assume costs to fulfill the obligations of the warranty.

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- f. Upon acceptance of the warranty paperwork and test results from the Contractor, System manufacturer will mail a notification letter to the installer and a notification letter with warranty certificate to Owner.
 - g. The warranty period shall commence following the final acceptance of the project by Owner and written confirmation of warranty from System manufacturer.
3. An additional 1-year written warranty covering workmanship and materials from the date of project completion. All repairs shall be made at no cost to the Owner during the warranty period.

C. Testing and Inspection of Communications Equipment

- 1. Provide tests specified below, when applicable or required by Owner, and as indicated under individual items of material, equipment, and work specified in this Specification.
 - a. Furnish all test equipment and instruments required for the tests.
 - b. Responsible, qualified employees of the contractor in the presence of the Owner or an authorized representative shall perform the cable testing.
 - c. All individuals involved in the testing phase of the project shall not have been involved in the installation phase nor shall have immediate knowledge of the installation task.
- 2. End-to-end performance of all parts and channels will be tested.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. To prevent damage, theft, soiling, and misalignment, protect equipment during transit, storage, and handling
- B. The contractor shall coordinate the secure storage of equipment and materials on site, or, if no on-site storage is available, shall provide their own secure storage at the Contractor's expense.
 - 1. Do not store equipment where conditions fall outside the manufacturer's recommendations for environmental conditions.
 - 2. Do not install damaged equipment. Remove environmental conditions from the site and replace damaged equipment with new equipment.
 - 3. If off-site storage of materials is necessary, this shall be at the Contractor's expense.

1.9 PROJECT CONDITIONS

- A. Project Environmental Requirements
 - 1. Hazardous Materials Prohibition

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- a. The Contractor shall ensure that all materials used in the project are asbestos-free, unless specifically authorized in writing by the Owner.
- 2. Existing Conditions
 - a. Verify that all conditions on the project site are acceptable for the Work specified in this Section. Prior to bid opening, notify the Consulting Engineer, in writing, of any discrepancies, conflicts, or omissions. Otherwise, correct these issues at no additional cost to the Owner.
 - b. Continue to monitor the project site. If conditions develop that require a variance from the Specifications or Drawings, then immediately notify the Owner in writing. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and, upon approval, proceed with the necessary changes without additional cost to the Owner.
- B. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, and work above ceilings is complete.
- C. Confirmation of Pathway and Cable Manager sizing:
 - 1. Wherever cabling pathways or managers are installed, it is the Contractor's responsibility to confirm pathway or manager sizing to represent no more than 25% fill upon installation according to manufacturer's fill tables.
 - 2. Pathways deemed overfilled upon installation will not be accepted and shall be remedied at Contractor expense.

1.10 USE OF THE SITE

- A. Where the Owner deems it necessary to place restrictions, use the site as directed by the Owner.
- B. When proceeding with the work, do not interfere with the ordinary use of streets, aisles, passages, exits, or operations of the Owner. During the day, set up cones and barriers in hallways and walkways. Do not string cable down the hallways during normal hours.
- C. Request a hazardous materials worksheet that identifies potentially-hazardous locations. Do not proceed with any work in locations where hazardous materials are known to be. Obtain instructions from the Contractor's Project Manager on and when to work in these areas.
- D. Multiple times each day, each contractor shall remove all trash and debris from the site. Before leaving the room each day:
 - 1. The Contractor shall replace all ceiling tiles that they have removed.

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2. The Contractor shall place all furniture and equipment that they have moved back into its original location.
3. The Contractor shall return any equipment that they have disconnected to working order.
4. The Contractor's Job Foreman shall inspect all work locations to ensure that the rooms are clean and that all of the tasks described above have been done.
5. It is recommended that the Contractor inspect the site and take pictures to document the condition of the ceilings and walls.

1.11 RESPONSIBILITIES AND COORDINATION

- A. The Contractor shall provide all materials, qualified labor and services required to ensure a complete and operational system, installed in accordance with the intent of the Contract Documents.
- B. The Contractor shall furnish and install all incidental items not actually shown or specified, but which are required by best practices to provide complete functional systems.
- C. The Contractor shall coordinate the details of facility equipment and construction for all specification divisions, which affect the work covered under this Division.
- D. The Contractor shall coordinate all activities with the overall construction schedule.
- E. The Contractor shall coordinate with all other trades. The Contractor will submit a schedule for the installation within 15 days of contract award.
 1. The schedule shall include delivery, installation, and testing for conformance to specific job completion dates.
 2. At minimum, the schedule shall provide dates for the start of demolition, the completion of demolition, the installation start date, the completion of copper cabling, the completion of backbone cabling, the completion of testing and labeling, cutover, the completion of the final punch list, final inspection, and acceptance.
- F. The Contractor shall develop a bill of materials, perform material management and efficient use of the materials whether they are issued by Owner or purchased by the Contractor.
- G. The Contractor shall ensure materials, in excess of, those required to complete the project are kept in their original condition and packaging for restocking.
- H. The Contractor shall maintain a spare set of all major parts for the system at all times.

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- I. The Contractor shall maintain existing cables and terminations not determined to be within the demolition scope of work. Cables damaged, removed, or unterminated shall be reinstalled and recertified with the manufacturer's certified installer, and test results provided to the Owner.

1.12 DESIGN CRITERIA

- A. Compliance by the contractor with the provisions of this Specification does not relieve him or she from the responsibilities of providing materials and equipment of proper design, mechanically and electrically suited to meet operating requirements at the specified service conditions.
- B. The following are incorporated into the design:
 1. The intent of the drawings is to restrict the maximum horizontal subsystem cabling length to 295 feet for all horizontal cabling.

PART 2 - PRODUCTS

2.1 GENERAL

- A. This Section includes General Requirements for each section in Division 27 and shall be used in conjunction with specifications, other related Divisions and related Contract Documents to establish the total requirements for the project:
 1. Refer to specific sections for Product Part Numbers.
- B. All materials and products shall be:
 1. Appropriate for the intended use
 2. Permitted by the Authority Having Jurisdiction (AHJ)
- C. All products shall be new, of the latest version at time of bid, and brought to the job site in original manufacturer's packaging. Used equipment and damaged material will be rejected.
- D. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.
- E. Take care during installation to prevent scratches, dents, chips, etc. Equipment with significant or disfiguring cosmetic flaws will be rejected.
- F. All components will be approved by the Engineer and shall have the most aesthetic value possible while maintaining specified functionality. Hardware shall:
 1. Be in compliance with the Construction Documents.

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2. Have fit and finish compatible with the existing surrounding structure.
 3. Be unobtrusive.
 4. Provide the required functionality.
- G. Fabricate custom-made equipment with careful consideration given to aesthetic, technical, and functional aspects of the equipment and its installation.
- H. Provide products that are suitable for the intended use, including, but not limited to environmental, regulatory, and electrical factors.
- I. All fittings, supports, splices, etc. for the system shall be installed to provide a complete assembly- including fasteners, hardware, and other items required to complete the installation as indicated in the Drawings and Specifications

2.2 SUBSTITUTION POLICY

- A. Substitution requests: Substitution requests will be considered only if submitted to Owner's Representative not less than 7 days prior to project bid date. Acceptance or rejection of proposed substitution is at Owner's Representative's sole discretion. Requests for substitutions shall be considered "not approved" unless approval is issued in writing by Owner's Representative.
- B. Rejection: For equipment, cabling, wiring, materials, and all other products indicated or specified as "no substitutions" or "no alternates", Owner does not expect not desire requests for substitutions or alternate products other than those specified. Owner reserves the right for Owner's Representative to reject proposed substitution requests and submissions of alternates without review or justification.
- C. Contractor shall assume all costs for removal and replacement of any product installed in substitution of those specified. Such costs shall include but not be limited to labor, materials as well as any penalties, fees or costs incurred for late completion.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. Manufactured products, materials, equipment, and components shall be provided, conditioned, applied, installed, connected, and tested in accordance with the manufacturer's specifications and printed instructions.
- B. The installation of all system components shall be carried out under the direction of qualified personnel. Appearance shall be considered as important as mechanical and electrical efficiency. Workmanship shall meet or exceed industry standards.

3.2 INTENT OF DRAWINGS

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- A. The technology drawings show only general locations of equipment, devices, raceways, cable trays, boxes, etc., unless specifically dimensioned.
- B. The Contractor shall be responsible for the proper placement and routing of equipment, cable, raceways, cable runway, and related components, according to the Contract Documents and subject to prior review by the Owner and System Designer.
- C. The Contractor shall refer any conflicts within the Contract Documents to the Construction Manager and/or Owner for resolution.

3.3 SERVICE CONTINUITY

- A. Maintain continuity of communications services to all functioning portions of the process or buildings during hours of normal use.
- B. Arrange temporary outages for cutover work with General Contractor. Keep outages to a minimum number and a minimum length of time in order to provide minimum impact.

3.4 LAYOUT AND TOLERANCES

- A. Follow as closely as practicable the design as shown on the Drawings. Make all necessary measurements in the field to verify exact locations and ensure precise location and fit of specified items. Make no substantial alterations without prior approval of the Owner and the System Designer.

3.5 TESTING AND INSPECTION OF OWNER-PROVIDED EQUIPMENT

- A. Provide tests specified below, when applicable or required by the Owner, and as indicated under individual items of material, equipment, and work specified in this Specification.
 - 1. Furnish all test equipment and instruments required for the tests.
 - 2. Responsible, qualified employees of the contractor in the presence of the Owner or an authorized representative shall perform the cable testing.
 - 3. All individuals involved in the testing phase of the project shall not have been involved in the installation phase nor shall have immediate knowledge of the installation task.

3.6 CONSTRUCTION REVIEW

- A. The System Designer and Owner will review and observe installation work to ensure compliance by the Contractor with Contract Document requirements.
- B. Review, observation, assistance, and actions by the System Designer and Owner shall not be construed as undertaking supervisory control of the work or of methods

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and means employed by the Contractor. The System Designer's and Owner's review and observation activities shall not relieve the Contractor from the responsibilities of the Contract Documents.

- C. The fact that the System Designer and Owner does not make early discovery of faulty or omitted work shall not bar the Owner from subsequently rejecting this work and withholding payment until the Contractor makes the necessary corrections.
- D. Regardless of when discovery and rejection are made, and regardless of when the Contractor is ordered to correct such work, the Contractor shall have no claim against the System Designer or Owner for an increase in the contract price, or for any payment on account of increased cost, damage, or loss.

3.7 PROJECT RECORD DOCUMENTS

- A. Provide detailed project record documentation for sections listed in Part 1 above in addition to the standard requirements, within 30 days after completion of the work.
- B. Maintain separate sets of redlined record drawings for the communications work, which show the exact placement, and identification of as-built system components. These are subject to weekly review by the General Contractor, Owner, or its representative.

3.8 ADDITIONAL CONTRACTOR REQUIREMENTS

- A. Contractor is responsible for the removal and disposal of all installation and construction debris created in the process of the job.
- B. All work areas will be cleaned at the conclusion of the project and no tools or materials shall be left in a manner as to pose a safety hazard.
- C. Projects are not considered finished and will not be paid by Owner until all debris, dust, etc. has been cleaned and removed to the Owner's satisfaction.
- D. Contractor shall remove all abandoned cable per Article 800 of the National Electrical Code and per TIA and BICSI standards, recycling these materials where possible. Removal of orphaned cable is mandatory. Contractors shall consider this when placing bids.
- E. Contractor shall abide by all Owner Security Policies pertaining to access and conduct while on the Owner's property.
- F. Contractor shall obey all posted speed limits and parking regulations at the Owner's facilities where the work is being performed.
- G. Contractor understands that illegally parked vehicles will be towed, and Contractor is responsible for and will assume all costs associated with towing.

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3.9 FINAL ACCEPTANCE

- A. The Contractor is required to notify the System Designer and Owner of a proposed appointment for Final Inspection at least 72 hours before the appointment.
- B. Owner may visit site during construction to ensure installation is in compliance with their requirements. Punch items discovered by Owner shall be resolved within 10 days of discovery.
- C. System acceptance shall be defined as that point in time when the following requirements have been fulfilled:
 - 1. All submittals and documentation have been submitted, reviewed, and approved.
 - 2. The complete system has successfully completed all testing requirements.
 - 3. All punch list items have been corrected and accepted.

END OF SECTION

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SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial building grounding and bonding requirements for telecommunications infrastructure.
2. Requirements for bonding and communications cabling, equipment, pathways, spaces, and mounting equipment.

B. Related Sections:

1. Section 010000 – General Requirements
2. Section 260526 – Grounding and Bonding for Electrical System
3. Section 270529 – Pathways for Communications Systems
4. Section 270539 – Surface Raceway for Communications Systems
5. Section 270553 – Identification for Communications Systems
6. Section 271116 – Communications Room Equipment
7. Section 271513 – Horizontal Cabling

1.2 DEFINITIONS

- A. AWG – American Wire Gauge – The standardized system for gauging the diameter of round, solid, non-ferrous, electrically-conducting wire.
- B. BBC – Bonding Backbone Conductor – A telecommunication bonding connection which interconnects telecommunications bonding backbones. Formerly known as the grounding equalizer.
- C. BN – Bonding Network – A set of interconnected conductive structures that provides a low impedance path for the associated telecommunications infrastructure.
- D. EF – Entrance Facility – An entrance to a building for both public and private network service cables, including wireless, that includes the entrance point of the building and continues to the entrance room or space.

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- E. ESD – Electrostatic Discharge – The sudden flow of electricity between two electrically-charged objects caused by contact, an electrical short, or dielectric breakdown.
- F. Mesh–BN – Mesh Bonding Network – A bonding network to which all associated equipment, such as cabinets, frames, racks, trays, and pathways, are connected using a bonding grid that is connected to multiple points on the common bonding network.
- G. PBB – Primary Bonding Busbar – A busbar placed in a convenient and accessible location and bonded, by means of the Telecommunications Bonding Conductor (TBC), to the building's service equipment (power) ground. Formerly known as the Telecommunications Main Grounding Busbar (TMGB).
- H. RBB – Rack Bonding Busbar – A busbar within a cabinet, frame, or rack.
- I. RBC – Rack Bonding Conductor – A bonding conductor from the rack or Rack Bonding Busbar (RBB) to the Telecommunications Equipment Bonding Conductor (TEBC).
- J. SBB – Secondary Bonding Busbar – A common point of connection for telecommunications system and equipment bonding to ground, located in the distributor room. Formerly known as the Telecommunications Grounding Busbar (TGB).
- K. TBB – Telecommunications Bonding Backbone – The conductor that interconnects the Primary Bonding Busbar (PBB) to the Secondary Bonding Busbar (SBB).
- L. TBC – Telecommunications Bonding Conductor – A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground. Formerly known as the bonding conductor for telecommunications.
- M. TEBC – Telecommunications Equipment Bonding Conductor – A conductor that connects the Primary Bonding Busbar (PBB) or Secondary Bonding Busbar (SBB) to equipment racks or cabinets.
- N. TR – Telecommunications Room – An enclosed space for housing telecommunications equipment, cable terminations, and cross-connect cabling. It is the recognized location of the cross-connect between the backbone and horizontal facilities.
- O. UBC – Unit Bonding Conductor – A bonding conductor from equipment or a patch panel to a Rack Bonding Conductor (RBB) or a Rack Bonding Busbar (RBB).

1.3 SUBMITTALS

- A. Refer to 27 0000.

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1.4 CLOSEOUT DOCUMENTS

- A. Refer to 27 0000.
- B. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
 - 1. PBB, SBB, RBB and routing of their bonding conductors

PART 2 - PRODUCTS

2.1 GENERAL

- A. Comply with TIA 607.
- B. Conductors shall comply with UL 486A–486B.

2.2 CONDUCTORS

- A. The Telecommunications Bonding Conductor (TBC) shall be a UL-listed, stranded conductor insulated with a green jacket. The TBC shall be equal in size to the TBB specified elsewhere in this Section.
- B. The Telecommunications Bonding Backbone (TBB) Grounding Conductors shall be:
 - 1. To be bare or insulated copper, of minimum conductor size #6 AWG and sized at 2 kcmil per linear foot up to a maximum size of 750 kcmil. For details on TBB sizing see Part 3.
 - 2. Where un-insulated, to be identified with green tape at termination location.
 - 3. Labeled in accordance with recommendations set forth in ANSI/TIA–606 Administration Standard for Telecommunications Infrastructure.
 - 4. Manufacturer:
 - a. General Cable
 - b. Southwire
 - c. Panduit
 - d. Or equal
- C. The Equipment Bonding Conductors (EBCs)

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1. Shall be #14AWG or larger stranded conductor with a green insulating jacket for all metallic components entering the telecommunications room.

2. Manufacturer:

- a. General Cable
- b. Southwire
- c. Panduit
- d. Or equal

D. Bonding Conductor (BC):

1. Shall be #6 insulated (green) stranded copper conductor.

2. Manufacturer:

- a. General Cable
- b. Southwire
- c. Panduit
- d. Or equal

E. Rack Bonding Conductor Kits (RBC):

1. Bonds the rack or cabinet to the telecommunications grounding busbar (PBB or SBB).
2. Jumper kits available with both ends factory terminated to provide a bolt-on solution.
3. Jumper kits available with one end factory terminated to attach to the rack or cabinet; free end accommodates unique length requirements.
4. Engineered to comply with US and international grounding requirements.
5. Shall be #6AWG or larger stranded conductor with a green insulating jacket.
6. Manufacturer:

- a. General Cable
- b. Southwire

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c. Panduit

d. Or equal

F. Equipment Jumper Kits (Unit Bonding Conductor or "UBC"):

1. Used to ground large, chassis-style rack mounted equipment that have built-in grounding pads or terminals.
2. Bond network equipment to grounding strip or grounding busbar.
3. Jumper kit available with both ends factory terminated to provide a bolt-on solution.
4. Jumper kit available with one end factory terminated to attach to the grounding strip or grounding busbar; free end accommodates unique equipment terminations.
5. Use jumpers with 90° bent lug, on grounding strip side, for high density grounding requirements up to one ground point per RU.
6. Use jumpers with 45° bent lugs on grounding strip side, for improved cable management.
7. Engineered to comply with US and International grounding requirements.
8. Manufacturer:
 - a. General Cable
 - b. Southwire
 - c. Panduit
 - d. Or equal

G. Surge Suppressor Jumper Kit:

1. Bonds power or data line surge suppressor to grounding strip or grounding busbar.
2. Both ends factory terminated to provide a bolt-on solution.
3. Engineered to comply with US and International grounding requirements.
4. Manufacturer:

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- a. General Cable
- b. Southwire
- c. Panduit
- d. Or equal

H. Armored Cable Grounding Kit:

1. Provides a secure bond to the armor sheath on indoor and indoor/outdoor fiber optic cables at both cassette and enclosure ends.
2. Worm–gear design evenly distributes forces across the armor.
3. Made from steel and aluminum material is compatible with common armor for long term reliability.
4. Black insulating cover protects and hides the connection for an aesthetically pleasing work area.
5. Complies with industry requirements ensuring a high level of reliability and safety.
6. Shall be #14AWG or larger stranded conductor with a green insulating jacket.
7. Manufacturer:
 - a. General Cable
 - b. Southwire
 - c. Panduit
 - d. Or equal

2.3 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A–486B
- B. Compression Wire Connectors: Crimp–and–compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
- C. Code/Flex Conductor H–TAPs

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1. Used as a splice, or to tap smaller (pigtail) conductors into larger continuous conductors.
2. Each HTAP terminates a wide range of conductor sizes and combinations of code and flex conductors Class G, H, I and Locomotive to suit a variety of applications.
3. Slotted design allows quick and easy assembly of conductor to HTAP using (3) Panduit 94V-0 cable ties (supplied).
4. Tap grooves are separated from one another, allowing them to function independently so HTAP can be used with single or multiple conductors, providing maximum design and installation flexibility.
5. Color coded and marked with Panduit die index numbers for proper crimp die selection.
6. UL Listed and CSA Certified, with wide size range of conductor sizes and rated for applications up to 600 V when crimped with Panduit tools and dies, or with other specified manufacturers' crimping tool and dies.
7. Tin plated to inhibit corrosion.
8. Available with an assortment of clear covers with integrated label fields.
9. Manufacturer:
 - a. Panduit
 - b. CPI
 - c. Or equal
 - d.

D. Code Conductor, Thin Wall, Tin-plated C-TAP (splice)

1. For copper-to-copper splicing or pigtail tap splicing.
2. Wide wire range-taking capability minimizes inventory requirements.
3. Color-coded for proper crimp die selection.
4. Ribbed design provides high strength.
5. Made from high conductivity wrought copper.
6. Tin-plated to inhibit corrosion and oxidation.

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7. UL Listed and CSA Certified with AWG conductor to 600 V and temperature rated to 90°C when crimped with Panduit and specified manufacturers' crimping tools and dies.
8. Manufacturer:
 - a. Panduit
 - b. CPI
 - c. Or equal

E. Two-hole, Long-Barrel Compression Lugs for Grounding Conductors

1. Meets TIA-607 requirements for network systems grounding applications.
2. Tested by Telcordia – meets NEBS Level 3 with AWG conductor.
3. UL Listed and CSA Certified with AWG conductor for use up to 35 KV** and temperature rated 90°C when crimped with Panduit and specified manufacturers' crimping tools and dies.
4. Color-coded barrels marked with Panduit and specified manufacturers' die index numbers for proper crimp die selection.
5. Have long barrel to maximize number of crimps and provides premium wire pull-out strength and electrical performance.
6. Have "inspection window" over tongue to visually assure full conductor insertion.
7. Be tin-plated to inhibit corrosion
8. Available with NEMA and BICSI hole-sizes and spacing
9. Manufacturer:
 - a. Panduit
 - b. CPI
 - c. Or equal

2.4 GROUNDING BUS BARS

A. The Secondary Bonding Busbar (SBB) shall be:

1. A solid, tinned copper bar, 2 inches wide by 10 inches long by 1/4 inch thick.

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2. Meet BICSI and TIA-607 requirements for network systems grounding applications.
3. Employ BICSI hole spacing to fit LCC series 2-hole lugs.
4. Be made of high conductivity copper and tin-plated to inhibit corrosion.
5. Come pre-assembled with brackets and insulators attached for quick installation.
6. Provide component labels, sold separately, to identify busbars to meet TIA-606.
7. Manufacturer:
 - a. Panduit
 - b. CPI
 - c. Or equal

B. Grounding Busbar for Racks and Enclosures

1. With each enclosure and rack, provide a tinned copper busbar to serve as an extension of the PBB or SBB for the equipment in the cabinet.
2. Shall be manufactured from copper alloy.
3. Provide horizontal and vertical busbars.
4. Horizontal Busbars shall be at least .75 inches (19 mm) wide, 19 inches (483 mm) long, and 0.1875 inches (5 mm) thick.
5. Have at least 14, factory-provided #12-24 threaded holes.
6. Have pre-punched EIA 310 D mountings, which match that of the vertical rail, for attachment to the mounting rail.
7. Vertical Busbars shall be at least 0.67 inches (17 mm) wide, 78.65 inches (2 m) long, and 0.05 inches (1.27 mm) thick and come in threaded rail and cage nut versions.
8. Include a hardware kit with rack installation hardware and with screws for bonding equipment to the busbar.
9. Manufacturer:
 - a. Panduit

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b. CPI

c. Or equal

2.5 OTHER GROUNDING AND BONDING PRODUCTS

A. Bronze Grounding Clamps for Conduit:

1. Used to ground copper conductor parallel to, or at a right angle to a rod, tube, or pipe.
2. Made from high strength, electrolytic cast bronze.
3. High strength silicon bronze hardware provides long term reliable assembly.
4. Accommodates a wide range of pipe, tube, rod and conductor sizes – minimizes inventory.
5. UL 467 Listed for grounding and bonding with AWG conductor and suitable for direct burial in earth or concrete.
6. Manufacturer:
 - a. Panduit
 - b. CPI
 - c. Or equal

B. Copper and Aluminum One–Hole Grounding Lay–in Lug for bonding ladder rack

1. Used for quick installation of a continuous grounding conductor.
2. UL 467 Listed for grounding and bonding, copper lugs. UL Listed for direct burial in earth or concrete.
3. UL Listed for use up to 600 V and temperature rated 90°C
4. Manufacturer:
 - a. Panduit
 - b. CPI
 - c. Or equal

C. Universal Beam Grounding Clamp

1. Used to for bonding structural steel (ex: I–beams) into bonding network.
2. Universal, fits on a wide range of standard (angled) and wide flange (parallel) structural steel beams.

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3. Provide a mounting pad suitable for a two-hole compression lug.
4. Installs quickly and easily with standard 1/4" key hex wrench tooling.
5. UL 467 Listed and CSA 22.2 Certified for grounding and bonding suitable for direct burial in earth or concrete.
6. Comply with vibration tests per MIL-STD-202G (METHOD 201A).
7. Manufacturer for beam grounding clamps:
 - a. Panduit
 - b. CPI
 - c. Or equal

2.6 LABELING

- A. Comply with TIA-606 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.
- C. Refer to Section 27 05 53 IDENTIFICATION FOR COMMUNICATION SYSTEMS for more detail.

PART 3 - EXECUTION

3.1 GENERAL

- A. Examination
 1. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
 2. Inspect the test results of the ac grounding system measured at the point of BCT connection.
 3. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 4. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

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B. Installation

1. This Specification document describes a generic enterprise communications bonding and grounding system for the construction of a complete and functioning grounding system without prior knowledge of the particular facilities where it will be used. It is the responsibility of the installing contractor to adapt these general guidelines and principles to the requirements of the actual environments where the systems are to be implemented.
2. System shall provide equipment ground connections (bonds) from the premises entrance facility and outside-plant earthing system to each telecommunication room telecommunication ground busbar, through the racking systems to bond the network equipment.
3. Entire grounding link from equipment to earth should be visually verifiable except where hidden by walls, conduit, or pathways.
4. Installing contractor shall label all elements of the communications bonding network according to guidelines defined in TIA-607-B and ANSI/TIA 606-B.
5. It is the responsibility of the installer to be knowledgeable of all previously cited Standards and Codes and to bring to the Owner's attention any conflicts or discrepancies to achieve a fully functioning, standards-compliant earthing system.
6. Contractors working around or adding to existing legacy systems shall bring to the Owner's attention previously installed network elements that may not comply with modern grounding requirements for possible remediation.

C. Secondary Bonding Busbar (SBB):

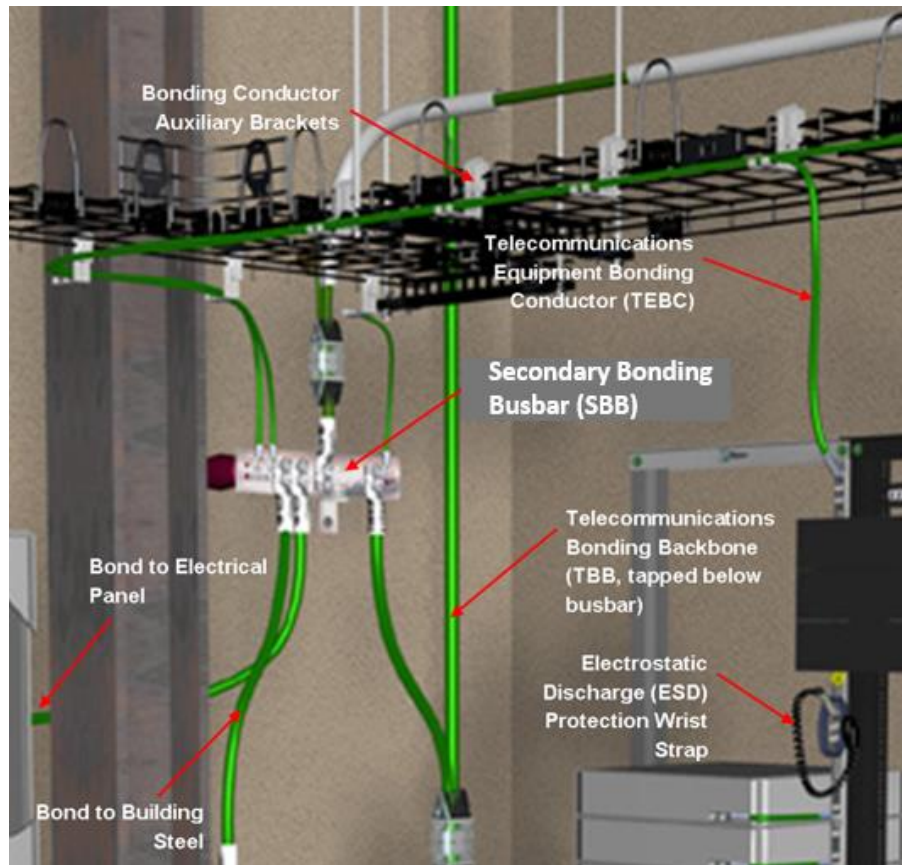
1. SBBs shall have tinned surfaces to restrain oxidation and shall be cleaned and have an antioxidant paste applied to both bonding surfaces prior to fastening conductors.
2. Connectors on backbone and rack/cabinet bonding conductors which attach to SBB shall be of two-hole, long-barrel compression lugs of the LCC series as specified in the "Materials" section of this document.
3. Building steel within six feet of the communications grounding system should be bonded into the system with beam clamps and other hardware appropriate to that purpose listed in "Materials" section of this document.
4. Racks and cabinets shall have individual Rack Bonding Conductors (RBC) bonding to the Telecommunications Equipment Bonding Conductor (TEBC) or underfloor "Supplemental Bonding Grid – DAISY CHAINING OR SERIAL

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CONNECTIONS OF ONE RACK OR CABINET TO ANOTHER WILL NOT BE ACCEPTED.

5. Rack Bonding Conductors (RBC) or above rack row grounds (TEBC) shall be installed to maintain a minimum of 2" separation from all other types of cable – power or communications.
6. To maintain this segregation of cables some telecommunications rooms may lend themselves to the installation of Auxiliary Conductor Brackets for routing bonding conductors outside of, yet parallel to ladder rack or basket tray. See "Auxiliary Brackets" in "Materials" section of this document.
7. Bonding conductor support systems like auxiliary brackets shall be spaced no further apart than three-foot intervals.
8. All cables containing metallic shielding or armor shall be properly bonded into the communications grounding system using the appropriately sized Armored Cable Grounding Kit listed in the "Materials" section of this document.
9. The illustration below depicts for reference the general location and layout of a typical telecom room and associated bonding connections into the SBB.

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Telecommunications Grounding in Small TR

Note: In this illustration individual Telecommunications Equipment Bonding Conductors (TEBC) go direct from each rack to the SBB.

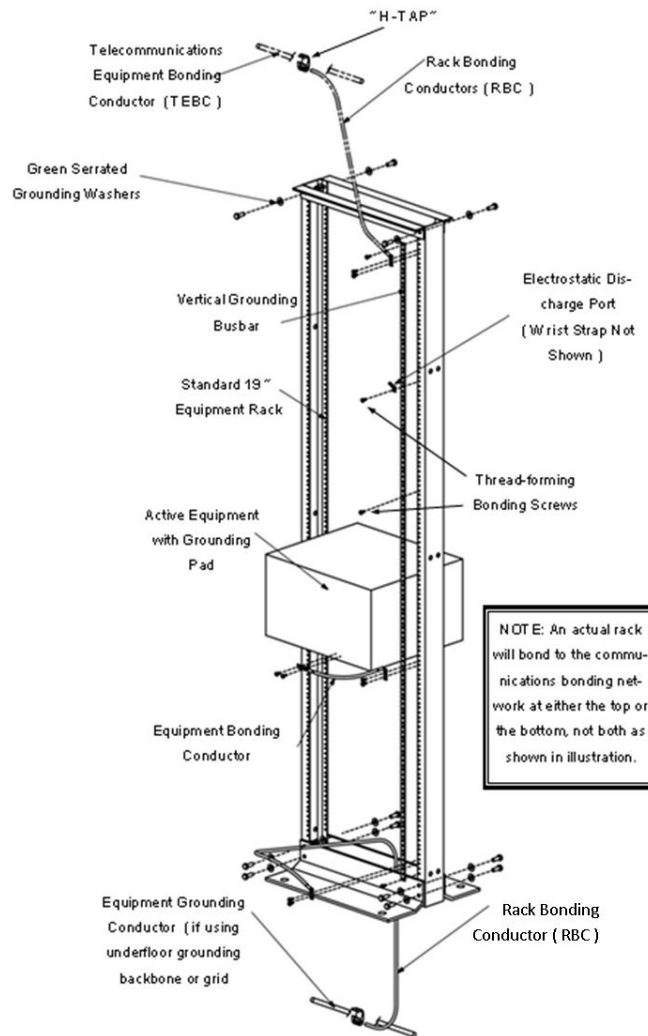
D. Bonding within Racks and Cabinets:

1. Racks and Cabinets shall be bonded into the communications bonding network with conductors of #6 AWG or larger.
2. Racks, cabinets, and similar enclosures shall not be attached serially, (daisy-chained) but must have individual RBC into the grounding system.
3. Newly installed racks and cabinets shall have vertical grounding busbars installed along one rail to provide clean bonding landing point for all rack mount equipment. For part numbers of vertical busbars see "Materials" section of this document. Grounding busbars shall not be isolated from the rack or cabinet.
4. All painted components of racks/cabinets shall be assembled using serrated grounding washers and thread-forming screws to ensure electrical continuity between the different structural components of the rack/cabinet.

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5. Larger equipment (chassis switches) with integral grounding terminals or pads shall be bonded to the vertical busbar with equipment grounding kits attached to those terminals and bonding them to the rack-mounted busbars. For kit part numbers see the "Materials" section of this document.
6. Anywhere two metallic surfaces are to be bonded, contractor shall clean the contact areas of paint or oxidation using abrasive pads and apply film of anti-oxidation compound between surfaces prior to bonding.
7. All cable fittings shall be of two-hole (LCC series) compression-type. Mechanical screw-lugs on racking systems will not be accepted and must be removed and replaced at contractor's expense.
8. All screws used to affix compression lugs to rack-mounted vertical busbars shall be of the thread forming type made specifically for electrical bonding.
9. Smaller equipment (servers, TOR switches) not having integral grounding pads must be bonded to the rack through the equipment mounting flanges using green thread-forming grounding screws with serrations under the head to cut through paint, coatings and oxidation that may be present on the equipment flange. Such equipment shall have minimally one grounding screw per piece of equipment.
10. Existing (installed) racking systems containing live active equipment may be retrofitted for Standards-compliant bonding using rack retrofitting kits listed in the "Materials" section of this document.
11. The following illustration demonstrates how the racks shall be bonded:

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3.2 FIELD QUALITY CONTROL

- A. On installations confined to a single telecommunications room, the installing contractor shall visually verify continuity of communications bonding system from equipment, through racking systems, to overhead or underfloor backbone to the wall mounted busbar in that telecommunications room.
- B. Contractor shall further verify the use of all appropriate bonding accessories in the racking systems such as grounding washers, thread-forming grounding screws and the presence of electro-static discharge ports and wrist straps within reach of all equipment to be maintained.
- C. On greenfield (new) projects involving installation of a building-wide telecommunications backbone, installing contractor is further responsible for visually verifying sizing and sound installation of the telecommunications bonding backbone

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including presence of properly sized and installed grounding equalizer conductors between backbones contained in separate risers.

- D. Inspecting Contractor shall verify that any conduit longer than 3 feet through which a grounding conductor passes is properly bonded to the grounding conductor as described in this document.
- E. During inspections, Contractor shall verify compliance with all stipulations specified in this document and compliance with all regulatory references (Standards and Codes) cited.
- F. All opens or gaps in the bonding system during final inspections will be recorded in the inspection report and remedied.
- G. During inspections, contractor shall check all grounding and bonding system conductors and connections for tightness and proper installation, including checking proper dies were used on compression taps and fittings by checking embossed die numbers on those connections.
- H. Owner may request a test of 10% of bonded connections within the grounding system with a volt-ohm meter. Resistance tests taken on either side of a compression or exothermic bond shall be less than 0.2 (2/10) of one ohm in resistance.
- I. Bonded joints to be tested may be random or individually tagged by the Owner.
- J. Contractor shall test system at bonded points indicated and provide results in report form.
- K. Based upon test results, Owner reserves the right to request testing on 100% of exothermic and compression bonds within the installed grounding system.
- L. All bonded connections failing the test described above shall be remedied and retested by the installation contractor at Contractor's expense.

3.3 IDENTIFICATION AND ADMINISTRATION

- A. Secondary Bonding Busbar (SBB): Label with "SBB".
- B. Bonding Conductor (BC): Label with "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!" Labels shall be affixed at both ends and at accessible intermediate points.

END OF SECTION

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SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor Shall Provide and Install

1. The materials and labor required for the installation of cable pathway systems include, but are not limited to:
 - a. Conduits and boxes
 - b. Non-continuous cable supports
2. Although such work is not specifically mentioned herein or on the Drawings, the Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, without claim for additional payment.

B. Related Sections:

1. Section 000000 – Procurement and Contracting Requirements
2. Section 010000 – General Requirements
3. Section 260526 – Grounding and Bonding for Electrical System
4. Section 260533.13 – Conduit for Electrical Systems
5. Section 260533.16 – Boxes for Electrical Systems
6. Section 270526 – Grounding and Bonding for Communications Systems
7. Section 270539 – Surface Raceway for Communications Systems
8. Section 271116 – Communications Room Equipment
9. Section 271323 – Backbone Cabling
10. Section 271513 – Horizontal Cabling
11. Section 271619 – Patch Cords
12. Section 272133 – Wireless Access Points

1.2 REFERENCES

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- A. Design, manufacture, test, and install telecommunications cabling networks per manufacturer's requirements and in accordance with latest revision of the NFPA-70 (the National Electrical Code®), state codes, local codes, requirements of Authorities Having Jurisdiction (AHJs), and the following standards, including the most current revisions, addenda, and any Technical Service Bulletins (TSB's) released at the time of bid, including the most recent editions and addenda of the following documents:
1. ANSI/TIA 568 series
 2. ANSI/TIA-569 Telecommunications Pathways and Spaces
 3. ANSI/TIA-606 Administration Standard for Telecommunications Infrastructure
 4. ANSI/TIA-607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
 5. ANSI/TIA-862 Structured Cabling Infrastructure Standard for Intelligent Building Systems
 6. ANSI/TIA-4966 Telecommunications Infrastructure Standard for Educational Facilities
 7. ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
 8. ASTM A 653 – Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process
 9. ASTM A 510 – Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
 10. ASTM A 641 – Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 11. IEC 61537 (2006) – Cable Tray Systems and Cable Ladder Systems for Cable Management
 12. ASTM D 3363 - 05 Standard Test Method for Film Hardness by Pencil Test
 13. TIA-TSB-162 Telecommunications Cabling Guidelines for Wireless Access Points
 14. Telecommunications Distribution Methods Manual
 15. Information Transport Systems Installation Methods Manual (ITSIMM)
- B. California Electrical Code (CEC)
- C. OSHA Standards and Regulations
- D. Local Codes and Standards
- E. UL 444 – Standard for Safety of Communications Cable

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- F. UL 514C – Standard for Safety for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
- G. UL 943 – Ground-Fault Circuit-Interrupters
- H. UL 1449 – Surge Protective Devices
- I. UL 1666 – Standard for Safety of Flame Propagation Height
- J. UL 1682 – Safety Standard for Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type
- K. Local Authority Having Jurisdiction (AHJ)
- L. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either
- M. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense

1.3 SYSTEM DESCRIPTION

A. Pathways

- 1. Pathways are the support system for the infrastructure. All pathways shall conform to the TIA-569-B Commercial Building Standard for Pathways and Spaces. All horizontal and backbone cable shall be properly supported every 48" to 60" inches. Infrastructure Support Systems include, but may not be limited to, the following:
 - a. Conduits, both inside or outside, both above ground or underground, all of which shall be properly supported
 - b. Non-continuous cable supports, which shall be spaced no more than 60" inches apart
 - c. Non-metallic Pathway to separate copper and fiber cables

PART 2 - PRODUCTS

2.1 CONDUITS AND BOXES

- A. Refer to Division 26 Specifications.

2.2 NON-CONTINUOUS CABLE SUPPORTS

- A. Non-continuous cable supports must:
 - 1. Have a cable-bearing surface on the bottom that is at least equal to the full radius of the cable

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2. Maintain complete horizontal and vertical bend radius control of 1 inch
 3. Have 90° radius edges to prevent damage while installing cables
 4. Be designed so that the mounting hardware is recessed to prevent cable damage
 5. Have a removable and reusable hook and loop retainer to contain the cables within the hook
 6. Be factory-assembled for direct attachment to walls, hanger rods, beam flanges, purlins, struts, floor posts, etc. as needed for various on-site conditions
 7. Be manufactured from a non-conductive material suitable for use in air-handling spaces
- B. Provide separate cabling compartments or where additional capacity is needed, multi-tiered non-continuous cable supports shall be used.
- C. Manufacturer:
1. nVent Caddy
 2. Panduit
 3. Or equal

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide any necessary screws, anchors, clamps, tie wraps, support hardware, etc. necessary to facilitate the installation of the identification communication system.
- B. Furnish any special installation equipment or tools necessary to properly complete the installation.
- C. Failure to follow the appropriate guidelines may require the installer to provide additional material and labor required to bring the installation back into alignment with the guidelines and to correct, any and all, damage to the cables by the installer during the implementation.
- D. All techniques and fixtures used in the installation must allow for easy maintenance of, and ready access to, all components for test measurements.
- E. No self-tapping screws shall be used.

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- F. All parts shall be made of corrosion resistant material, such as plastic, anodized aluminum or brass.
- G. All materials used in installation shall be resistant to fungus growth and moisture deterioration.
- H. All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

3.2 NON-CONTINUOUS CABLE SUPPORTS

- A. The use of non-continuous cable supports as a primary pathway is not permitted.
- B. Non-continuous cable supports shall be used to support horizontal cables from the point of their exit from the main pathway (conduit) to the point of termination.
- C. Follow the manufacturer's recommendations for allowable fill capacity for each size of non-continuous cable support.
- D. Installation and configuration of non-continuous cable supports shall conform to the requirements of the ANSI/EIA/TIA Standards 568-C and 569-B, NFPA 70 (National Electrical Code), and applicable local codes.
- E. Non-continuous cable supports shall be placed straight, following building lines on 48" to 60" (1200 mm to 1500 mm) centers.
- F. Non-continuous cable supports shall be installed every 48" to 60", with a maximum sag of 6".
- G. At no point shall cables rest on acoustic ceiling grids or panels.
- H. Cables shall be supported within 12" of any conduit or raceway entrance.
- I. Non-continuous cable supports shall be attached to walls, purlins, beams, threaded-rod, or other components in strict compliance with all manufacturer Instructions and as directed by the Authority Having Jurisdiction (AHJ).

END OF SECTION

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SECTION 27 05 39 - SURFACE RACEWAY FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. The supply, delivery, supervision, coordination, and installation of equipment items specified herein and shown on the Drawings
2. The documentation and instruction for completing the installation of Surface Raceway Systems.

B. Contractor Shall Provide and Install

1. The materials and labor required for the installation of cable pathway systems include, but are not limited to:
 - a. Surface Raceway
2. Although such work is not specifically mentioned herein or on the Drawings, the Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, without claim for additional payment.

C. Related Sections:

1. Section 000000 – Procurement and Contracting Requirements
2. Section 010000 – General Requirements
3. Section 260526 – Grounding and Bonding for Electrical System
4. Section 270526 – Grounding and Bonding for Communications Systems
5. Section 271513 – Horizontal Cabling
6. Section 271619 – Patch Cords
7. Section 272133 – Wireless Access Points

1.2 REFERENCES

- A. Design, manufacture, test, and install telecommunications cabling networks per manufacturer's requirements and in accordance with latest revision of the NFPA-70 (the National Electrical Code®), state codes, local codes, requirements of Authorities

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Having Jurisdiction (AHJs), and the following standards, including the most current revisions, addenda, and any Technical Service Bulletins (TSB's) released at the time of bid, including the most recent editions and addenda of the following documents:

1. ANSI/TIA 568 series
2. ANSI/TIA-569 Telecommunications Pathways and Spaces
3. ANSI/TIA-606 Administration Standard for Telecommunications Infrastructure
4. ANSI/TIA-607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
5. ANSI/TIA-862 Structured Cabling Infrastructure Standard for Intelligent Building Systems
6. ANSI/TIA-4966 Telecommunications Infrastructure Standard for Educational Facilities
7. ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
8. ASTM A 653 – Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process
9. ASTM A 510 – Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
10. ASTM A 641 – Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
11. IEC 61537 (2006) – Cable Tray Systems and Cable Ladder Systems for Cable Management
12. ASTM D 3363 - 05 Standard Test Method for Film Hardness by Pencil Test
13. TIA-TSB-162 Telecommunications Cabling Guidelines for Wireless Access Points
14. Telecommunications Distribution Methods Manual
15. Information Transport Systems Installation Methods Manual (ITSIMM)
- B. California Electrical Code (CEC)
- C. OSHA Standards and Regulations
- D. Local Codes and Standards
- E. UL444 – Standard for Safety of Communications Cable

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- F. UL 1666 – Standard for Safety of Flame Propagation Height
- G. Local Authority Having Jurisdiction (AHJ)
- H. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either
- I. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense

1.3 SYSTEM DESCRIPTION

A. Surface Raceway

- 1. Surface Raceway refers to a surface raceway system used for branch circuit wiring and/or data network, voice, video and other low-voltage cabling.
- 2. Surface raceway shall be used in solid wall and/or slab floor applications or for applications where moves, adds and changes are very typical to the workflow.

PART 2 - PRODUCTS

2.1 MULTI-CHANNEL RACEWAY

A. Raceway shall have the following attributes:

- 1. A two-piece design with a base and a cover
- 2. Base shall have a hinge attaching the cover to the base
- 3. Two channels
- 4. Available in 6", 8' and 10' sections
- 5. Tamper resistant characteristics inherit with the design of the latch
- 6. Raceway manufactured of rigid PVC compound and have a smooth texture
- 7. Available in three colors: off-white (IW), electric ivory (EI), and white (WH)

B. Fittings

- 1. A full complement of fittings must be available including but not limited to flat, internal and external elbows, divided tees and entrance fittings, couplers, and end caps.

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2. The fittings shall be manufactured from a rigid PVC (or ABS/PC) compound and a matte texture and they shall overlap the raceway to hide any uneven cuts
3. Available in three colors: off-white (IW), electric ivory (EI), and white (WH) to match the raceway.

C. Accessories

1. Junction boxes and faceplates shall be available for mounting standard devices.
2. The junction boxes shall be available in standard, deep, and extra deep versions.
3. The faceplates shall allow for terminating of standard electrical devices, both duplex and rectangular styles.
4. The faceplates must be designed to accept Panduit communications modules for data terminations. The faceplates may accommodate up to 6 jacks and shall be modular in design to accept UTP-type of connector.
5. They shall be available in off-white (IW), electric ivory (EI), and white (WH) to match the raceway.

D. Manufacturer:

1. Legrand Wiremold
2. Commscope
3. Panduit
4. Or equal

2.2 SINGLE CHANNEL RACEWAY

A. Raceway shall have the following attributes:

1. A one-piece base and cover design
2. The raceway shall have an integral hinge attaching the cover to the base.
3. The base and cover shall be manufactured of a rigid PVC compound.
4. The raceway and all system components must exhibit non-flammable self-extinguishing characteristics, tested to comparable specifications of UL94V-0
5. The raceway shall have a smooth texture and be available in three colors: off-white (IW), electric ivory (EI), and white (WH).

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B. Fittings

1. A full complement of fittings must be available including but not limited to flat, internal and external elbows, divided tees and entrance fittings, couplers, and end caps.
2. Applicable fittings shall be of either cover only design or cover & base design if required to provide bend radius control.
3. The fittings shall be manufactured from high impact polystyrene (HIPS).
4. The fittings shall have a matte texture and be available in three colors, off-white (IW), electric ivory (EI), and white (WH) to match the raceway.
5. They shall overlap the raceway to hide uneven cuts.

C. Accessories

1. Junction boxes and faceplates shall be available for mounting standard devices.
2. The junction boxes shall be available in standard, deep, and extra deep versions.
3. The faceplates shall be designed to accept communications modules for data terminations. The faceplates may accommodate up to 6 jacks and shall be modular in design to accept UTP-type of connectors.
4. They shall be available in off-white (IW), electric ivory (EI), and white (WH) to match the raceway.

D. Manufacturer:

1. Legrand Wiremold
2. Commscope
3. Panduit
4. Or equal

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide any necessary screws, anchors, clamps, tie wraps, support hardware, etc. necessary to facilitate the installation of the Surface Raceway systems.

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- B. Furnish any special installation equipment or tools necessary to properly complete the installation.
- C. Failure to follow the appropriate guidelines may require the installer to provide additional material and labor required to bring the installation back into alignment with the guidelines and to correct, any and all, damage to the cables by the installer during the implementation.
- D. All techniques and fixtures used in the installation must allow for easy maintenance of, and ready access to, all components for test measurements.
- E. All the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact horizontal, feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

3.2 INSTALLATION

- A. On brownfield installations, Contractor shall match raceway to that already installed in the facility unless instructed otherwise in project-specific documentation.
- B. On Greenfield installations where there are solid block walls, walls that are otherwise impenetrable due to historic protection, hazardous materials or project documentation requires cable to be surface-mounted in the work area; horizontal cable shall be routed through the appropriate raceway.
- C. Contractor is responsible to size raceway to accommodate not less than 35% fill upon installation, per manufacturer fill tables, providing room for at least 50% growth in additional cables: i.e. a work area requiring 4 cables, raceway shall be sized to hold 6, etc.
- D. Contractor is responsible that raceway installation includes all associated fittings, drop ceiling fittings, couplers and 1" control-bend-radius fittings.
- E. Contractor shall not rely on the pressure sensitive adhesive foam to mount raceway, but rather use adhesive to hold raceway in place while screwing down the raceway to the structure beneath using anchors appropriate to the wall type at intervals not to exceed 2 ft. (24 inches).

END OF SECTION

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SECTION 27 05 53 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. The supply, delivery, supervision, coordination, and installation of equipment items specified herein and shown on the Drawings.
2. The documentation and instruction for completing the Identification for Communication Systems.

B. Related Sections:

1. Section 000000 – Procurement and Contracting Requirements
2. Section 010000 – General Requirements
3. Section 260526 – Grounding and Bonding for Electrical System
4. Section 270526 – Grounding and Bonding for Communications Systems
5. Section 270528 – Pathways for Communications Systems
6. Section 271116 – Communications Room Equipment
7. Section 271323 – Backbone Cabling
8. Section 271513 – Horizontal Cabling
9. Section 271619 – Patch Cords
10. Section 271700 – Testing of Structured Cabling Systems
11. Section 272133 – Wireless Access Points

1.2 SYSTEM DESCRIPTION

- A. The Contractor will provide and install identification labeling for the project's communications systems, including all components from the TR to the work outlet and between telecommunications spaces.
- B. Identification

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1. In addition to the general requirements above, the Contractor shall submit the following additional data:
 - a. Cable identification numbers scheme for all installed items.
 - b. Cable identification matrix

PART 2 - PRODUCTS

2.1 LABELING

- A. Labels shall be compliant with Owner's labeling standards.
- B. Handwritten labels will be rejected.
- C. Comply with TIA-606 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- D. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.
- E. Label shall be black typeface on white tape.
- F. Manufacturer:
 1. Brother PT-D400
 2. Or equal

2.2 COMMUNICATIONS ROOM EQUIPMENT

- A. Refer to Owner's labeling standards.
- B. Refer to 27 11 16 for additional requirements.
- C. Label components where they are administrated (i.e. punch down points, panels, wall blocks, faceplates, etc.)
- D. Fiber enclosures shall clearly indicate type of fiber cable terminated: singlemode or multimode.

2.3 CABLE LABELS

- A. Refer to Owner's labeling standards.
- B. Cables labels are identified with information that defines the connection between the near end panel connection and the far end panel connection.

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- C. Label cables within 3" from termination on both ends of cable. Label shall match faceplate label.
- D. Label fiber cables 12" from where cable enters enclosure with a label that identifies the cable's origin and destination.
 - 1. Label corresponding fiber strand pairs.
 - 2. Labels shall note the strand's color, origin, and destination. Origin and destination shall include room name.
- E. The near end connection is the connection that is closest to the Main Distribution Area (MDA) in the network topology. A near end connection identifier would consist of the cabinet/rack location, panel location, and port location.
- F. The far end connection identifier would consist of the cabinet/rack location, panel location, and port location.
- G. A typical cable label would have information in the following scheme:
 - 1. This identifier would be decoded to define the cable connects between cabinet AB04 panel 24 port 01 going to cabinet AB07 panel 36 port 13. The far end of the cable would have a label that would have the same information.

2.4 PATCH CORD/EQUIPMENT CORD LABELS

- A. Refer to Owner's labeling standards.
- B. Refer to 27 16 19 for additional requirements.
- C. Patch cord/equipment cord labels are identified with information that defines the connection between the near end patch panel front connections and the far end patch panel front connections or equipment connections.
- D. A near end connection identifier would consist of the cabinet/rack location, panel location, and port location.
- E. The far end connection identifier would consist of the cabinet/rack location, panel location, and port location.

2.5 GROUNDING AND BONDING

- F. Refer to Owner's labeling standards.
- A. Refer to 27 0526 for additional requirements.
- B. Labeling of the Ground and Bonding system involves the identifications of the Conductors Connecting Devices to Busbars.

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- C. The typical scheme for the secondary busbar connections would be:

2-R201-SBB

1. This identifier can be decoded to define that this is the conductor that connects the primary bonding busbar located on floor 1 in space B301 to the secondary bonding busbar on floor 2 in space R201.

2.6 WIRELESS ACCESS POINT LABELS

- G. Refer to Owner's labeling standards.
- H. Provide unique alphanumeric identifier.

2.7 CAMERA LABELS

- I. Refer to Owner's labeling standards.
- J. Provide unique alphanumeric identifier.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide any necessary screws, anchors, clamps, tie wraps, support hardware, etc. necessary to facilitate the installation of the identification communication system.
- B. Furnish any special installation equipment or tools necessary to properly complete the installation.
- C. Failure to follow the appropriate guidelines may require the installer to provide additional material and labor required to bring the installation back into alignment with the guidelines and to correct, any and all, damage to the cables by the installer during the implementation.
- D. All techniques and fixtures used in the installation must allow for easy maintenance of, and ready access to, all components for test measurements.
- E. No self-tapping screws shall be used.
- F. All parts shall be made of corrosion resistant material, such as plastic, anodized aluminum or brass.
- G. All materials used in installation shall be resistant to fungus growth and moisture deterioration.

3.2 SYSTEM ADMINISTRATION

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- A. All components of the installed system shall be uniquely identified by location, function, unit, and sub-unit.
- B. Each location shall be identified by a unique alphanumeric identifier.
- C. Each equipment enclosure in the building shall be assigned a unique alphanumeric identifier.
- D. Each adapter module installed in each distribution or interconnect enclosure shall be identified by an alphanumeric identifier.
- E. All conduits, and pathways shall be identified by a unique alphanumeric identifier.
- F. Optical fiber cables shall be identified by a textual label, which indicates its type, strand count, point of origin, and termination
- G. Supply all records in compliance with ANSI/TIA-606.
- H. Provide a database, compliant with Open Database Connectivity (ODBC), for administration of the Structured Cabling System described herein.

3.3 IDENTIFICATION

- A. Prior to the installation or termination of cabling, confirm all specific labeling requirements with the Owner or the Owner's Engineer.
- B. Cables
 - 1. Mark backbone cables at each endpoint and at all intermediate pull points, access points, and junction boxes. Labels shall indicate the origination and destination identifier, the sheath identifier, and the strand or pair range.
 - 2. Horizontal cables shall be marked at each end, on the sheath indicating the TR, patch panel and panel port to which the cable is wired.
- C. Faceplates, Patch Panels
 - 1. Label patch panels alphabetically or numerically. Individual ports shall come from the factory pre-labeled with a general number designation.
 - 2. Label each faceplate to indicate, for each cable that it houses, the TR, patch panel, and panel port to which the cable is wired.
 - 3. Fit each cable with a self-laminating label, bearing the appropriate cable identifier, that surrounds the outermost jacket. Place the label at each end of the cable, within 3 inches (75 mm) of the end of the sheath.

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4. Fit each equipment enclosure with a self-adhesive label bearing its respective identifier, affixed to the top center of the front and rear doors.
5. Fit each adapter inside enclosures with a label bearing its identifier, affixed directly adjacent to its shortest side. Rotate characters so that their orientation is kept left to right, top to bottom.
6. Label conduits and pathways within 0.5 m (18 inches) of each end, where exposed and accessible. It is recommended that additional labeling be provided every 3 m (10 feet) of exposed length.
7. Fit network equipment with a label, placed in an accessible area on the front and rear, bearing the appropriate identifier, MAC address, and date of installation. The label shall not interfere with the operation of or interface to the unit, nor shall it obscure manufacturer's labels.

END OF SECTION

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SECTION 27 11 16 - COMMUNICATIONS ROOM EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor Shall Provide and Install

1. The Contractor shall furnish and install telecommunications passive equipment, including:
 - a. Racks
 - b. Patch Panels
 - c. Cable Management
 - d. Uninterruptible Power Supplies
2. Although such work is not specifically mentioned herein or on the Drawings, the Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, without claim for additional payment.
3. The Contractor shall provide system demonstration, system documentation, and instruction of Owner personnel, without claim for additional payment.

B. Related Sections:

1. Section 000000 – Procurement and Contracting Requirements –
2. Section 010000 – General Requirements
3. Section 260526 – Grounding and Bonding for Electrical Systems
4. Section 270500 – Common Work Results for Communications
5. Section 270526 – Grounding and Bonding for Communications Systems
6. Section 270553 – Identification for Communications Systems
7. Section 271116 – Patch Cords

1.2 SYSTEM DESCRIPTION

- C. This document describes the products and execution requirements relating to furnishing and installing Communications Equipment Room Fittings.

PART 2 - PRODUCTS

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2.1 RACKS

- A. Racks shall be used to provide a neat and efficient means for routing and protecting cables, patch cords and power cables in cabinets for server applications.
- B. Racks shall have provisions for routing cables from overhead, and shall accept horizontal cable managers, and cable management accessories used throughout the cabling system.
- C. Racks and accessories shall be provided to support Owner's requirements.
- D. Provide mounting accessories.
- E. Racks shall have the following attributes:
 - 1. Black powder coated and constructed of steel
 - 2. Adjustable front and rear cage nut equipment rails with rail position markers
 - 3. Rack unit markers
 - 4. 45 Rack units
 - 5. Single point bonding at top and bottom of cabinet
 - 6. Floor mount brackets
 - 7. 19" loading width
- F. Manufacturer:
 - 1. CPI
 - 2. Or equal

2.2 COPPER PATCH PANELS

- A. Patch panels for modular field termination of Category 6 Unshielded Twisted Pair (UTP) cable shall:
 - 1. Be flat modular components with a maximum capacity of 48 connections per RU
 - 2. Made of a steel frame with black powder coat finish
 - 3. Have space on the front for labeling and identification
 - 4. Accept a variety of media and connectivity components, including UTP, optical fiber, and audio/visual components

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5. Be made by an ISO 9001 Certified Manufacturer
6. CAT6 Patch Panel Manufacturer:
 - a. CommScope
 - b. Panduit
 - c. Or equal

2.3 FIBER DISTRIBUTION ENCLOSURES

A. Fiber distribution enclosures shall:

1. Have slide out tray with front and rear metal covers.
2. Have front and rear openings designed to allow room for cable entry and exit and also help minimize cable build-up.
3. Be made of high-quality material and fold-edge design allow for strength and durability.
4. Be designed to fit in standard 19" racks and cabinets.
5. Hold up to 12 fiber optic adapter panels or 12 cassettes.
6. Accept 5 splice trays.
7. Have transparent front window for visibility that allows monitoring and troubleshooting with the enclosure closed.
8. Be 4RU.

B. Manufacturer:

1. CommScope
2. Panduit
3. Or equal

2.4 FIBER PATCH PANELS

- ### A. A connector panel is a modular removable plate containing optical fiber connector adapters or copper jacks.

B. Optical fiber couplers shall have:

1. A modular unit of the same manufacture as the Fiber Distribution Enclosures and shall have keyed openings on the front and rear to provide proper alignment of the connectors.

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2. Couplers will be factory-installed to maintain an appropriate A-B orientation throughout the optical link.
3. Couplers will be aqua with ceramic alignment sleeves for 50 μ m graded-index optical fiber and blue for single-mode.

C. Connector Panels

1. Connector panels shall:
 - a. Be manufactured from 16-gauge cold-rolled steel or injection molded polycarbonate for structural integrity
 - b. Be finished with a black powder-coat texture to match other hardware
 - c. Have a single mounting footprint
 - d. Be available twelve, or twenty-four connector adapters in each panel for a maximum of to 72 connectors per panel.
 - e. Be both rack-mountable and wall-mountable
 - f. Be attached with two push-pull latches to allow for quick installation and removal
 - g. Be available with industry standard single-fiber and small form factor multi-fiber TIA/EIA 604 10A (LC) adapters.
 - h. Include removable icons that identify the circuits, including blank, telephone, computer, CATV, video camera, satellite dish, or CAT 6/6A, and in colors including blue, yellow, red, white, electric ivory, ash, green, purple, gray, black, brown, and orange

D. Blank Connector Panels

1. Blank connector panels shall be available to fill unused space in the housings. The blank connector panels shall be:
 - a. Attached with at least two push-pull latches to allow for quick installation and removal
 - b. Manufactured from injection molded polycarbonate
 - c. Finished with a wrinkled black texture to match the housing

E. Manufacturer:

1. Corning

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2. CommScope

3. Panduit

4. Or equal

2.5 HORIZONTAL CABLE MANAGEMENT

- A. Horizontal cable management devices will provide containment and concealment of interconnect or equipment cordage in an enclosure or rack, guide patch and equipment cords between the vertical cable manager and individual connections and allow access for cables without blocking the jacks
- B. The horizontal cable manager will be of an appropriate size to accommodate cabling requirements. A single horizontal cable manager may be used to support multiple patch panels, if it can accommodate cable fill requirements.
- C. The horizontal cable manager shall:
 - 1. Be manufactured of composite materials
 - 2. Have a color that matches the rack or enclosure
 - 3. Provide 1 RU of horizontal cable management for every RU of connectivity
 - 4. Match the rack-mount width of the racks, frames, or cabinets that it serves
 - 5. Attach to the front or rear of the equipment mounting rail with screws and will be of a size that fits within standard EIA 310 spacing
 - 6. Fitted with a removable cover, hinged to open up or down, that will snap on to secure the cover in the closed position
 - 7. Have bend-limiting slots or holes at the rear to facilitate front-to-rear cabling through the horizontal manager
 - 8. Have bend-radius-controlling T-shaped or L-shaped cable guides, along the top and bottom surfaces
 - 9. Have evenly-spaced cable openings, with rounded edges to protect cables, between the cable guides to allow cables to enter and exit the cable manager in a neat and orderly fashion
- D. Manufacturer:
 - 1. CommScope 360 DM Series

2.6 UNINTERRUPTIBLE POWER SUPPLY

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- E. UPS will provide temporary power in the event of a power outage until emergency is activated or main building power is restored.
- F. UPS will be sized to accommodate power loads of the systems it serves with an 8-hour runtime.
- G. Accessories will be provided for installation.
- H. UPS shall:
 - 1. Be rack-mounted
 - 2. Be viewable and configurable via web management software
 - 3. Be 3kVA
- I. Manufacturer:
 - 1. APC Smart UPS
 - 2. Or equal

PART 3 - EXECUTION

3.1 RACKS

- A. Provide all components of the rack system (racks, front and rear doors, side panels, mounting rails, cable managers, power strips, and accessories) as specified elsewhere in this Section and other referenced sections.
- B. Position the rack so that the front and rear doors and the rack body (as applicable) can be fully opened without being obstructed by other building, storage, or architectural components.
- C. Follow the manufacturer's installation instructions when securing the rack to the floor.
- D. On floor-supported cabinets, the wheeled base must contact the floor. The wheeled base should not be removed or omitted from the installation.
- E. Do not attach the rack to gypsum wall board.
- F. Before installing equipment in the rack:
 - 1. Install and adjust the position of all accessories, including vertical cable managers, power strips, equipment-mounting rails, fan kits, lights, etc.
 - 2. Verify that fans, lights, and power strips work prior.

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- G. If shelves are used, they may be installed with the equipment.
- H. Provide a telecommunications bond for equipment in the rack.
- I. Attach a vertical busbar to the equipment mounting rails to provide electrical continuity from the equipment to the SBB or Mesh-BN through the enclosure.
- J. The ground shall meet TIA 607-C, local code requirements and shall be approved by the Authority Having Jurisdiction (AHJ).

3.2 PATCH PANELS

- A. Install patch panels in the equipment racks/cabinets as identified by the Owner. Locate fiber patch panels at the top of the rack/cabinet.
- B. Install patch panels square and plumb and fasten them to the mounting rails in four places using manufacturer-supplied screws, with at least one fastener at each corner.
- C. Install horizontal cable support bars at the rear of all patch panels as indicated on the manufacturer's instructions.
- D. Attach all accessories supplied with the panels per the manufacturer's instructions.
- E. Fully load copper patch panels with jacks.
- F. Restore all covers, panels, label holders, and accessories removed during the installation of panels to their original places and states.
- G. On the front and rear of each patch panel, place a machine-generated, self-adhesive white label bearing the panel's identifier, as listed in the submittals, in black ½ inch block letters.

3.3 CABLE MANAGEMENT

- A. Place and install all horizontal wire and cable management devices and assemblies so as not to impede the efficient use of or connection to adjacent panels, enclosures, or equipment.
- B. Upon completion of the task, replace all covers, doors, and panels that were removed during the installation.
- C. Horizontal Cable Managers
 - 1. When more than one horizontal cable manager is used on a rack, frame, or cabinet, or on a group of racks, frames, or cabinets, use the same make and style cable manager.
 - 2. The color of the cable managers must match the color of the racks or frames.

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3. Attach horizontal cable managers to the rack, frame, or cabinet with four screws according to the manufacturer's installation instructions. Each cable manager should be centered in the allocated rack-mount space.
4. Place horizontal managers so that the number of ports (cables) they support will not exceed the cable fill capacity of the cable managers.
5. After cabling is complete, attach the covers to the cable managers in the closed position.
6. Install equipment rack horizontal cable and wire management panels directly adjacent to (above and below) all distribution enclosures, patch panels, and termination hardware in the rack as depicted in the appropriate project Drawings.

3.4 WIRING PRACTICES

- A. Where specific instructions are not given, perform all wiring in strict adherence to standard industry practices as described in the referenced Telecommunications Distribution Methods Manual (TDMM), and ANSI/TIA-568 standards.
- B. All cables shall originate and terminate at active or passive devices. Cables shall not be spliced. Where several devices are in close proximity, use approved housing to housing connectors and adapters.
- C. All cables terminated in a connection plate mounted in an enclosure shall be dressed to allow cables to be removed from the enclosure and shall be of sufficient cable length to allow for service or re-termination. The plate shall either set on the floor or freely swing clear.

3.5 IDENTIFICATION

- A. Uniquely identify all components of the installed system by location, function, unit, and sub-unit.
- B. Identify each location with a unique alphanumeric identifier.
- C. Assign a unique alphanumeric identifier for each equipment enclosure in the building.
- D. Identify each adapter module in each distribution or interconnect enclosure with an alphanumeric identifier.
- E. Identify optical fiber cables by a textual label that indicates its type, strand count, point of origin, and termination.
- F. Supply all records in compliance with ANSI/TIA 606.

END OF SECTION

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SECTION 27 13 23 – BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Contractor Shall Provide and Install
 - 1. The Contractor shall furnish and install telecommunications passive equipment, including:
 - a) Backbone fiber optic cable
- B. Related Sections:
 - 1. Section 000000 – Procurement and Contracting Requirements
 - 2. Section 010000 – General Requirements
 - 3. Section 260526 – Grounding and Bonding for Electrical Systems
 - 4. Section 270526 – Grounding and Bonding for Communications Systems
 - 5. Section 270528 – Pathways for Communications Systems
 - 6. Section 270539 – Surface Raceway for Communications Systems
 - 7. Section 270553 – Identification for Communications Systems
 - 8. Section 271619 – Patch Cords
 - 9. Section 271700 – Testing of Structured Cabling Systems

1.2 SYSTEM DESCRIPTION

- A. The Contractor will provide, install, and test a complete structured cabling system for the project's voice and data communications systems in between the Telecommunications Room (TR). The Contractor will provide and install all required components as identified below.
 - 1. Fiber optic backbone cabling includes backbone cable, connectors in the Technology rooms or adjacent to active equipment, and patch cords or jumpers.

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2. Copper backbone cabling includes backbone cable, connectors in the Technology rooms or adjacent to active equipment, and patch cords or jumpers.

PART 2 - PRODUCTS

2.1 OPTICAL FIBER CABLE PERFORMANCE

- A. Shall comply with Owner's standards.
- B. Where not included in standards, Contractor shall provide as specified below.
- C. Optical Fiber Strands
 1. All optical fibers shall:
 - a) Be usable and shall meet required specifications.
 - b) Be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification.
 - c) Consist of a doped silica core surrounded by a concentric glass.
 - d) Be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m²).
 - e) Be coated with a dual layer acrylate protective coating that is in physical contact with the cladding surface.
 - f) Have a maximum attenuation value for each cabled fiber at 23°C ± 5°C on the original shipping reel.
- D. Graded Index (50/125 µm OM4)
 1. The multi-mode fiber utilized in the OM4 optical fiber cable shall meet TIA 492AAAD "Detail specification for OM4 850-nm laser-optimized, 50-µm core diameter/125 µm cladding diameter class 1a graded-index multimode optical fibers." The fibers shall have:
 - a) A core diameter of 50.0 µm ± 2.5 µm.
 - b) Core non-circularity of no more than 5%.
 - c) A cladding diameter of 125.0 µm ± 1.0 µm.

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- d) Cladding non-circularity of no more than 1.0%.
- e) Core-to-cladding concentricity of no more than 1.0 μm .
- f) A coating diameter of 250 μm , plus optional 900 μm buffer.
- g) A refractive index core (graded index).
- h) A numerical aperture of 0.200 ± 0.015 .
- i) Maximum attenuation of 2.3 dB/km at 850 nm and 0.6 dB/km at 1300 nm.
- j) IEEE 802.3ae performance that supports laser-based 10 Gigabit Ethernet (10GbE) operation in the 10GBASE-SR/SW (850 nm) to a maximum distance of 550 meters and 10GBASE-LX/LX4 (1300 nm) to a maximum distance of 300 meters.
- k) A minimum LED bandwidth of 500/500 MHz•km at 850/1300 nm.
- l) Attenuation uniformity with no point discontinuities greater than 0.2 dB at either 850 nm or 1300 nm.
- m) Water peak attenuation with a coefficient at 1380 nm that does not exceed the attenuation coefficient at 1300 nm by more than 3.0 dB/km.
- n) Macrobend attenuation due to 100 turns of fiber around a 75 mm \pm 2 mm diameter mandrel that does not exceed 0.5 dB at 850 nm or 1300 nm.

E. Fiber Optic Cable Fire Ratings

- 1. Listed optical fiber backbone cable is acceptable for use on this project.

F. Fiber Optic Cable Termination

- 1. Where cables are installed, the 900 μm buffer, 250 μm coated fibers or ribbonized fibers contained in these cables may be terminated either by:
 - a) Fusion splicing of factory-polished splice-on connectors or factory-terminated cable assemblies ("pigtailed").
 - b) Cam-style mechanical splice connectors using a tool that provides calculated insertion loss at the point of termination

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- c) Individual fibers secured in a protective covering, such as an aramid-reinforced tube with connectors mated to the resulting assembly

G. Fiber Optic Cable Features

1. The size and configuration of fiber optic cables shall be as shown on the Drawings.
2. The buffered fibers shall be grouped in subunits of 6 or 12 fibers.
 - a) Subunits shall be stranded around a dielectric central member.
 - b) Layered aramid yarns shall serve as the tensile strength member of the subunit.
 - c) To facilitate jacket removal, a ripcord may be applied between the aramid yarns and the subunit jacket.
 - d) For physical and environmental protection, the subunit jacket shall be extruded over the aramid yarns.
 - e) The jacket shall be continuous and free from pinholes, splits, blisters, or other imperfections have a consistent, uniform thickness and be smooth, as is consistent with the best commercial practice
 - f) The subunits shall be stranded around a dielectric central member, a ripcord shall be inserted beneath the outer jacket to facilitate jacket removal, an outer jacket shall be extruded around the subunits.
3. An overall helically wound interlocking metallic armor shall be provided, to surround the outer cable jacket, to which a listed outer jacket shall be applied.
4. The individual fibers shall be color-coded for identification and shall meet these requirements:
 - a) The optical fiber color coding shall be in accordance with TIA-598-C, "Optical Fiber Cable Color-Coding."
 - b) The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers.

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- c) Color-coded buffered fibers shall not adhere to one another.
- 5. The overall jacket for graded index cables as specified herein shall be aqua for distribution cables, or black for indoor-outdoor rated cables.
- 6. The overall jacket for single-mode cables as specified herein shall be yellow for distribution cables, or black for indoor-outdoor rated cables.

2.2 BACKBONE FIBER OPTIC CABLE

- A. Refer to drawings for required cable and strand counts.
- B. Indoor Multimode OM4
 - 1. Color: Aqua
 - 2. Plenum rated, OFNP
 - 3. Manufacturer:
 - a) Corning MIC series
 - b) Siemon XGLO series
 - c) Commscope

2.3 CONNECTORS

- A. Shall comply with Owner's standards.

2.4 DISTRIBUTION ENCLOSURES AND CONNECTOR PANELS

- A. Enclosures are existing.
- B. Shall comply with Owner's standards.

PART 3 - EXECUTION

3.1 GENERAL

- A. Upon completion of work, a Registered Communications Distribution Designer (RCDD) shall submit as-built drawings to the Owner and Engineer.
- B. The Contractor shall input the cabling data into the cable management software.
- C. Install all cables in accordance with project Drawings.

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- D. Provide any screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc. needed to facilitate the installation of the cable plant system.
- E. Furnish any special installation equipment or tools required to properly complete the installation.
- F. Do not roll or store cable reels without an appropriate underlay.
- G. Failure to follow the appropriate guidelines may require the installer to provide the additional material and labor required to bring the installation back into alignment with the guidelines. This shall also apply to any and all damages caused to the cables by the installer during the implementation.
- H. Provide fire blocking at all fire-rated ceiling, wall, and floor penetrations.
- I. Plug conduits where cabling has been installed in the main equipment room, backbone and other cable entrance locations with re-enterable duct seal of flame-retardant putty.
- J. Provide bushings on all conduit ends.
- K. All wiring, materials, and equipment must be listed and labeled by an NRTL. To certify that performance characteristics, meet ANSI/TIA 568 Standards, provide all Original Equipment Manufacturer (OEM) documentation to the Owner.
- L. All techniques and fixtures used in the installation must minimize complexity must allow for easy maintenance of, and ready access to, all components for test measurements.
- M. No self-tapping screws shall be used.
- N. All parts shall be made of corrosion-resistant material, such as plastic, anodized aluminum, or brass.
- O. All materials used in the installation shall be resistant to fungus growth and moisture deterioration.
- P. To avoid corrosion caused by electrolysis between dissimilar metals under the environmental operating conditions specified, separate dissimilar metals with an inert dielectric material.
- Q. All empty innerduct or conduit shall include a non-corrosive pull-rope.

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- R. All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

3.2 BACKBONE FIBER OPTIC CABLE

- A. Install the optical fiber backbone in a continuous length from the FDE in the MC to an FDE within each TR.
- B. Throughout its length, run the backbone cable in appropriate, listed raceway.
- C. Leave a 3 m long maintenance loop at each end of the link, neatly contained in the integral management rings and saddles in a "figure 8" loop at the rear of the FDE.
- D. Throughout the length of the cable, maintain the minimum bend radius and pulling force recommended by the manufacturer and required by industry standards, both during installation and after termination and testing.
- E. On each end, remove all outer jacket and strength member materials to expose the individual fiber strands or ribbons for a length of 0.5 m (18 inches).
- F. On each end, hold the cable ends securely in place with the cable clamping accessories in each FDE.
- G. Route individual strands in the rear of the FDE in a neat and orderly fashion and place them so as not to create undue stress or micro bending of the strands.

3.3 CABLE BUNDLING MATERIALS

- A. Secure all cable bundles with proper bundling or securing materials so as to ensure that the cable runs are securely held in place both vertically and horizontally.
- B. Do not tighten bundling materials or securing devices so tightly that they deform the inherent cable geometry or construction.
- C. Do not use cable ties or hook-and-loop tape to secure cable runs to other building systems such as electrical conduit, Electric Metallic Tube (EMT), sprinkler pipes, ceiling suspension members.

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D. In environmental air-handling spaces, only use appropriately-listed materials.

END OF SECTION

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SECTION 27 15 13 - HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor Shall Provide and Install

1. The Contractor shall furnish and install telecommunications passive equipment, including:
 - a. Horizontal cable
 - b. Device connections

B. Related Sections:

1. Section 000000 – Procurement and Contracting Requirements
2. Section 010000 – General Requirements
3. Section 260526 – Grounding and Bonding for Electrical Systems
4. Section 270526 – Grounding and Bonding for Communications Systems
5. Section 270528 – Pathways for Communications Systems
6. Section 270539 – Surface Raceway for Communications Systems
7. Section 270553 – Identification for Communications Systems
8. Section 271116 – Communications Room Equipment
9. Section 271700 – Testing of Structured Cabling Systems
10. Section 272133 – Wireless Access Points

1.2 SYSTEM DESCRIPTION

- A. The Contractor will provide, install, and test a complete structured cabling system for the project's voice and data communications systems from the Telecommunications Outlet (TO) to the Telecommunications Room (TR), and between telecommunications spaces. The Contractor will provide and install all required components as identified below.

B. Horizontal Cabling

1. Horizontal cabling includes horizontal cable, telecommunications outlet/connectors in the Work Area (WA), mechanical terminations and patch cords or jumpers located in a Telecommunications Room (TR).

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PART 2 - PRODUCTS

2.1 HORIZONTAL UTP CABLE

A. Jacketing shall be rated for the environment:

1. CMP

B. Provide same manufacturer as existing system for new cabling.

C. Acceptable alternates:

1. Panduit TX series
2. Commscope Uniprise
3. Siemon
4. Legrand
5. Or equal

D. Category 6 Unshielded Twisted Pair Cable

1. Inside 4 pair horizontal cable for Owner's facilities shall be blue-jacketed plenum-rated Category 6 UTP Copper Cable.
2. In addition, plenum Category 6 UTP Copper Cable must meet the following mechanical and performance criteria:
 - a. Exceeds requirements of ANSI/TIA-568.2-D Category 6 and ISO 11801 2nd Edition Class E channel standards.
 - b. Exceeds requirements of ANSI/TIA-568.2-D and IEC 61156-5 Category 6 component standards.
 - c. Meets requirements of IEEE 802.3af, IEEE 802.3at and IEEE 802.3bt for PoE applications
 - d. Third party tested to comply with ANSI/TIA-568.2-D.
 - e. Cable diameter: Plenum 0.215 in. (5.2mm) nominal.
 - f. Installation temperature range: 32°F to 140°F (0°C to 60°C).
 - g. Operating temperature range: -4°F to 140°F (-20°C to 60°C).
 - h. Descending length cable markings enable easy identification of remaining cable which reduces installation time and cable usage.
 - i. Tested to meet or exceed 1 Gbps.

E. Cabling

1. CAT6, plenum-rated
 - a. Blue

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F. Jacks

1. CAT6, plenum-rated
 - a. Blue

G. Faceplates

1. Faceplates shall have the following attributes:
2. Be single-gang or double-gang
 - a. Supplied in colors and finishes coordinated with the [Insert Architect or Owner].
 - b. Have the capability for integral labeling and identification
 - c. Provide capacity for a maximum of four individual jacks for single-gang applications, and up to 8 individual jacks for double-gang applications
 - d. Provide blank inserts for unused ports.
3. Wall plates
 - a. 1-port, white
 - b. 2-port, white
 - c. 4-port, white
4. Floor boxes
 - a. 1-port, white
 - b. 2-port, white
 - c. 4-port, white
 - d. Blank
5. Surface-mount box
 - a. 2-port, white
 - b. 4-port, white

2.2 CABLE BUNDLING MATERIALS

A. Hook and Loop Tape

1. Provide hook and loop tape, that is at least 0.5 inches wide, of a length equal to 150% of the circumference of the cable bundle.
2. Tie wraps are not allowed on this project.
3. When used in areas considered environmental air spaces, all bundling materials must be appropriately listed.
4. Manufacturer:
 - a. Commscope
 - b. Or equal

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PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall input the cabling data into the cable management software.
- B. Install required cables, a faceplate/surface box/furniture insert, and a jack at each location designated on the Drawings.
- C. Provide any required screws, anchors, clamps, hook and loop, miscellaneous grounding and support hardware, etc. needed to facilitate the installation of the cable plant system.
- D. Furnish any special installation equipment or tools necessary to properly complete the installation.
- E. Do not roll or store cable reels without an appropriate underlay.
- F. Failure to follow the appropriate guidelines may require the installer to provide additional material and labor required to properly rectify the situation. This shall also apply to any and all damages caused to the cables by the installer during the implementation.
- G. Provide fire blocking at all fire rated penetrations.
- H. Plug conduits where cabling has been installed in the main equipment room, backbone, and other cable entrance locations with re-enterable duct seal of flame retardant putty.
- I. Provide bushings on all conduit ends.
- J. All techniques and fixtures used in the installation must minimize complexity and must allow for easy maintenance of, and ready access to, all components for test measurements.
- K. All materials used in installation shall be resistant to fungus growth and moisture deterioration.
- L. All cable runs must be continuous from patch panel to the outlet location.
- M. All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

3.2 WIRING PRACTICES

- A. Group and bundle all wiring by power level or signal type.

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- B. Wire all cabling to in accordance to ANSI/TIA-568B standards.
- C. Exercise care in wiring to avoid damaging the cables and equipment. Where conduit or chase nipples are not installed around cutouts or knockouts, use grommets.
- D. Where wiring of different classifications shares a common enclosure or junction box, provide metallic isolation barriers to completely electrically separate wiring groups.
- E. Coordinate with tradespeople in the field, and employ proper installation techniques, including earthing and bonding and adequate Electromagnetic Compatibility (EMC). The following table lists the distances that should be maintained between power sources and copper data cabling to avoid Electromagnetic Interference (EMI).

| Condition | <2kVA | 2-5kVA | >5kVA |
|--|-----------|-----------|-----------|
| Unshielded power lines or electrical equipment in proximity to open or non-metal pathways | 6 inches | 12 inches | 24 inches |
| Unshielded power lines or electrical equipment in proximity to grounded metal conduit pathway | 3 inches | 6 inches | 12 inches |
| Power lines enclosed in a grounded metal conduit (or equivalent shielding (in proximity to grounded metal conduit pathway) | 2 inches | 6 inches | 6 inches |
| Transformers and Electric Motors | 36 inches | 36 inches | 47 inches |
| Fluorescent lighting | 12 inches | 12 inches | 12 inches |

- 1. These guidelines apply to properly earth-bonded tray containing communications circuits in parallel with power circuits for a distance of 45 feet or more.
 - 2. Communications circuits, contained in properly-bonded, ventilated trough tray, shall not be placed in the same cable tray as power circuits.
- F. All cables shall originate and terminate at active or passive devices. Cables shall not be spliced. Where several devices are in close proximity, use approved housing to housing connectors and adapters.
- G. Strip and terminate cabling utilizing manufacturer's recommended tools. Pins, plugs, and terminals shall not be damaged.
- H. All cables terminated in a connection plate mounted in an enclosure shall be dressed to allow cables to be removed from the enclosure and shall be of sufficient cable length to allow for service or re-termination. The plate shall either set on the floor or freely swing clear.
- I. Cabling shall not be visible when walking through the facility. Cabling shall be in conduits, in cable tray, or in j-hooks above accessible ceiling.

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- J. All cables installed in vertical tray or chases shall be supported by means of appropriately-sized vertical cable supports on every third floor. Do not use nylon cable ties.
- K. Cables shall not be pulled across sharp edges. Provide protection where edges exist or manually grind down edges for a smooth, polished surface.
- L. Cables shall not be jammed between assemblies or equipment.
- M. Abide by manufacturer's pulling tension and bend radii.
- N. Cable Installation in Conduit
 - 1. Through the entire length of all underground conduits, pull mandrel that is one size smaller than the conduit.
 - 2. When pulling cable, use water-based pulling lubrication. Lubricants that harden after installation are not allowed.
 - 3. During long or difficult runs, use a dynamometer to measure pulling tension. Place the dynamometer between the cable puller and the pull line to monitor pulling tension. Do not exceed the manufacturer's maximum pulling tension.
 - 4. Apply pulling grips suitable for use with copper cables to the ends of the cable. Consult the cable manufacturer to determine the appropriate pulling grip and method of attachment. Use breakaway or fuse links at the pulling grip and ensure that the correct "fuse pin" is installed in the fuse link. Channel locks and pliers used for pulling are now allowed.
 - 5. To protect the cable ends until they are terminated, use cable caps (heat-shrinking type) to seal the ends of the cable.
 - 6. Use cable blocks to facilitate the bending of cable. For bends between 5° and 45°, use a 45° cable block. For bends between 45° and 90°, use a 90° cable block.
 - 7. The bend radius for all cables shall conform to manufacturer's specifications.

3.3 HORIZONTAL UTP

- A. Install horizontal cable in a continuous length from the point of origin to the point of termination. Group all cables and bundle them in the overhead pathways in a neat and workmanlike manner.
- B. The Contractor shall terminate and test all cables.
- C. The Contractor shall not exceed the manufacturer's maximum pulling tension.
- D. Splices are not allowed.

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- E. The Contractor shall make sure that all the materials being installed on this project are of the proper rating (Plenum or Riser) required for the pathways and spaces by local, state, and federal codes.
- F. No horizontal cables, including any required service loops, shall be more than 90 meters or 295 feet long. Prior to installation, the Contractor shall identify any area that cannot be reached within these constraints and shall report them to the Engineer. Do not install any data cable outside of these parameters without written approval from the Engineer.
- G. Install cable paths perpendicular or parallel to the ceiling structure, unless otherwise shown on the Drawings.
- H. Provide 6' service loop in overhead runway in Technology rooms.
- I. Provide 6' service loop in device backbox, nearest cable tray, or j-hook, wherever is closest to the cable termination.
- J. Do not expose cable to water, paint overspray, paint removal products, or water-based pulling lubricants, as these substances can negatively impact the performance of the cable.
- K. Pulling tension shall not exceed 25 lbs.

3.4 CABLE BUNDLING MATERIALS

- A. Bundles shall not exceed 25 cables.
- B. Use cable bundling and securing materials as required to ensure that cable runs are securely held in place both vertically and horizontally.
- C. Do not tighten bundling materials or securing devices so as to cause deformation of the inherent cable geometry or construction.
- D. Do not use cable ties or hook and latch tape to secure cable runs to other building systems (such as electrical conduit, EMT, sprinkler pipes, ceiling suspension members, etc.). Staples and drive rings are not allowed.
- E. In areas considered environment air-handling spaces, only use appropriately-listed materials.

END OF SECTION

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SECTION 27 16 19 - PATCH CORDS

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor Shall Provide and Install

1. The Contractor shall furnish and install telecommunications passive equipment, including:
 - a. Intersystem connections
 - b. Device connections

B. Related Sections:

1. Section 000000 – Procurement and Contracting Requirements
2. Section 010000 – General Requirements
3. Section 260526 – Grounding and Bonding for Electrical Systems
4. Section 270526 – Grounding and Bonding for Communications Systems
5. Section 270528 – Pathways for Communications Systems
6. Section 270539 – Surface Raceway for Communications Systems
7. Section 270553 – Identification for Communications Systems
8. Section 271116 – Communications Room Equipment
9. Section 271513 – Horizontal Cabling
10. Section 271700 – Testing of Structured Cabling Systems
11. Section 272133 – Wireless Access Point

1.2 SYSTEM DESCRIPTION

- A. The Contractor will provide, install, and test a complete structured cabling system for the project's voice and data communications systems from the Telecommunications Outlet (TO) to the Telecommunications Room (TR), and between telecommunications spaces. The Contractor will provide and install all required components as identified below.

1. Copper Patch Cords

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2. Fiber Patch Cords

1.3 SUBMITTALS

A. Copper Patch Cords

1. In addition to the general requirements, the Contractor shall submit the following additional data:
 - a. The length of the patch cords
 - b. The connector type for the patch cords

B. Fiber Patch Cords

1. In addition to the general requirements, the Contractor shall submit the following additional data:
 - a. The length of the patch cords
 - b. The connector type for the patch cords

C. Testing and Test Results

1. Refer to Section 27 17 00.

PART 2 - PRODUCTS

2.1 COPPER PATCH CORDS

- D. Shall comply with Owner's standards.
- E. Where not included in standards, Contractor shall provide as specified below.
- F. Provide (2) patch cords per horizontal cable run.
- G. Category 6 copper 28 AWG patch cords shall have the following attributes:
 1. Cable diameter not more than 0.235 in. (5.97mm) nominal.
 2. Category 6/Class E channel and component performance.
 3. Exceeds all ANSI/TIA-568.2-D Category 6 and ISO 11801 Class E Edition 2.1 electrical performance requirements for all frequencies from 1 to 250 MHz
 4. FCC and ANSI compliance: Meets ANSI/TIA/EIA-1096-A; contacts plated with 50 micro inches of gold for superior performance.
 5. IEC compliance: Meets IEC 60603-7 c (UL) US listed: UL 1863, CSA standard C22.2.

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6. PoE compliance: Meets IEEE 802.3af and IEEE 802.3at for PoE applications in bundle sizes up to 48 cables.
7. Operating temperature: 14°F to 140°F (-10°C to 60°C).
8. Plug housing: UL94V-0 rated clear Polycarbonate.
9. Plug contact plated with 50 microinches of gold and rated to 2500 mating cycles
10. RoHS compliance: Compliant.
11. Color:
 - a. Blue
12. Length:
 - a. Device side: 5'
 - b. Technology room side: 7'

H. Manufacturer

1. Commscope Uniprise
2. Panduit TX6
3. Or equal

2.2 CABLE BUNDLING MATERIALS

A. Hook and Loop Tape

1. Provide hook and loop tape, that is at least 0.5 inches wide, of a length equal to 150% of the circumference of the cable bundle.
2. Tie wraps are not allowed on this project.
3. When used in areas considered environmental air spaces, all bundling materials must be appropriately listed.
4. Manufacturer:
 - a. Commscope
 - b. Or equal

2.3 FIBER PATCH CORDS

- A. Shall comply with Owner's standards.

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- B. Where not included in standards, Contractor shall provide as specified below.
- C. Patch cords shall be LC-to-LC or LC-to-SC, depending on equipment.
- D. Patch cords shall be 1, 2, or 3 meters long.
- E. Manufacturer:
 - a. Commscope
 - b. Panduit
 - c. Or equal

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall input the cabling data into the cable management software.
- B. Provide any required screws, anchors, clamps, hook and loop, miscellaneous grounding and support hardware, etc. needed to facilitate the installation of the cable plant system.
- C. Furnish any special installation equipment or tools necessary to properly complete the installation.
- D. Failure to follow the appropriate guidelines may require the installer to provide additional material and labor required to properly rectify the situation. This shall also apply to any and all damages caused to the cables by the installer during the implementation.
- E. All techniques and fixtures used in the installation must minimize complexity and must allow for easy maintenance of, and ready access to, all components for test measurements.
- F. All materials used in installation shall be resistant to fungus growth and moisture deterioration.
- G. All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

3.2 WIRING PRACTICES

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- A. All cables shall originate and terminate at active or passive devices. Where several devices are in close proximity, use approved housing to housing connectors and adapters.
- B. All cables terminated in a connection plate mounted in an enclosure shall be dressed to allow cables to be removed from the enclosure and shall be of sufficient cable length to allow for service or re-termination. The plate shall either set on the floor or freely swing clear.
- C. Do not use nylon cable ties.

3.3 CABLE BUNDLING MATERIALS

- A. Use cable bundling and securing materials as required to ensure that cable runs are securely held in place both vertically and horizontally.
- B. Do not tighten bundling materials or securing devices so as to cause deformation of the inherent cable geometry or construction.
- C. Do not use cable ties or hook and latch tape to secure cable runs to other building systems (such as electrical conduit, EMT, sprinkler pipes, ceiling suspension members, etc.).
- D. In areas considered environment air-handling spaces, only use appropriately listed materials.

3.4 IDENTIFICATION

- A. Before installing or terminating cable, confirm all specific labeling requirements with the Owner or the Owner's Engineer.
- B. Cables
 - 1. Mark each cable at each endpoint and at all intermediate pull and access points, and junction boxes with labels that indicate the origination and destination identifiers, the sheath identifier, and the strand or pair range.
 - 2. Mark each horizontal cable on the sheath at each end with the TR, patch panel, and panel port to which the cable is wired.

END OF SECTION

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SECTION 27 17 00 - TESTING OF STRUCTURED CABLING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the minimum requirements for the test certification, identification, and administration of horizontal balanced twisted pair cabling and optical fiber cabling.
- B. The Contractor provides all labor, materials, tools, field-test instruments and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.
- C. In order to conform to the overall project event schedule, the cabling Contractor shall survey the work areas and coordinate cabling testing with other applicable trades.
- D. In addition to the tests detailed in this document, the Contractor shall notify the Owner or the Owner's representative of any additional tests deemed necessary to guarantee a fully functional system. The Contractor shall carry out and record any additional measurement results at no additional charge.

1.2 SCOPE

- A. This Section includes the minimum requirements for:
 - 1. Identification, including labels and labeling
 - 2. Administration, including:
 - a. Test results documentation
 - b. As-built drawings
 - 3. The testing of copper cabling, including:
 - a. Test instruments
 - b. Test procedures
 - 4. The testing of fiber optic cabling, including:
 - a. Test instruments
 - b. Test procedures
- B. Testing shall be carried out in accordance with this document. The Contractor shall:
 - 1. Test all installed balanced twisted pair cabling permanent links to the applicable performance level.

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2. Test the attenuation and polarity of the installed optical fiber cable plant with an Optical Loss Test Set (OLTS)
 3. Test the installed condition of the optical fiber cabling system and its components with an Optical Time Domain Reflectometer (OTDR)
 4. Verify the condition of the fiber end faces
- C. The Contractor shall document all tests including:
1. OLTS dual wavelength attenuation measurements
 2. OTDR traces with event tables and OTDR maps – Edit or remove this item as appropriate for the project.
 3. Optical length measurements and pictures of the connector end faces

1.3 RELATED SECTIONS

- A. Section 000000 – Procurement and Contracting Requirements
- B. Section 010000 – General Requirements
- C. Section 260526 – Grounding and Bonding for Electrical System
- D. Section 270526 – Grounding and Bonding for Communications Systems
- E. Section 270528 – Pathways for Communications Systems
- F. Section 270539 – Surface Raceway for Communications Systems
- G. Section 270 53 – Identification for Communications Systems
- H. Section 271316 – Communications Room Equipment
- I. Section 271513 – Horizontal Cabling
- J. Section 271619 – Communications Patch Cords

1.4 REFERENCES

- A. Requirements, Codes, and Standards
 1. All testing procedures and field test instruments shall comply with the applicable requirements of the following standards including the most current revisions, addendums, and any Technical Service Bulletins (TSBs) released at the time of bid:

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2. ANSI Z136.2, ANS For Safe Use of Optical Fiber Communication Systems Utilizing Laser Diode and LED Sources
3. ANSI/EIA/TIA 455 50B, Light Launch Conditions For Long-Length Graded-Index Optical Fiber Spectral Attenuation Measurements
4. ANSI/TIA/EIA-455-59A, Measurement of Fiber Point Discontinuities Using an OTDR
5. ANSI/TIA/EIA 455 60A, Measurement of Fiber or Cable Length Using an OTDR
6. ANSI/TIA/EIA 455 61A, Measurement of Fiber or Cable Attenuation Using an OTDR
7. ANSI/TIA/EIA 526 7, Optical Power Loss Measurements of Installed Single-mode Fiber Cable Plant
8. ANSI/TIA 526 14 B, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; IEC 61280-4-1 edition 2, Fibre-Optic Communications Subsystem Test Procedure- Part 4-1: Installed cable plant- Multimode attenuation measurement
9. TIA-TSB-4979 Practical Considerations for Implementation of Multimode Launch Conditions in the Field
10. ANSI/TIA-1152, Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
11. ANSI/TIA-568-0. D, Generic Telecommunications Cabling for Customer Premises.
12. ANSI/TIA-568-1. D, Commercial Building Telecommunications Cabling Standard
13. ANSI/TIA 568.2-D, Balanced Twisted-Pair Telecommunications Cabling and Components Standards.
14. ANSI/TIA 568 C.3, Optical Fiber Cabling Components Standard
15. ANSI/TIA-606-C, Administration Standard for Commercial Telecommunications Infrastructure, including the requirements specified by the customer, unless the customer specifies their own labeling requirements.

B. Applicability of Codes, Rules, and Regulations

1. Federal, state, and local codes, rules, regulations, and ordinances governing the work, are as fully part of the specifications as if herein repeated or hereto attached.

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2. If the Contractor notes items in the drawings or the specifications, construction of which would be code violations, the Contractor should promptly call them to the attention of the Owner's representative in writing.
3. Where the requirements of other sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply.
4. Balanced Twisted Pair Testing
 - a. Trained technicians, who have successfully attended an appropriate training program and have obtained a certificate as proof thereof, shall execute the tests. Acceptable certificates are ones that have been issued by any of the following organizations or an equivalent organization:
5. The manufacturer of the connectors and/or the cable
6. The manufacturer of the test equipment used for the field certification
7. Training organizations such as Building Industry Consulting Service International (BICSI), the Association of Cabling Professionals™ (ACP), the Cabling Business Institute (CBI)

C. Optical Fiber Testing

1. Trained technicians who have successfully attended an appropriate training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
2. The manufacturer of the connectors and/or the cable
3. The manufacturer of the test equipment used for the field certification
4. Training organizations such as Building Industry Consulting Service International (BICSI), the Association of Cabling Professionals™ (ACP), the Cabling Business Institute (CBI)

D. Owner's Participation

1. The Owner or the Owner's representative shall be invited to witness and/or review field testing.
2. Five business days before testing commences, the Owner or the Owner's representative shall be notified of the start date of the testing phase.
3. The Owner or the Owner's representative shall:
 - a. Select a random sample of five percent of the installed links.
 - b. Test these randomly-selected links.

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- c. Store the results in accordance with Part 3 of this document.
- 4. The Contractor shall compare the results obtained by the Owner to the data provided by the installation Contractor. If more than two percent of the pass/fail determinations in the sample results differ from the data provided by the installation Contractor, the Contractor, under the supervision of the Owner's representative, shall repeat one hundred percent of the testing at no cost to the Owner.

1.5 SUBMITTALS

- A. The Contractor shall submit the following:
 - 1. The manufacturer's catalog sheets and specifications for the test equipment.
 - 2. A schedule (list) of all links and channels to be tested.
 - 3. Sample test reports.
 - 4. The test equipment serial number.
 - 5. A graphic diagram documenting the test procedure, including all connectors, the light source (as applicable,) the origin, and the destination of each cable tested.

1.6 Closeout

- A. Submit test equipment along with test results.

1.7 TEST RESULTS

- A. Fiber test results shall be submitted in sequential order by telecommunications space they are terminated in.
- B. Category cable test results shall be submitted in sequential order by telecommunications space they are terminated in, and then by unique label identifier.
- C. Balanced Twisted Pair Links
 - 1. Category 6 Balanced Twisted Pair
 - a. Unless otherwise specified by the Owner or the Owners representative, each Category 6 balanced twisted pair cabling link shall be tested for:
 - 1) Wire Map
 - 2) Length
 - 3) Propagation Delay
 - 4) Delay Skew
 - 5) DC Loop Resistance
 - 6) DC Resistance Unbalance within a pair
 - 7) DC Resistance Unbalance between pairs

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- 8) Insertion Loss
 - 9) Near-End Crosstalk (NEXT)
 - 10) Power Sum Near-End Crosstalk (PS NEXT)
 - 11) Attenuation to Crosstalk Ratio Near-End (ACR-N)
 - 12) Power Sum Attenuation to Crosstalk Ratio Near-End (PS ACR-N)
 - 13) Attenuation to Crosstalk Ratio Far-End (ACR-F)
 - 14) Power Sum Attenuation to Crosstalk Ratio Far-End (PS ACR-F)
 - 15) Return Loss
 - 16) Transverse Conversion Loss (TCL)
 - 17) Equal Level Transverse Conversion Transfer Loss (ELTCTL)
2. When a Balanced Twisted Pair Permanent Link Fails
- a. All installed balanced twisted pair cabling permanent links shall be field-tested and shall pass the test requirements and analysis described in Part 3.
 - b. Any permanent link that fails these requirements shall be diagnosed and corrected.
 - c. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected permanent link meets performance requirements.
 - d. The final and passing result of the tests for all permanent links shall be provided in the test results documentation, in accordance with Part 3.

D. Optical Fiber Links

1. Test Limits – ANSI/TIA-568.3-D Singlemode (STD) and Multimode (STD)
2. Unless otherwise specified by the Owner or the Owners representative, each optical fiber cabling link shall comply with the following test limits:
 - a. Optical loss testing
 - b. Multi-mode and single-mode links
 - c. Link attenuation calculated by the formulas, as specified in ANSI/TIA-568-C.0:
 - 1) $\text{Link Attenuation (dB)} = \text{Cable Attn (dB)} + \text{Connector Attn (dB)} + \text{Splice Attn (dB)}$
 - 1) $\text{Cable Attn (dB)} = \text{Attenuation Coefficient (dB/km)} * \text{Length (Km)}$
 - 2) $\text{Connector Attn (dB)} = \text{number of connector pairs} * \text{connector loss (dB)}$
Maximum allowable connector loss = 0.75 dB
 - 3) $\text{Splice_Attn (dB)} = \text{number_of_splices} * \text{splice_loss (dB)}$ Maximum allowable splice_loss = 0.3 dB
 - d. The values for the Attenuation_Coefficient (dB/km) are listed in the table below. Where application limits are more stringent, those shall apply.

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| <i>type of optical fiber</i> | <i>wavelength (nm)</i> | <i>attenuation coefficient (dB/km)</i> | <i>wavelength (nm)</i> | <i>attenuation coefficient (dB/km)</i> |
|--------------------------------|----------------------------|--|----------------------------|--|
| Multi-mode 62.5/125 μ m | 850 | 3.5 | 1300 | 1.5 |
| Multi-mode 50/125 μ m | 850 | 3.5 | 1300 | 1.5 |
| Single-mode (Inside plant) | 1310 | 1.0 | 1550 | 1.0 |
| Single-mode (Outside plant) | 1310 | 0.5 | 1550 | 0.5 |

3. OTDR Testing

- a. Reflective events (connections) shall not exceed the following limits. Where application limits are more stringent, those shall apply.
 - 1) 0.75 dB in optical loss when bi-directionally averaged
 - 2) -35 dB reflectance for multi-mode connections
 - 3) -40 dB reflectance for UPC single-mode connections
 - 4) -55 dB reflectance for APC single-mode connections
 - 5) Non-reflective events (splices) shall not exceed 0.3 db

4. Magnified End Face Inspection

- a. Fiber connections shall be visually inspected for compliance with IEC 61300-3-35 Edition 1.0 for end face quality.
- b. Scratched, pitted or dirty connectors shall be diagnosed and corrected.

5. When an Optical Fiber Link or Channel Fails

- a. All installed optical fiber cabling links and channels shall be field-tested and pass the test requirements and analysis as described in Part 3.
- b. Any link or channel that fails these requirements shall be diagnosed and corrected.
- c. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link or channel meets performance requirements.
- d. The final and passing result of the tests for all links and channels shall be provided in the test results documentation, in accordance with Part 3.

E. Acceptance of Test Results

- 1. Once the project is fully completed and tested in accordance with the Contract Documents and to the satisfaction of the Owner, the Owner's acceptance of the test results shall be given in writing to the Engineer.

1.8 PROJECT CONDITIONS

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A. Project Environmental Requirements

1. Seismic Safety

- a. Observe mechanical and electrical support means for all installed equipment as required by all applicable local building codes for this installation's earthquake risk hazard zone and as recommended by Telcordia Specification GR-63.
- b. All equipment racks should be anchored with suitable anchors that meet safety standards.
- c. Overhead devices should be mounted with appropriate safety attachments as required.
- d. Where cabinets and racks are secured directly to the building, this should be done in accordance with guidance provided by the Authority Having Jurisdiction (AHJ) or a structural engineer.
- e. Equipment and fixtures should have shock and vibration isolation.

2. Fiber Optic Cable Safety

- a. The following warnings shall be posted on the job site:

WARNING: PERMANENT EYE DAMAGE CAN RESULT FROM
LOOKING DIRECTLY INTO A LIGHT BEAM GENERATED BY AN LED
OR LASER SOURCE OR INTO THE END OF A CABLE FIBER
CONNECTED TO ONE OF THESE SOURCES.

CAUTION: LIGHT GENERATED BY THESE SOURCES MAY NOT BE
VISIBLE YET REMAIN HAZARDOUS TO THE EYE. LOOK FOR
WARNING LABELS ON SOURCE DEVICES.

- b. Observe all warning signs on equipment and all written safety precautions in the equipment instruction and technical manuals.
- c. Always handle cable carefully to avoid personal injury. Care should be taken with individual fibers to prevent injury to the eyes or penetration of the fibers into the skin.

3. Hazardous Materials Prohibition

- a. The Contractor shall make sure that all materials used in the project are asbestos-free, unless specifically authorized in writing by the Owner.

PART 2 - PRODUCTS

2.1 BALANCED TWISTED-PAIR CABLE TESTERS

- A. The field test instrument shall be manufactured by Fluke Networks.
- B. The field test instrument shall have been calibrated within the last twelve months.
- C. There shall be independent verification that the field test instrument meets the following accuracy requirements:

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1. For Category 6, Level III accuracy in accordance with ANSI/TIA-1152

D. Permanent Link Adapters

1. The RJ45 plug must meet the requirements for NEXT, FEXT, and Return Loss in accordance with ANSI/TIA-568.2-D.
2. Twisted pair Category 6 cords are not permitted, as their performance degrades with use and can cause false Return Loss failures.

E. Results Storage

1. The field test instrument shall be capable of storing more than 10,000 results for all measurements found within this section.

F. Measurement Capabilities for Category 6 Links

1. On Category 6 links, the field test instrument shall be capable of testing the following parameters:
 - a. Wire Map
 - b. Length
 - c. Propagation Delay
 - d. Delay Skew
 - e. DC Loop Resistance
 - f. DC Resistance Unbalance within a pair
 - g. DC Resistance Unbalance between pairs
 - h. Insertion Loss
 - i. Near-End Crosstalk (NEXT)
 - j. Power Sum Near-End Crosstalk (PS NEXT)
 - k. Attenuation to Crosstalk Ratio Near-End (ACR-N)
 - l. Power Sum Attenuation to Crosstalk Ratio Near-End (PS ACR-N)
 - m. Attenuation to Crosstalk Ratio Far-End (ACR-F)
 - n. Power Sum Attenuation to Crosstalk Ratio Far-End (PS ACR-F)
 - o. Return Loss
 - p. Transverse Conversion Loss (TCL)
 - q. Equal Level Transverse Conversion Transfer Loss (ELTCTL)
 - r. Time Domain Reflectometer
 - s. Time Domain Xtalk Analyzer

G. PC Software

1. The field test instrument's PC software shall:
 - a. Be Windows® based
 - b. Show when 3 dB and 4 dB rules are applied
 - c. Have re-certification capability where results have "(RC)" added to the end of the Cable IDs
 - d. Have a built-in PDF export capability, as no additional third party software is permitted

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- e. Have built-in statistical analysis

2.2 OPTICAL FIBER CABLE TESTERS

- A. The field test instrument shall have been calibrated within the period recommended by the manufacturer, and a copy of the calibration certificate shall be made available.
- B. Optical Loss Test Set (OLTS)
 - 1. Multi-Mode Optical Fiber Light Source
 - 2. The multi-mode optical fiber light source shall:
 - a. Provide dual LED light sources with central wavelengths of 850 nm (± 30 nm) and 1300 nm (± 20 nm). VCSEL sources are not permitted per ANSI/TIA-526-14-B.
 - b. Have output power of at least -20 dBm
 - c. Meet the Encircled Flux launch requirements of ANSI/TIA-526-14-B
 - d. Have test reference cords that demonstrate an insertion loss of 0.15 dB when mated against each other
 - e. Be manufactured by Fluke Networks
 - 3. The single-mode optical fiber light source shall:
 - a. Provide dual laser light sources with central wavelengths of 1310 nm (± 20 nm) and 1550 nm (± 20 nm).
 - b. Have output power of at least -10 dBm
 - c. Have test reference cords that demonstrate an insertion loss of 0.25 dB when mated against each other
 - d. Be manufactured by Fluke Networks
 - 4. Power Meter shall:
 - a. Provide test capability at wavelengths of 850 nm, 1300 nm, 1310 nm, and 1550 nm
 - b. Have power measurement uncertainty of ± 0.25 dB
 - c. Store reference power measurements
 - d. Save at least 10,000 results to internal memory
 - e. Have a USB PC interface
 - f. Be manufactured by Fluke Networks
 - 5. Optional Length Measurement
 - a. An OLTS capable of measuring the optical length of the fiber using time-of-flight techniques is preferable.
 - b. For MPO/MTP trunk cables, length shall be calculated using cable jacket length markings.
- C. Optical Time Domain Reflectometer (OTDR)
 - 1. The OTDR shall:
 - a. Have a color LCD display with backlight

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- b. Have rechargeable Li-Ion battery for 8 hours of normal operation
 - c. With battery and module, weigh no more than 4.5 pounds and have a volume of no more than 200 in²
 - d. Have internal non-volatile memory with capacity for storing at least 2,000 OTDR bi-directionally-tested fiber links
 - e. Have a USB port to transfer data to a PC or thumb drive/memory stick
 - f. Be manufactured by Fluke Networks
2. The multi-mode OTDR shall:
- a. Provide test capability at wavelengths of 850 nm (± 10 nm) and 1300 nm (± 35 nm / ± 15 nm)
 - b. Have event dead zones that do not exceed 0.7 m at 850 nm and 1300 nm
 - c. Have attenuation dead zones that do not exceed 2.5 m at 850 nm and 4.5 m at 1300 nm
 - d. Have distance range of at least 9,000 m
 - e. Have a dynamic range of at least 28 dB for 850 nm and 30 dB at 1300 nm
 - f. Allow bi-directional testing without moving the OTDR to the far end
3. The single-mode OTDR shall:
- a. Provide test capability at wavelengths of 1310 nm (± 25 nm) and 1550 nm (± 30 nm)
 - b. Have event dead zones that do not exceed 0.6 m at 1310 nm and 1550 nm
 - c. Have attenuation dead zones that do not exceed 3.7 m at 1310 nm and 1550 nm
 - d. Have distance range of at least 80 km at 1310 nm and 130 km at 1550 nm
 - e. Have a dynamic range of at least 32 dB for 1310 nm and 30 dB at 1550 nm
 - f. Allow bi-directional testing without moving the OTDR to the far end

D. Fiber Microscope

1. The fiber microscope shall:
- a. Have a field of view of 420 μ m by 320 μ m
 - b. Have camera probe tips that permit inspection through adapters
 - c. Be capable of saving and reporting the end face image to IEC 613003-3-35
 - d. Be manufactured by Fluke Networks
 - e. Preferably be a video camera system

E. Integrated OLTS, OTDR, and Fiber Microscope

1. Test equipment that combines an OLTS, an OTDR, and a fiber microscope into one instrument may be used.
2. Any such system shall be manufactured by Fluke Networks.

PART 3 - EXECUTION

3.1 GENERAL

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- A. Prior to field-testing, all outlets, cables, patch panels, and associated components shall be fully assembled and labeled. Any testing performed on incomplete systems shall be redone after the systems are fully assembled and labeled.
- B. The Contractor shall input the cabling data into the cable management software.

3.2 CABLE TERMINATION AND TEST PLANS

A. General

- 1. Provide proof of testing technician(s) certification for operation of the specific units of test equipment, which are proposed for use.
- 2. The Contractor shall obtain General Contractor approval for each termination and test plan prior to execution of the work.
- 3. This Section covers work necessary to furnish communications system testing, including the following:
 - a. Outside Plant (OSP) Cabling Infrastructure (Campus LAN/WAN extension)
 - b. Back-Bone Cabling Infrastructure
 - c. Horizontal Cabling Systems
- 4. Inspection Requirements:
 - a. As part of any performance test, inspect cable, material, and equipment for physical damage, continuity, and proper connection.
 - b. Verify identification and labeling at required locations for visibility, condition, legibility, and accuracy.
- 5. Test Report Requirements – Each test report shall include the following sections:
 - a. Scope of testing
 - b. List of equipment used in the test with a photocopy of the factory calibration certificate.
 - c. List of technicians performing the tests identified in the scope of testing.
 - d. Summary of test results: Hardcopy and electronic copies of the summary forms are to be delivered at conclusion of the project before final payment will be made.
 - e. Individual test data sheets: The individual test data sheets shall be developed and completed by the Contractor. Formatted output from cable scanners is typically acceptable provided they contain all of the test parameters including graphs of the information required by this Section.

B. Cable Termination Plans

- 1. Submit detailed termination plans for both fiber optic and twisted pair cables, which describe how each system component will be installed and terminated.

C. Cable Test Plans

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1. Submit detailed test plans for both fiber optic and twisted-pair cable channels which include at least the following information:
 - a. Describe the tests to be performed.
 - b. Explain when and how each system component will be tested.
 - c. List the test equipment to be used.
 - d. Itemize how theoretical loss budgets and test parameters will be calculated and listed.
 - e. Provide an example of the test reporting documentation for each type of test, which provides a written verification of the results, as required in paragraph 2 below.
2. Provide testing documentation which includes:
 - a. Dates and times of test
 - b. Personnel performing tests
 - c. Initial test results
 - d. Description of discrepancies found or failure, if any
 - e. Corrective action, if any
 - f. Date and person performing corrections
 - g. Retest results, if required
 - h. Include space for Owner's sign-off
 - i. Copy of test equipment calibration certificates
 - j. Intrabuilding (Vertical and Horizontal Subsystem) fiber optic segment post-installation test plan
3. Twisted-Pair Cable Tests: Testing shall be performed using a minimum level IIIe tester, approved by the engineer.
4. Twisted-Pair Test Plans: Provide separate post-installation test schemes for the following activities:
 - a. Backbone Subsystem twisted-pair segment test plan.
 - b. Horizontal Subsystem twisted-pair segment test plan.
5. Fiber-Optic Cable Tests: Testing shall be performed using a level IIIe tester, with approved test-heads approved by the engineer.
6. Fiber-Optic Test Plans: Provide separate post-installation test schemes for the following activities:
 - a. Backbone subsystem fiber-optic segment test plan.
 - b. Horizontal subsystem fiber-optic segment test plan.

3.3 SYSTEM ADMINISTRATION

A. Test Results Documentation

1. At the end of each working day, upload the copper cable permanent link test results, except for alien crosstalk testing, to the associated PC software for inspection by the Owner or the Owner's representative.

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2. Test results uploaded shall allow for the maintenance, inspection, and archiving of the test records.
3. Prior to the Owner accepting the project:
 - a. Store the database of the complete project, including, if applicable, fiber links, in the format native to the software.
 - b. Deliver the database to the Owner on CD, DVD, or thumb-drive.
 - c. To allow the Owner to inspect and print the test reports, include a working and fully-licensed copy of the software.
4. Circuit IDs reported by the test instrument should match the specified label ID.
5. Provide the detailed test results documentation data, in an electronic database, for each tested optical fiber and include the following information:
 - a. The identification of the customer site as specified by the end-user.
 - b. The name of the test limit selected to execute the stored test results.
 - c. The name of the personnel performing the test.
 - d. The date and time that the test results were saved in the memory of the tester.
 - e. The manufacturer, model, and serial number of the field test instrument.
 - f. The version of the test software and the version of the test limit database held in the test instrument.
 - g. The fiber identification number.
 - h. The length of each optical fiber.
 - i. The index of refraction used for length calculation when using a length-capable OLTS.
 - j. The backscatter coefficient of the fiber under test when using an OTDR.
 - k. The OLTS attenuation link and channel measurements at the appropriate wavelengths and the margin (the difference between the measured attenuation and the test limit value).
 - l. The OTDR link and channel traces, event tables at the appropriate wavelengths, and a map of the link tested.
 - m. The length of each optical fiber, as calculated by the OTDR.
 - n. The overall pass/fail evaluation of the link-under-test for OLTS and OTDR measurements.
 - o. A picture or image of each fiber end-face.
 - p. A pass/fail status of the end-face using IEC 61300-3-35 Edition 1.0.
6. Testing of Category 6 Permanent Links
 - a. For each Category 6 balance twisted-pair permanent link, provide the detailed test results documentation data in the associated PC software including:
 - b. The overall pass/fail evaluation of the link-under-test.
 - c. The date and time the test results were saved in the memory of the tester.
 - d. The identification of the customer site, as specified by the Owner.
 - e. The name of the test limit selected to execute the stored test results.
 - f. The name of the personnel performing the test.

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- g. The version of the test firmware and the version of the test limit database held in the test instrument.
- h. The manufacturer, model, and serial number of the field test instrument.
- i. The adapters used.
- j. The factory calibration date.
- k. Wire map.
- l. Propagation delay values for all four pairs.
- m. Delay skew values for all four pairs.
- n. DC resistance values for all four pairs.
- o. DC resistance unbalance within a pair values for all four pairs.
- p. DC resistance unbalance between pairs values for all four pairs.
- q. Insertion loss worst case values for all four pairs.
- r. NEXT worst-case margin and worst-case values in both directions.
- s. PS NEXT worst-case margin and worst-case values in both directions.
- t. ACR-N worst-case margin and worst-case values in both directions.
- u. PS ACR-N worst-case margin and worst-case values in both directions.
- v. ACR-F worst-case margin and worst-case values in both directions.
- w. PS ACR-F worst-case margin and worst-case values in both directions.
- x. Return loss worst-case margin and worst-case values in both directions.
- y. TCL worst-case margin and worst-case values in both directions.
- z. ELTCTL worst-case margin and worst-case values in both directions.
- aa. Time domain crosstalk data, if the link is marginal or fails.
- bb. Time domain reflectometer data, if the link is marginal or fails.

B. Submit test reports within seven (7) business days of completion of testing.

3.4 FIELD QUALITY CONTROL

A. General

- 1. The Owner reserves the right to be present during any or all of the testing.
- 2. All cabling not tested in strict accordance with these specifications shall be re-tested at no additional cost to the Owner.
- 3. 100% of the installed cabling must be tested. All tests must meet the acceptance criteria defined in the media specific sections of this document.
- 4. Prior to each day's testing, fully charge all test equipment and bring an appropriate alternate power source to the job site.
- 5. Throughout the testing, have a competent supervisor and supporting technical personnel, acceptable to the Owner, available on site. Changing the supervisor during the testing shall not be acceptable without prior written approval from the Owner.
- 6. Upon completion of the testing, it shall be the responsibility of the Contractor to perform the necessary adjustments and other controls to ensure proper system

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operation. The system shall be physically inspected by the Owner to assure that all equipment is installed in a neat and workmanlike manner as called for by the contract documents.

7. Verify the performance parameters of the individual systems, following established professional procedures, in addition to those specified herein. Document all acceptance testing, calibration, and correction procedures described herein, taking care to include the following information:
 - a. The date on which each procedure was performed.
 - b. The reason that the procedure was performed.
 - c. The type of and a description of the procedure.
 - d. The parameters measured and their values, including, as applicable, the values measured prior to calibration or correction.
 - e. The parameters associated with calibration or corrective networks, components, or devices.
 - f. The names of the personnel conducting the procedure.
 - g. The equipment used to conduct the procedure.

B. General Specifications for Testing Balanced Twisted Pair Cable

1. Use field test instruments that have the latest firmware installed.
2. Upon completion of each test, record the permanent link test results, including the individual frequency measurements from the tester, in the test instrument for subsequent uploading to the associated test equipment software in which the administrative documentation (reports) may be generated.
3. Perform permanent link testing on each cabling segment, connector to connector. Sampling is not acceptable.
4. Perform alien crosstalk testing on all Category 6 links using a sampling plan. For populations of up to 500,000 links, use an Acceptance Quality Level (AQL) of 0.4%, normal inspection, general inspection level I, as defined in ISO 2859-1. The following table lists the sample sizes to be used.

| <i>total number of links (N)</i> | <i>sample size (No. of links to test)</i> |
|----------------------------------|---|
| 3 – 33 | 3 or 0.1 x N (whichever is greatest) |
| 34 – 3,200 | 33 |
| 3,201 – 35,000 | 126 |
| 35,001 – 150,000 | 201 |
| 150,001 – 500,000 | 315 |

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5. Choose an equal combination of short, medium, and long disturbed (victim) links for alien crosstalk testing.
6. Permanent link adapters made from twisted pair Category 6 cords are not permitted.
7. The installer shall build a reference Category 6 link. All components shall be anchored so that it is not possible to disturb them. Each day, the technician is to conduct a Category 6 permanent link test to ensure that there is no degradation of the tester or its permanent link adapters.

3.5 TESTING CATEGORY 6 LINKS

A. Frequency Resolution for all measurements shall be:

1. 1 – 31.25 MHz: 150 kHz
2. 31.25 – 100 MHz: 250 kHz
3. 100 – 250 MHz: 500 kHz

B. Wire Map Measurement

1. The length of each balanced twisted pair shall be recorded.

C. Propagation Delay

1. Make the propagation delay measurement, per ANSI/TIA-1152, at 10 MHz.
2. Record the propagation delay of each balanced twisted pair.
3. Propagation delay shall not exceed 498 ns per ANSI/TIA-568-C.2 Section 6.3.18
4. Record the delay skew measurement for each balanced twisted pair.
5. Per ANSI/TIA-568-C.2 Section 6.3.19, propagation delay is not to exceed 44 ns.
6. Record DC resistance for all four pairs.
7. Record DC resistance unbalance for all four pairs.

D. Insertion Loss

1. Report the worst case for all four pairs in one direction only.
2. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).

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3. Insertion loss is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA-568-C.2 Section 6.3.7.

E. Near-End Crosstalk (NEXT)

1. Measure NEXT in both directions for all 12 possible pair-to-pair combinations.
2. Report both worst case and worst margins.
3. NEXT is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA-568-C.2 Section 6.3.8.
4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
5. Store the time domain Xtalk data for any marginal or failing NEXT results.

F. Power Sum Near-End Crosstalk (PS NEXT)

1. Measure PS NEXT in both directions for all 8 possible pair combinations.
2. Report both worst case and worst margins.
3. PS NEXT is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA-568-C.2 Section 6.3.9.
4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
5. Store the time domain Xtalk data for any marginal or failing PS NEXT results.

G. Attenuation Crosstalk Ratio Near-End (ACR-N)

1. Calculate ACR-N in both directions.
2. Record ACR-N for all 12 possible combinations.

H. Power Sum Attenuation Crosstalk Ratio Near-End (PS ACR-N)

1. Calculate PS ACR-N in both directions.
2. Record PS ACR-N for all 8 possible combinations.

I. Attenuation Crosstalk Ratio Far-End (ACR-F)

1. Measure ACR-F in both directions for all 24 possible pair-to-pair combinations.
2. Report both worst case and worst margins.

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3. ACR-F is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA-568-C.2 Section 6.3.11.
4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).

J. Return Loss

1. Measure return loss in both directions for all 8 possible pair combinations.
2. Report worst case and worst margins.
3. Ignore return loss at all frequencies where the insertion loss is less than 3 dB for that pair.
4. Return loss is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA-568-C.2 Section 6.3.6.
5. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
6. Store the time domain reflectometer data for any marginal or failing return loss results.

K. Transverse Conversion Loss (TCL)

1. Measure TCL in both directions.
2. TCL for a permanent link is not specified in ANSI/TIA-1152 but record it for all 8 possible combinations.

L. Equal Level Transverse Conversion Transfer Loss (ELTCTL)

1. Measure ELTCTL in both directions.
2. Record ELTCTL for all 8 possible combinations.

3.6 TESTING OPTICAL FIBER CABLE

A. General

1. All tests performed on optical fiber cabling that use a laser or LED in a test set shall be carried out with in accordance with the safety precautions specified in ANSI Z136.2.
2. Prior to field-testing, fully assemble and label all outlets, cables, patch panels, and associated components. Any testing performed on incomplete systems shall be redone after the systems are fully assembled and labeled.

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3. Use field test instruments that have the latest software and firmware installed.
4. Upon completion of each test, record the link and channel test results from the OLTS and OTDR in the test instrument for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.
5. Inspect fiber end faces using a video scope with a field of view of no less than 425 μm x 320 μm .
6. Record the end face images in the memory of the test instrument for subsequent uploading to a PC and reporting.
7. Perform testing on each cabling segment, connector to connector. Sampling is not acceptable.
8. Test the cabling using high-quality test reference cords that:
 - a. Are of the same core size as the cabling under test
 - b. Are terminated with reference grade connectors that have a loss of no more than 0.1 dB for multi-mode and 0.2 dB for single-mode
 - c. For OLTS testing, are between 2 m and 5 m long
 - d. For multi-mode OTDR testing, have launch and tail fibers that are at least 100 m (328 feet) long
 - e. For single-mode testing, have launch and tail fibers of lengths appropriate for the link under test, as indicated in the following table:

| <i>maximum length of link (km)</i> | | <i>typical pulse width (ns)</i> | <i>minimum launch and tail cord length (m)</i> |
|------------------------------------|---------------------|---------------------------------|--|
| <i>1310 nm</i> | <i>1550 nm only</i> | | |
| 0 to 35 | 0 to 50 | = 1,000 | 130 |
| 35 to 45 | 50 to 65 | 3,000 | 400 |
| 45 to 50 | 65 to 75 | 10,000 | 1,000 |
| = 50 | = 75 | 20,000 | 2400 |

B. Optical Loss Testing for Horizontal and Backbone Links

1. Test multi-mode links in both directions at 850 nm and 1300 nm in accordance with ANSI/TIA-526-14-B, one-cord reference method, with an Encircled Flux compliant launch.
2. Single-mode backbone links shall be tested in both directions at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1 (the one-cord reference method).

C. Magnified End-Face Inspection

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1. Inspect fibers using a video scope with a minimum field of view of 425 μm by 320 μm per IEC 61300-3-35 Edition 1.0.
2. Use the following test limits:
 - a. For multi-mode connectors, Table 6 of IEC 61300-3-35 Edition 1.0
 - b. For single-mode field polished connectors, Table 5 of IEC 61300-3-35 Edition 1.0
 - c. For single-mode factory polished connectors, Table 3 of IEC 61300-3-35 Edition 1.0
 - d. For Angled Physical Contact (APC) connectors, Table 4 of IEC 61300-3-35 Edition 1.0
3. Length Measurement
 - a. Record the length of each fiber.
 - b. It is preferable that the optical length be measured using an OLTS or OTDR.
4. Polarity Testing
 - a. Test paired duplex fibers in multi-fiber cables to verify that polarity is in accordance with Clause E.5.3 of ANSI/TIA-568-C.0.
 - b. Verify the polarity of the paired duplex fibers using an OLTS.

D. Manufacturer's Field Service

1. At the start of the installation, periodically as the Work progresses, and after completion, furnish:
 - a. The services of the manufacturer's technical representative at the job site, as needed, to advise on every phase of the Work
 - b. Full-time attendance at least during the first three work days and at least once every week thereafter
 - c. Technical assistance to the Installer as required.

3.7 FINAL TEST AND ADJUST

- A. The Contractor shall be responsible for post-installation performance testing of all cabling systems specified elsewhere in this Section of the Contract Documents.
 1. Testing procedures shall permit recording the length of each link, theoretical loss budget, and tested parameters for each pair and fiber, including space for sign-off by General Contractor and Owner.
 2. Any cable links or fiber strands, which fail to meet performance test criteria, shall be re-terminated, re-connectorized, or replaced by the Contractor free of charge.
 3. Submit final field test documentation in list form, including the General Contractor signature for Owner's approval.
- B. Unshielded Twisted-Pair Cable System Testing

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1. Permanent Link Test Configuration: Perform metered tests on each multi-pair twisted-pair and/or four-pair UTP cable through the wiring block, patch panel, at each end of the cable section and/or telecommunication outlet (T.O.). The permanent link test shall be undertaken as described in ANSI/TIA 568.2-D.
2. Performance Testing:
 - a. Horizontal Cable System:
 - 1) Use a minimum Level IIIe field test instrument capable of the following swept/stepped frequency voltage measurements in accordance with the performance parameters required by ANSI/TIA 568.2-D
 - 2) Test each horizontal link to verify/determine, wire map, length, attenuation, skew, and near-end-crosstalk (NEXT) as described in ANSI/TIA 568.2-D.
 - b. Test Reports: Include field test results for each cable including cable link length in accordance with ANSI/TIA 568.2-D.
 - c. The test summary shall include:
 - 1) Cable Identification as it appears on cable schedule.
 - 2) Cable identification as it appears on the individual test reports.
 - 3) Cable identification as it is labeled in accordance to the Specifications.
 - 4) Pass/Fail Status.
 - 5) All test parameters shall appear on each test document including graphics and indicating each test parameter result.
 - 6) The individual test data sheet shall include the automated printout produced by the cable scanning equipment.

END OF SECTION

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SECTION 27 21 33 – WIRELESS ACCESS POINTS

PART 1. GENERAL

1.01 SUMMARY

- A. Contractor shall provide and install
 - 1. Wireless access points, mounting brackets
- B. Contractor shall perform:
 - 1. Active wireless survey
- C. Related Sections:
 - 1. Section 000000 – Procurement and Contracting Requirements
 - 2. Section 010000 – General Requirements
 - 3. Section 260526 – Grounding and Bonding for Electrical System
 - 4. Section 270526 – Grounding and Bonding for Communications Systems
 - 5. Section 270528 – Pathways for Communications Systems
 - 6. Section 270539 – Surface Raceway for Communications Systems
 - 7. Section 270553 – Identification for Communications Systems
 - 8. Section 270628 – Pathways for Communications Systems
 - 9. Section 271116 – Communications Room Equipment
 - 10. Section 271119 – Communications Termination Blocks and Patch Panels
 - 11. Section 271513 – Horizontal Cabling
 - 12. Section 271619 – Patch Cords
 - 13. Section 271700 – Testing of Structured Cabling Systems

1.02 DEFINITIONS

- A. WAP – Wireless Access Point
- B. NEMA – National Electrical Manufacturers Association
- C. NIST – National Institute of Standards and Technology

1.03 REFERENCES

- A. Refer to 27 0000.
- B. Most recent revisions, editions, addenda, and bulletins of the following documents:
 - 1. IEEE 802.11 series
 - 2. NIST SP 800-153

1.04 SYSTEM DESCRIPTION

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- A. The Contractor will provide, install, and test a complete wireless access point system for the project. The Contractor will provide and install all required components as identified below.
- B. Wireless Access Points (WAP)
 - 1. WAPs include active electronic hardware, mounting brackets & attachments, and directional antennas.

1.05 QUALIFICATIONS

- A. Contractor shall have experience performing active surveys with at least (3) previous installations of comparable size and complexity undertaken within the last (5) years.

1.06 SUBMITTALS

- A. Action Submittals:
 - 1. Product data:
 - a. Refer to 27 0000.
 - b. Submit licensing for complete solution

1.07 CLOSEOUT DOCUMENTS

- A. Maintain complete set of redlined drawings. Redlines shall include moves, adds, or changes from the Drawings from coordination due to predictive surveys, field conditions, or Owner changes.
- B. Results of active survey shall be submitted with project closeout documentation.

1.08 QUALITY ASSURANCE

- A. Contractor shall have the equipment (i.e. spectrum analysis, surveying) to perform an active survey of the installed WAP system.

PART 2. PRODUCTS

2.01 WIRELESS ACCESS POINTS

- A. Provide minimum 3-year software support and associated licenses.
- B. Wi-Fi 6 Wireless Access Points shall be:
 - 1. IEEE 802.11ax-compliant
 - 2. Have on-premises management
 - 3. Accept RJ-45 connectors
 - 4. Internal omnidirectional 2.4GHz and 5GHz antennas
 - 5. Orthogonal frequency-division multiple access multiplexing
 - 6. PoE
 - 7. Supports WiFi Protected Access (WPA1/WPA2/WPA3)

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8. Manufacturers:
 - a. Netgear WAX220
 - b. Cisco MR36
 - c. Ruckus R350
 - d. Or equal

PART 3. EXECUTION

3.01 GENERAL

- A. Ensure required cables, outlets, jacks, and required transmission media is in the correct location each location designated on the Drawings.
- B. Provide any required screws, anchors, clamps, hook and loop, miscellaneous grounding and support hardware, etc. needed to facilitate the installation of the system.
- C. Furnish any special installation equipment or tools necessary to properly complete the installation.
- D. Failure to follow the appropriate guidelines may require the installer to provide additional material and labor required to properly rectify the situation. This shall also apply to any and all damages caused to the cables by the installer during the implementation.
- E. All techniques and fixtures used in the installation must minimize complexity and must allow for easy maintenance of, and ready access to, all components for test measurements.
- F. All materials used in installation shall be resistant to fungus growth and moisture deterioration.
- G. All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact cable pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other

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trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

3.02 IDENTIFICATION

- A. Refer to 27 0000.

3.03 LAYOUT AND TOLERANCES

- A. Locate WAPs within 10' horizontally and 2' vertically of location within drawings.
- B. Exterior WAPs and assemblies shall be located above 8' AFF, or as noted in the drawings.

3.04 TESTING

- A. Contractor shall perform a site inspection prior to the active survey to identify possible sources of interference.
 - 1. Spectrum analysis shall be performed for identified sources, and considered for modifications to the WAP layout.
 - 2. Common sources of interference include:
 - a. Analog phone lines
 - b. Baby monitors
 - c. Bluetooth devices
 - d. Wireless devices
 - e. Ovens and microwaves
 - f. Motion sensors
 - g. Jammers
 - h. RF signal generators
 - i. Zigbee devices
- B. Active survey shall be performed after all WAPs have been installed and verified operational.
 - 1. Ensure wireless adapters are up-to-date and compatible with the wireless generation (i.e. 802.11ac vs 802.11ax).
 - 2. Ensure floor plan scales are properly set and the system is calibrated.
 - 3. Pre-plan the survey walk to ensure the project is completely walked.
 - a. When walking, ensure both sides of obstacles are walked, and walk around the edges of walls/barriers.
 - 4. Scan all channels.
 - 5. Ensure correct SSIDs are detected.
 - 6. Verify dwell time is set to ensure all measured beacons are recorded. Adjust walking speed to ensure all measured channels are measured.
 - 7. Adjust signal propagation to suit the space. Large venues with minimal obstructions will require larger propagation values than smaller spaces or spaces with high occupancy densities.

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SECTION 27 41 34 - AV SYSTEMS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. All requirements under Instructions to Bidders, General Conditions, Supplementary Conditions, Special Conditions, Division One, Technical Specifications, Referenced Documents or Practices and any Addenda of these Specifications will be a part of this section. The Contractor is responsible to be thoroughly familiar with all its contents as to requirements which affect this Division or Section.

1.02 RELATED DOCUMENTS

- A. AV Drawings.
- B. Specification Sections:
 - 1. 27 05 29, Pathways for AV Systems.
- C. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions 00 and 01 Specification Sections, apply to this Section.

1.03 REFERENCES

- A. National Fire Protection Association (NFPA).
 - 1. NFPA 72 *National Fire Alarm and Signaling Code*, as adopted and/or amended by the Authority Having Jurisdiction (AHJ).
 - 2. NFPA 101 *Life Safety Code*, as adopted and/or amended by the Authority Having Jurisdiction (AHJ).
- B. Building Codes.
 - 1. International Building Code.
 - 2. State and Local Building codes as adopted and/or amended by the Authority Having Jurisdiction (AHJ).
 - 3. Americans with Disabilities Act (ADA) and/or State and Local equivalency standards as adopted by the AHJ.
- C. Audio Video Integrated Experience Association (AVIXA).
 - 1. F501.01: 2015, Cable Labeling for Audiovisual Systems.
 - 2. F502.01: 2018, Rack Building for Audiovisual Systems.
- D. National Cable Television Association (NCTA).
- E. Society of Motion Picture and Television Engineers (SMPTE).
- F. International Telecommunications Union (ITU).

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1. BT.709-6: 2015, Parameter Values for the HDTV Standards for Production and International Programme Exchange.
2. BT.2020: 2015, Parameter Values for Ultra-High-Definition Television Systems for Production and International Programme Exchange.

1.04 DEFINITION OF TERMS & ABBREVIATIONS

- A. Provide: to supply and install.
- B. Furnish: to supply to another contractor for installation.
- C. Supply: to supply but not install.
- D. Install: to install but not supply.
- E. OFOI: Owner Furnished Owner Installed.
- F. OFCI: Owner Furnished Contractor Installed.
- G. NIC: Not In Contract. Refers to items that are not included in the scope of work outlined in this section but may be shown for coordination purposes or reference.
- H. Future: Equipment that will be provided by owner later. Accommodations shall be provided for future equipment as shown on the drawings.

1.05 RESPONSIBILITY AND RELATED WORK

- A. The written specification and drawings AV0.00 through AV6.00 will be collectively referred to herein as the Contract Documents.
- B. The systems described in this section will be called the "AV Systems" and the installer will be named "The Contractor."
- C. The Contractor must provide all labor, materials, equipment, necessary tools, test equipment, hoisting, transportation, supervision and coordination necessary to complete the installation of the "AV Systems" as described in these specifications and illustrated on the Project drawings.
- D. Contractor shall provide, based on the Contract Documents, a complete, turnkey system, tested and ready for acceptance testing. The Contract Documents are developed to the extent required to properly convey design intent, signal flow, and system infrastructure. Contractor will supply any additional equipment required to provide a complete and working system.
- E. Contractor will supply any accessories, such as power supplies, adaptors, connectors and converters, required to provide a complete and working system.

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- F. System features or devices which are mentioned in one part of the Contract Documents may not be shown in the other. In case of conflict between the written specifications and the drawings, Contractor must seek clarification from the Consultant. If the Contractor fails to obtain such clarification, the interpretation of the Consultant will prevail.
- G. Contractor shall obtain all licenses and permits necessary for the execution of any work pertaining to the installation within this scope of work.
- H. Contractor shall comply with all union jurisdiction and prevailing wage requirements.
- I. Refer to AV0.00 for division of responsibilities related to the AV Systems.

1.06 SYSTEM DESCRIPTION

- A. Auditorium
 - 1. The auditorium will be equipped with typical audiovisual systems appropriate for a modern performing arts program, including jazz and film festivals. These systems will include sound reinforcement, assistive listening, cueing, presentation, control, and production intercom systems.
 - 2. Sound Reinforcement System
 - a. The audio system will include a left and right loudspeaker cluster with full-range large format speakers.
 - b. Speakers will be powered by amplifiers located in the AV rack in the Equipment Room.
 - c. Processing for the speaker system will be provided by a Digital Signal Processor (DSP) with audio networking capabilities.
 - d. A contact closure from the fire alarm control panel will be interfaced to the system to provide audio muting in case of an alarm event.
 - e. Microphone and Line Level inputs to the systems will be routed through wall mounted panels or floor boxes. The microphone inputs will be through a digital audio input system that is connected via CAT6 cabling to the mixing console in the control booth. Various intercom, tie lines and microphone line cables will also interconnect to other locations within the room.
 - f. All related equipment for the reinforcement system will be located in the control booth. All equipment located in the control booth must be securable.
 - 3. Auditorium Audio Sources and Mixing System
 - a. A 64-channel digital mixing console with remote stage boxes will be provided in the bid. The console will be located in the control booth at the rear of the auditorium. Audio sources will include:
 - 1) Audio input panels at:
 - 2) Downstage and Upstage Left and Right (4 locations)
 - 3) Each panel will have 2 dedicated mic inputs, audio tielines, and network connections for the mixing console stage boxes.
 - 4) Audio feeds from the video system sources
 - 5) Media playback from CD, MP3 player, Bluetooth portable devices.
 - 6) 4 or more channels of input from a computer interface for sound effects playback

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- 7) 8 wireless mics, with 6 bodypacks and 2 handheld transmitters.
- 8) Headworn microphones are to be provided for bodypack transmitters.
- 9) Wireless receivers will connect to the facility network to allow for monitoring at any location via iPad or computer.
- b. All input signals will connect to stage boxes to allow the digital console to be easily moved.
- 4. Audio Monitoring System
 - a. Monitor mixes will originate at the mixing console.
 - b. Two speaker level outputs for portable monitor wedges will be provided at all audio I/O panels on stage.
 - c. A pair of small nearfield monitors will be provided in the sound booth(s) for cueing purposes.
- 5. Assistive Listening System
 - a. A wireless, RF-based, system with a transmitter and multiple receivers will be provided for compliance with ADA in the auditorium. Receiver quantity is to equal 4% of the total seat count, and 25% of the receivers must be hearing aid compatible. Receivers will be provided with rechargeable batteries, and in a portable carrying case(s). Program audio will be provided to the ALS transmitter from the audio DSP.
- 6. Ancillary Speaker Systems
 - a. Ceiling-mounted speakers will be provided in the backstage spaces, restrooms, and lobby for monitoring of events, as well as potential chime playback for intermission cueing. Volume control for these speakers will be provided via the control system.
- 7. Production Intercom System
 - a. A 2-channel analog partyline intercom system will be provided in the bid. Intercom drops will be provided at:
 - 1) Control booth (2 drops)
 - 2) Stage (4 drops)
 - b. Program audio will be provided to the intercom system from the audio DSP. Three rack-mount remote stations will be provided at booth locations. All other drops will use standard single-channel belt packs. 8 belt packs and 8 headsets will be provided.
- 8. AC power systems
 - a. All power circuits for the facility wide sound systems must have isolated ground receptacles. All power circuits for the sound system will originate from one power panel, and will split to several sub-panels, if required.
- 9. Loose Equipment
 - a. A loose equipment package will be provided, including microphones, stands, cables, and monitor speakers.
- 10. Video Projection and Presentation System
 - a. Video projection will utilize motorized a front-projection screen with an aspect ratio of 16:9.
 - b. The projector will be located in the spot booth above the control booth.
 - c. The projector screen will be mounted in line with the proscenium in front of the curtains.

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- d. The screen, projector, video switcher, and one wireless mic will be controllable from a wired touch screen at the control booth. Video sources will include:
 - 1) Blu-ray player
 - 2) Computer inputs, both analog and digital, at downstage Stage Right and Stage Left, on the upstage side of the proscenium Stage Right and Stage Left, and at the control booth.
- e. Video sources will be routed through a digital video switcher that is HDCP compliant and provides HDBaseT inputs and outputs as well as HDMI.
- 11. Intercom
 - a. An intercom system will be provided that is compatible with the intercom system of the existing building and will be an extension of the existing system.
- 12. Televisions
 - a. A TV system will be provided that is compatible with the TV system of the existing building and will be an extension of the existing system.
- 13. AV Tielines
 - a. A system of general-purpose tielines for the interconnection of AV signals between various locations will be provided in the bid. This system will primarily use balanced audio and STP connections to allow signals to be routed around the facility as needed. STP and audio patching will be provided in the backstage equipment rack. Audio tielines will terminate in paralleled male/female XLR connectors, and Bantam-TT patch panels. STP lines will terminate in 8P8C connectors (RJ45), and STP patch panels. All STP lines will be CAT6 or better. Tieline panel locations will include:
 - 1) 2 AV wall panels front of stage (2 audio and 2 STP each)
 - 2) 2 AV floor boxes downstage lip (2 audio and 2 STP each)
 - 3) 4 AV wall panels on stage (2 audio and 2 STP each)
 - 4) Control Booth (2 STP on a panel at each control location)
- 14. AV Control System
 - a. A control system will be provided to allow various AV and lighting functions to be easily controlled.
 - b. Touchscreens and tablet devices will be used as user interfaces for the AV control system.
- 15. Camera
 - a. One still, wide-shot camera will be provided for a basic view of the theater. The feed will be sent to the video router for various distribution.
- 16. Add Alt – Cinema Audio
 - a. A loudspeaker cluster consisting of full-range large format speakers will be provided above the stage for additional audio coverage.
- 17. Add Alt – Cinema Video
 - a. An external digital cinema media server will be provided for Film Festivals and other movie viewing events.
 - b. The media server will be cable of playing DCP content.
- 18. Add Alt – Livestream System
 - a. A livestream encoder will be provided to livestream productions to streaming websites like YouTube, Twitch, Facebook Live, and TikTok.

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- b. Three PTZ cameras (one at the rear and one on each side wall) will be provided for additional camera shots for livestream productions.
- 19. Add Alt – Microphone Package
 - a. A loose inventory package will be provided consisting of microphones, stands, and cables.

1.07 PRE-BID SUBMITTALS

- A. Bid Clarifications. Contractor is responsible for reading and understanding all information presented in these specifications and related documents outlined in Section 1.02. Discrepancies between drawings and specifications or other errors or omissions should be brought to the Consultant's attention a minimum of 5 days prior to bid date. Failure to do so does not relieve the Contractor from the requirement to provide a fully operational and turnkey system as outlined above. In this event, the Contractor agrees to abide by the decision of the Consultant for resolution.
- B. Contractor Qualifications. Contractors will be considered by the Owner and Consultant upon receipt of the following information:
 - 1. Company profile including history, number of employees, facility size and completed projects.
 - 2. Resume of key personnel to be used on this project, including but not limited to: Project Manager; Lead Engineer; Job-Site Superintendent.
 - 3. Contractor shall have previously installed at least three jobs of similar magnitude, completed within the last five years. A resume shall be provided for these projects including project name, scope of services, year completed, and contact information for a reference. Provide at least one such completed job for inspection by the Architect and/or Consultant.
 - 4. Contractor shall have five years of experience with equipment and systems of the types specified, shall maintain a fully staffed and equipped service facility, and shall be a franchised dealer and authorized service facility for the major brands specified, and shall be properly licensed to work at the project location.
 - 5. A description of the Contractor's abilities for in-shop assembly, fabrication, and testing.
 - 6. A sample set of shop drawings or as-built documents that confirm the Contractor's capabilities to provide engineering and documentation for the project.
 - 7. A line sheet listing all manufacturers the Contractor is a dealer and/or authorized service center for.

1.08 BID SUBMITTAL

- A. Submit according to conditions of the Construction Contract and Project Manual.
- B. The Bidder shall disclose in the bid whether any portions of the project work will be subcontracted out. All terms of this contract, including bidding and qualification statements, shall apply to the subcontractor. Provide the following information for each subcontractor to be used:
 - 1. Name of the proposed subcontractor.

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2. A statement of qualifications for each subcontractor.
 3. A scope of work outlining what portions of the project for which the subcontractor will be responsible.
- C. Include the following information with the bid submittal:
1. The total contract price.
 2. The price for any add or deduct alternates.
 3. An itemized equipment list which includes unit pricing for all equipment.
 - a. List to be presented in the same sequential order as in Part 2 below.
 4. A breakdown of the cost and number of labor hours for each of the following:
 - a. Engineering and documentation.
 - b. On site coordination meetings and supervision.
 - c. In shop fabrication and assembly.
 - d. On site fabrication, assembly, and installation.
 - e. On site verification and testing.
 - f. Contractor tests and adjustments as outlined in Section 3.07.
 - g. Manufacturer training, inclusive of travel expenses.
- D. Substitutions. Contractor shall note all substitutions at the time of bid. Comply with General Conditions. Any proposed substitutions must meet all specifications of the specified equipment. No product substitution will be accepted without the written approval of the Consultant or Owner. Consultant and Owner retain the right to reject any proposed substitution.
- 1.09 PROJECT SUBMITTALS
- A. Submit according to conditions of the Construction Contract and Project Manual.
- B. Each submittal shall be as a coordinated package complete with all required information. Uncoordinated sets will be returned without review.
- C. Product Data.
1. Submit manufacturer's product data sheets for each item of equipment that will be provided as part of this contract for approval prior to purchase of equipment.
 2. Submit electronically as a single PDF. All equipment cut sheets will be arranged per specification section number. Provide a table of contents and a bookmark at the start of every product sheet.
 3. Failure to submit without time for evaluation shall not entitle the Contractor to purchase, substitute product or delay the project's delivery product without approval.
- D. Color Submittal.
1. Submit according to conditions of the Construction Contract and Project Manual.
 2. Organize according to location, device, and color option.
 3. Where custom colors have been specified, include the appropriate reference (RAL, Pantone, etc).

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4. This shall include but not be limited to: floorbox lids, wall mounted devices and panels, ceiling mounted devices and panels, and loudspeakers.
- E. Millwork Colors and Samples. Submit according to conditions of the Construction Contract and Project Manual.
- F. Shop Drawings.
 1. Review of shop drawings is for general conformance with the design intent and general compliance with the contract documents of the project. Corrections, comments, or markings made do not relieve the Contractor from compliance with the Contract Documents nor allow departure therefrom. Contractor remains responsible for detailing and accuracy, confirming and correlating quantities and dimensions, selecting fabrication processing and techniques of construction, coordinating work with that of other trades, and performing work in a safe a satisfactory manner.
 2. Failure to submit shop drawings without time for evaluation shall not entitle the Contractor to an extension of contract time.
 3. There will be no work authorized on site without the prior submittal and subsequent approval of a complete set of shop drawings. Any exceptions to this must be in writing and approved by the Consultant.
 4. Submit as a multi-sheet searchable PDF document with:
 - a. 42" X 30" sheets.
 - b. Table of Contents.
 - c. Bookmarks for every sheet with Sheet Name and Number.
 5. Drawings shall be a standalone package containing all information required for system installation. The package shall include:
 - a. A legend of all symbols and abbreviations used in the drawing package.
 - b. Plan View Drawings showing:
 - 1) Locations of all equipment and devices.
 - 2) Locations of junction boxes, with associated conduits and cable fill.
 - 3) Coordinated layouts of:
 - a) Equipment Rooms.
 - b) Control Booths.
 - c) Production Suites.
 - c. Section and Elevation Drawings including but not limited to:
 - 1) Speakers.
 - 2) Large Displays.
 - 3) Projection Screens.
 - 4) Projectors.
 - 5) LED Display Boards.
 - 6) Monitor Walls.
 - d. Equipment Rack Elevations including:
 - 1) Location of all equipment within the rack.
 - 2) Heat loads for each equipment rack and calculations showing how numbers were derived.
 - e. Custom Furniture and Millwork Details.

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- 1) Show all dimensions and finishes for custom furniture and millwork including equipment locations and mounting methods, coordinate with Division 6.
- f. AC Power Requirements.
 - 1) For each equipment rack show:
 - a) Power requirements and calculations showing how numbers were derived.
 - b) Power distribution details within each rack.
- g. Rigging Details.
 - 1) Submit for LED Displays and Speakers.
 - 2) Details will be submitted with licensed engineer stamp licensed to practice at the project location.
 - 3) Drawings will include:
 - a) Structural attachment details.
 - b) Welding calculations.
 - c) Types of hardware to be used.
 - d) Speaker aiming angles.
 - 4) Provide structural calculations along with the stamped drawings. Refer to all requirements of Division 5 – Metals.
- h. Wiring Schematics.
 - 1) Provide complete and detailed wiring schematic for all systems including:
 - a) Cable types.
 - b) Cable identification by number and color codes.
 - c) Detailed wiring of connections to equipment and between equipment racks.
 - d) Equipment identifier matching that used in the Contract Documents.
- i. Schematic drawings of any custom circuitry or equipment modifications, including connector pin-outs and component lists.
- j. Schedules showing:
 - 1) Cable Types.
 - a) Type identifier matching that used in the Contract Documents.
 - b) Manufacturer.
 - c) Part Number.
 - d) Signal Group.
 - e) Nominal Outside Diameter.
 - 2) Junction Boxes.
 - a) Box Name matching that used in the Contract Documents.
 - b) Drawing Reference.
 - c) Location.
 - d) Dimensions.
 - e) Mounting Height.
 - 3) Pull Schedule.
 - a) Pull Length.
 - b) Source and Destination.
 - c) Wire Number.

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- 4) Custom Color and Finishes for:
 - a) Speakers.
 - b) Custom Panels.
 - c) Exposed Cabling.
 - d) Custom Furniture.
 - k. Conduit riser diagram showing interconnect of all systems.
 - l. Terminal strip layouts for all terminal strips to be used in junction boxes or equipment racks.
 - m. Connector wiring details including connector model numbers and labeling methodology.
 - n. Network schematic showing:
 - 1) Logical Connections of all devices.
 - 2) IP address scheme.
 - 3) VLAN Scheme.
 - o. Custom Panel Details including:
 - 1) Materials.
 - 2) Finishes.
 - 3) Dimensions.
 - 4) Connector Layout.
 - 5) Connector Labeling.
 - p. Audio, Video and Data patch bay layouts and labeling scheme.
 - q. Mounting and orientation details for:
 - 1) Flat Panel Displays.
 - 2) Surface Mount Speakers.
 - 3) Wireless antennas.
- G. Custom Software Programming including Graphical User Interface (GUI).
- 1. Provide for approval at least 6 weeks prior to system commissioning electronic copies of all custom software. It is the Contractor's responsibility to provide all custom software programming. Coordination with the Consultant is required for the development of this software.
- H. Wireless Frequency Analysis.
- 1. It is the responsibility of the contractor to coordinate all wireless frequencies. The contractor shall perform a spectral sweep from 140 MHz through 3 GHz in the facility and then present a written report of proposed new frequencies.
 - 2. The Contractor must arrange and perform this sweep at a time of day that reflects the time of facility use.
 - 3. The contractor should also include in the report additional frequencies for future expansion.
 - 4. The Contractor will incorporate any existing and other new frequencies in the determination of the new frequencies to be used, including but not limited to wireless intercom, wireless cameras and wireless radios.
- I. Assistive Listening System Analysis.
- 1. Contractor is responsible for providing documentation showing the Assistive Listen system meets accessibility requirements of the project location.

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2. Contractor is to provide a quantity of receivers per prevailing code.

J. Final Inspection Notification Report.

1. Two copies of a computer-generated checkout report for the entire system must be prepared and submitted 2 weeks prior to system commissioning. It will include:
 - a. A complete listing of every piece of equipment including serial number, the date it was tested and by whom, the results and (if failure occurred during any previous tests) the date retested.
 - b. The final report will indicate that every device tested successfully.
 - c. A performance test report indicating that the system meets all the Contractor testing requirements in Section 3.07.
 - d. A copy of the Final Inspection Report must be included in the Project Manual.

1.10 CONTRACT CLOSEOUT SUBMITTALS

- A. Submit according to conditions of the Construction Contract and Project Manual.
- B. Submit all contract closeout documentation within 30 days after substantial completion, unless otherwise noted.
- C. Contractor shall work off approved shop drawings only. Note changes made during installation on a single set of drawings. This set of marked up drawings will not leave the jobsite until after the final system commissioning. Submit 4 corrected sets of reproducible drawings showing work as installed. All "as-built" drawings to be provided both in electronic form (ACAD 2010 or later) and in hard copy (same size as architectural drawings).
- D. Contractor to provide a Project Manual prior to acceptance testing. Provide a minimum of one hard copy and one electronic copy. This manual shall contain the following information:
 1. Table of Contents.
 2. Contractor's contact information for warranty and/or service.
 3. A complete list of equipment, both installed and loose gear. Include manufacturer, model number, and serial number for all devices. Include settings (software or hardware) for any devices that required modification or adjustment during the acceptance testing.
 4. Operating manuals for each device.
 5. Documentation of all testing results as outlined in Section 3.07.
 6. Wireless microphone frequency coordination report.
 7. A USB drive containing all As-Built drawings in PDF & DWG format.
 8. Replacement parts lists of major items of equipment.
 9. Provide a suggested schedule of routine maintenance. Schedule should include dates of replacement of all batteries, cleaning of air filters and procedures for verifying system functionality.
- E. Create a quick start guide to provide information specific to each room/system, such as procedures for system power on/off, patching, different modes of operation, etc.

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1. The guide should convey information specific to each room/system. It is not intended to be a guide on generic system operation.
 2. Anticipated length of each guide is less than 2 pages front and back.
- F. Software Licensing and Manuals. Provide a copy of all software installed on computers or equipment in the system, including all device configuration files, on a USB disk drive.
- G. Produce compact system flow diagrams showing all components, cables, and wire numbers that will be mounted on the wall of each equipment room. Provide photographically reproducible as-built wiring diagrams at a reduced scale that are easy to handle and fully legible.
- H. Provide a complete list of spares inventory that includes quantity, manufacturer, model number, and serial number.
- I. System Remote Controls. All remotes for displays, projectors, etc. to be collected and turned over to Owner.

1.11 PROJECT CONDITIONS

- A. Verify conditions on the job site applicable to this work. Notify the Consultant and General Contractor in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The drawings diagrammatically show cabling, conduit, wiring, and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Consultant for approval, showing how the work may be installed.

1.12 WARRANTY

- A. Contractor shall warrant equipment to be free of defects in materials and workmanship for not less than one year after date of Substantial Completion. Defects occurring in labor or materials within the one-year warranty shall be rectified by replacement or repair. Owner furnished equipment is excluded from the warranty, but terminations and wire leading to or from Owner furnished equipment is included. Within the warranty period, provide answer to service calls and requests for information within a 48-hour period, and repair or replace any faulty item within a 72-hour period without charge, including parts and labor.
- B. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.
- C. Contractor to provide Owner with exact beginning and ending dates of the warranty period. Include the name and telephone number of the person to call for service. This information is to be part of Project Record Drawings.

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- D. Contractor to conduct a final site visit and verify that the system is operational, and all items are functioning correctly at the end of the warranty period. Contractor shall not be responsible for correcting items that have been changed by the Owner or end user.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Model numbers and manufacturers included in this specification are listed as a standard of quality. Equipment and materials will be new, meet the latest published specifications of that product.
- B. All devices will have applicable approvals from a Nationally Recognized Testing Laboratory and meet all applicable local codes and requirements. Should any equipment lack proper approval the Contractor will arrange for onsite inspections and certification at no additional expense to the Owner.
- C. Product Substitutions.
1. Consultant will consider other qualified manufacturers subject to review. Submit according to conditions of the Construction Contract and Project Manual.
 2. Proposed substitutions must meet all specifications of the specified equipment. The Contractor will supply complete technical data specifications at the time of proposed substitution.
 3. The Contractor will arrange for product demo at the request of the Consultant or Owner Representative and will pay ground freight shipping to and from site, or to and from Consultant's office.
 4. No product substitution will be accepted without the written approval of the Consultant and Owner. The Owner, General Contractor, and the Consultant reserve the right to accept or refuse any substitution without condition.
 5. Upon acceptance of a substitution, Contractor assumes all responsibility for verification and coordination of all heat, power, rack space and architectural requirements.
- D. If product is discontinued and/or no longer publicly advertised as a part of a manufacturer's current product line-up at time of installation, the project team reserves the right to request a substitution of product for new and currently offered product of like function fulfilling the design intent. Substitution value will be based on fair market value of original product at time of bid.

2.02 EQUIPMENT LIST

- A. In addition to the equipment below, include all product specified in Attachment A.
- B. Color selection shown in the equipment list does not designate a selected color. All colors must be coordinated with Architect and Consultant.

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2.03 AV SYSTEMS COMPONENTS

- A. AV Equipment Racks:
 - 1. Rack color: coordinate with Architect.
 - 2. Verify exact rack space required.
 - 3. Provide service lamp in the top of each rack.
 - a. Middle Atlantic LT-CABUTL Series
 - 4. Modular power raceway system. Include as required:
 - a. Middle Atlantic MPR-8A.
 - b. Middle Atlantic MPR-JB####A (Provide size as required).
 - c. Middle Atlantic M-2X20A.
 - d. Middle Atlantic M-30TL-HWA.
 - e. Middle Atlantic power cabling as required.
 - 5. Provide & install rubber mat under all floor standing racks.
- B. Rackmount UPS Backup.
 - 1. UPS must have contact closure for remote shut down of load circuits.
 - 2. UPS to have a minimum 15 min run time under load.
 - 3. Use fanless UPS in noise control booths and control rooms.
- C. Digital Signal Processor.
 - 1. See Section 3.02 for Programming Requirements.
 - 2. Interface DSP logic with fire mute in each rack location.
- D. Network Switches.
 - 1. Contractor to configure switches as required.
 - 2. Work with related DIV 27 contractors, Owner's IT Provider and other contractors to allocate IP addresses and configure network VLANs to support AV system needs.
 - 3. All network capable equipment shall be connected to the AV network, including but not limited to Amplifiers, wireless microphones, DSP, playback devices, etc.
- E. Power Amplifiers.
 - 1. Each amplifier to have a 2-ply phenolic label on the front and rear, stating amplifier number and which speakers it is feeding.
- F. Loudspeakers.
 - 1. Coordinate all colors with Architect.
 - 2. All rigging to allow for +/- 10deg of horizontal and vertical adjustment.
 - 3. Provide a support structure for speaker systems sized to safely handle the system weight.
- G. FM transmitter with headset receivers for Assistive Listening System.
 - 1. Contractor is responsible for verification of receiver quantities per project code requirements.
 - 2. Install antenna system in accordance with manufacturer's recommendations.

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H. Wireless Microphone Systems

1. Select wireless frequency bands based upon frequency analysis performed in Section 1.6.J.
2. Ensure all modules necessary for a complete system are included.
3. Ensure all cabling required for remote antenna locations is included.
4. Contractor shall perform calculations to determine cable and connector loss based on install conditions. Install antenna boosters as required per calculations. Include this report with shop drawing submittals.

I. Projection Screens

1. Unless otherwise noted on drawings, set limits so the bottom of projected images are 48" above finished floor in classrooms, conference rooms, and meeting rooms and 60" above finished floor in auditoriums and ballrooms. Include additional black drop as needed to meet projected images specified heights. Ensure deployed screens clear all wall protrusions and allow for future installation of wall mounted whiteboard or chalkboard.

J. Televisions and Mounts

1. TVs must meet the following specifications:
 - a. TV viewable diagonal sizes may be +/- 3" from that specified
 - b. Internal ATSC & QAM tuner
 - c. Internal speakers.
 - 1) TVs will have digital audio output following the selected input.
 - 2) TVs will have an analog audio output following the selected input with variable volume.
 - d. Wall mounted TVs are to be compliant with ADA clearance requirements.
 - 1) If the bottom of the TV is below 6'-8" AFF the following applies:
 - a) Displays 2.5" or less in total thickness to use mounts with a depth of 1.5" or less with micro adjust, tilt & swing arm capabilities.
 - b) Displays 2.5" or greater in total thickness to use ultra-thin mounts with a depth of 1" or less with micro adjust & tilt capabilities.
 - c) Display & mounting solution total overall protrusion from the wall not to exceed 4".
 - 2) The total depth of the display & mounting solution not to exceed 4" protrusion from the wall to the front face of the display.
 - 3) The contractor will provide ultra-low-profile mounts per each display to meet all relevant ADA clearance requirements.
 - e. Controllable by 3rd party control system via hardwired RS-232 / serial port.
 - f. LED backlit LCD technology only.
 - g. VESA mount compatible
 - h. Acceptable Manufacturers
 - 1) Sony
 - 2) Samsung
 - 3) LG
 - 4) Panasonic
 - 5) Planar
 - 6) NEC

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K. Audio Patchbays:

1. Label each patch point with unique wire label to match label on panel or equipment. Provide functional labels over groups of patch point to label destination hardware or location.
2. Front programmable patchbay
 - a. Bittree B96DC-FNAIT/E3 M2OU12B. (Qty. per design)
3. Patch Cords:
 - a. Coordinate color with owner.
 - b. Bittree BPC1800-110 (Qty. 24 per patchbay provided)
 - c. Bittree BPC2402-110 (Qty. 12 per patchbay provided)

L. Data Patchbays:

1. Data patch point to match specification for cable terminating to patch point. Shielded cabling will require a shielded connector.
2. Label each patch point with unique label to match label on panel or equipment. Provide functional labels over groups of patch point to label destination hardware or location.
3. Modular Patch Panel:
 - a. Install with printed labeling strip.
 - b. Belden AX103114 24-Port 1RU (Qty. per design)
 - c. Belden AX103115 48-Port 2RU (Qty. per design)
4. Cat6 UTP Connector
 - a. Black Keystone
 - b. Belden AX101321 (Qty. per design)
5. Cat6 STP Connector
 - a. Shielded Keystone
 - b. Belden AX104596 (Qty. per design)
6. Provide all patch cables required for use, per system schematics, plus additional 8 matching patch cables per patch bay.

M. Fiber Patchbays:

1. Label each patch point with unique wire label to match label on panel or equipment. Provide functional labels over groups of patch point to label destination hardware or location.
2. Modular Enclosure:
 - a. Belden ECX-01U 1RU LAN Housing (Qty. per design)
 - b. Belden ECX-02U 2RU LAN Housing (Qty. per design)
 - c. Belden ECX-04U 4RU LAN Housing (Qty. per design)
3. Splice Cassettes
 - a. Provide Dual LC Connectors.
 - b. Belden FC3X06LDFS OM3 Aqua Adaptor (Qty. per design)
 - c. Belden FCSX06LDFS SM Blue Adaptor (Qty. per design)
 - d. Belden FCSX06LAFS SM/APC Green Adaptor (Qty. per design)
4. Patch Cables:
 - a. Provide all patch cables required for use, per system schematics, plus additional 4 matching patch cables per splice cassette.
 - b. Belden FP3LDLD002M, OM3 2m

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- c. Belden FPSLDLD002M, OS2 2m
- d. Belden FPSLALA002M, OS2/APC 2m

N. Video Patchbays:

- 1. Label each patch point with unique wire label to match label on panel or equipment. Provide functional labels over groups of patch point to label destination hardware or location.
- 2. Normalled patchbay:
 - a. Bittree B64T-2MWNHD (Quantity Per Design)
 - b. Bittree VPCM 24 02-75 Patch Cords (Qty. 8 per patchbay provided)
 - c. Bittree VPCM 24 05-75 Patch Cords (Qty. 8 per patchbay provided)
 - d. Bittree VPCM 24 06-75 Patch Cords (Qty. 8 per patchbay provided)
 - e. Bittree ADMW48 BNC to Mini-WECO (Qty. 4 per patchbay provided)

2.04 CUSTOM PANELS

- A. Panels to be fabricated by Contractor, engraved and loaded with connectors with information shown on Drawings.
- B. Unless otherwise specified, all wall and ceiling panels will be 1/8-inch-thick, anodized aluminum. (Brush in direction of aluminum grain only.) Engraving will be 1/8-inch block sans serif characters.
 - 1. Coordinate all panel colors/finishes with Architect.
 - 2. All custom panels will have beveled edges.
 - 3. Text color will be white for all black/dark colored panels and black for all white/light colored panels.
 - 4. Connector color will be silver for all white/light colored panels and black for all black/dark colored panels.
 - 5. Plastic plates will not be accepted.
 - 6. Where Extron, Crestron, or other manufacturer's transmission equipment will be mounted on a wall or ceiling plate visible to the public, uses Decora style plates, coordinate color of equipment and wall plate with Architect.
 - 7. Wall panels sizes to be coordinated with J-boxes dimensions and mounting conditions.
 - a. Panels mounted on surface mount boxes will not protrude beyond the edge of the box thereby creating a sharp edge condition.
 - b. Panels mounted on flush mount boxes will extend beyond the edge of the J-box by 1/4" on all sides.
- C. Unless otherwise specified, all rack panels and floor box panels will be 1/8-inch-thick, black anodized aluminum. (Brush in direction of aluminum grain only.) Engraving will be 1/8-inch block sans serif characters. Lettering will be white.
 - 1. Coordinate all panel finishes with Architect.
 - 2. Connector color will be silver for all white/light colored panels and black for all black panels.
 - 3. Rack panels will be standard EIA sizes.
 - 4. Plastic plates will not be accepted.

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- D. Floor Boxes will be flush mounted.
- E. Panels in outdoor or harsh environmental conditions will be stainless steel and contain connectors fit for their environment.
- F. Contractor will submit panel engraving schedule and fabrication drawings for approval
- G. Panels to be manufactured by one of the following manufacturers:
 - 1. Panel Authority
 - 2. Proco
 - 3. RCI
 - 4. Whirlwind
- H. Panel Connectors.
 - 1. Panels to contain components listed below:
 - a. Female XLR: Neutrik NC3FD-L-B-1.
 - b. Male XLR: Neutrik NC3MD-L-B-1.
 - c. Locking 1/4": Neutrik NJ3FP6C-B.
 - d. Female XLR-1/4" TRS Combo: Neutrik NCJ6FI-S
 - e. Rugged RJ45: Neutrik NE8FDX-P6-B or NE8FDX-Y6-B
 - f. BNC (75 Ohm): Neutrik NBB75DFIB-P
 - g. BNC (50 Ohm): Canare BJ-JRUD
 - h. 4-Pole Speaker: Neutrik NL4MP
 - i. 8-Pole Speaker: Neutrik NL8MPR-BAG
 - j. Mass Connectors: Whirlwind W-series
 - k. Triax: ADC ProAx Plugs and Jacks w/45 Degree Mount Kit.

2.05 CABLE, CONTROL WIRING & TERMINATIONS

- A. Electrical conductors installed under this contract, except where otherwise specified, will be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper.
- B. Refer to drawing AV0.00 for scope of work related to supply, installation, and termination of cable.
- C. Refer to drawing AV0.01 for cables to be used.
 - 1. Use plenum and underground cables as required by code.
 - 2. It is assumed all underground cables, where they transition to cable tray or free air, will not pass through plenum spaces outside of conduit.
- D. Refer to drawing AV0.01 for minimum cable lengths required outside of boxes.
- E. The Contractor will verify all connector details required for installation of equipment, including make, model, connector sex, attachment configuration, pinouts, and cable clamp accessories.

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- F. Video Connectors: All primary video equipment will use crimp-on style BNC connectors. If consumer grade equipment is furnished with RCA connectors, the cable will be terminated in a crimp-on style RCA connector. It will not be acceptable to use BNC to RCA adapters for consumer grade connections.
- G. Video Terminators: Video terminations will be comprised of commercially available 75-ohm 0.1% tolerance units with integral BNC connectors, which are applied as required, plus a 20-count spare.
- H. Speaker Level Rail Mounted Terminal Blocks:
 - 1. To be used in speaker cluster and Equipment Room junction boxes where shown on schematic drawings or as required by field conditions
 - a. Rail-Mounted Terminal Blocks
 - 1) Positive Terminal (+): Orange Part #2010-1302
 - 2) Negative Terminal (-): Gray Part #2010-1301
 - b. Mount on non-corrosive DIN rail
 - 1) Wago 210-112
 - c. Use insulated Ferrules on all terminations
 - 1) 8 AWG: Wago 216-289
 - 2) 10 AWG: Wago 216-288
 - 3) 12 AGW: Wago 216-287
 - 4) 14 AWG: Wago 216-286
 - d. Crimp with
 - 1) 6-10 AWG: Wago 206-216
 - 2) 12-24 AWG: Wago 206-204
 - e. Use end and intermediate plates
 - 1) Orange: Wago 2010-1392
 - 2) Grey: Wago 2010-1391
 - f. Use push-in jumpers as required
 - 1) Wago 2010-4xx
 - g. Use marking strip system
 - 1) Wago WFB Continuous Marking Strip
- I. Microphone and Line Rail Mounted Terminal Blocks
 - 1. To be used in Equipment Room junction boxes where shown on schematic drawings or as required by field conditions
 - a. Rail-Mounted Terminal Blocks
 - 1) Wago 280-550
 - b. Mount on non-corrosive DIN rail
 - 1) Wago 210-112
 - c. Use insulated Ferrules on all terminations
 - 1) 20 AWG: Wago 216-222
 - 2) 22 AWG: Wago 216-221
 - 3) 24 AGW: Wago 216-321
 - d. Crimp with
 - 1) Wago 206-204
 - e. Use end and intermediate plates

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- 1) Wago 280-305
- f. Use push-in jumpers as required
- 1) Wago 280-4xx

J. Cable Mount Connectors.

- 1. Cables to use components listed below, unless otherwise noted:
 - a. Female XLR: Whirlwind WI3F-BK
 - b. Male XLR: Whirlwind WI3M-BK
 - c. Male XLR Numbered: Whirlwind WI3M -BK-#
 - d. To be used on all audio console and stage box inputs.
 - e. 1/4" TS: Switchcraft 280
 - f. 1/4" TRS: Switchcraft 297
 - g. Rugged CAT6 RJ45: Neutrik NE8MX-B-1
 - h. RCA: Canare 75 Ohm
 - i. BNC (75 Ohm): Canare 75 Ohm
 - j. BNC (50 Ohm) Type F Cables: Amphenol Connex 112563
 - k. BNC (50 Ohm) Type G Cables: Amphenol Connex 112120
 - l. 4-Pole Speaker smaller than 12AWG: Neutrik NL4FC
 - m. 4-Pole Speaker greater than 12AWG: Neutrik NLT4FX-BAG
 - n. 8-Pole Speaker smaller than 12AWG: Neutrik NL8FC
 - o. 8-Pole Speaker greater than 12AWG: Neutrik NLT8FX-BAG
 - p. Mass Connectors: Whirlwind W-series
 - q. Triax: ADC ProAx Plugs and Jacks.
 - r. SM Fiber Optic: Amp Metallic ST style (Flat Finish)

- K. Use the following chart for color coding cables for use in the AV systems. Please see the drawing package for specific cable part numbers

| Signal Type | Letter | Color |
|--------------------------|--------|-------------|
| HD Video | H | Violet |
| SDI Video | H | Blue, Light |
| Composite Video | H | Green |
| Bi-Level Sync/Reference | H | Red |
| Tri-Level Sync/Reference | H | Orange |
| V-TIE (multi-use) | H | Grey |
| Triax Camera Cable | T | Black |
| Multicore Camera Cable | M | Black |
| Analog Line Level Audio | D | Green |
| Analog Mic Level Audio | E | Orange |
| Digital Audio (AES) | X | Yellow |

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| | | |
|---------------------------|-----|----------------|
| Time Code | E | White |
| RF (Distributed) | K | White |
| RF (Trunk Line) | L | Black |
| RF Antenna | F/G | Black |
| Tally | E | Chrome |
| RS-232/422/485 Control | R | Chrome |
| Network 10/100/1000 | U | Yellow |
| Network Facility LAN | U | Blue |
| KVM | U | Green, Dark |
| Intercom | E | Brown |
| Speaker | A | Grey |

2.06 J-HOOKS, CABLE HANGER AND TIES

- A. Non-metallic cable support systems such as J-hooks, ties, etc. must be CMP, plenum rated or CMR, riser rated, where applicable. Panduit J-Pro J-hooks Caddy brand "Cable-Cat" hangers or owner and engineer approved equal.
- B. Metallic cable support systems such as J-hooks or Caddy brand "Cable-Cat" hangers must be CMP, plenum rated.
- C. J-hooks will provide a fully radiused support structure with no tight corners to pinch or bind cables, must provide a minimum 1" wide load bearing surface with a minimum 1/4" radius edge.
- D. Cable support system devices will be provided complete with cable retainer.
- E. Cable installation accessories (e.g. pulleys for J-hooks) may be provided and utilized as applicable in compliance with TIA/EIA standards.
- F. "Velcro" type cable wraps will be utilized for cable management only, in the horizontal plane and the vertical plane in MDF, BDF, TR and data cabinets. "Velcro" may not be used in other locations requiring vertical support.
- G. Cable ties of a minimum 0.190" width, installed in a figure 8 pattern around the support member and crossing over the cable/cables will be utilized for cable management and support in a vertical plane.

PART 3 - EXECUTION

3.01 GENERAL

- A. Coordinate work with other trades to avoid causing delays in construction schedule.

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- B. Delivery, Storage and Handling.
 - 1. All products and materials to be handled and shipped in accordance with manufacturer's recommendation.
 - 2. Provide protective covering on equipment and furniture during construction to prevent damaging or entrance of foreign matter.
 - 3. Replace at no expense to Owner, product damaged during delivery, storage, handling or construction.
- C. Mount equipment and enclosures plumb and square. Permanently installed equipment to be firmly and safely held in place.
- D. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting. Adhesive-backed electrical tape and friction tape is not acceptable for insulating or protective purposes.
- E. Equipment Racks
- F. Mount equipment in racks and consoles and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Consultant in writing that racks will be fabricated on site and the reasons for the change.
- G. Provide and install equipment racks as specified under this section in a manner in keeping with local seismic codes. Racks located on concrete floors in equipment rooms or non-finished spaces are to be mount on a 4 inch di-electrically isolated riser such as a 4-inch concrete riser, provided by Division 3. Ensure that all equipment racks are electrically decoupled from flooring to prevent coming into contact with any safety grounded items during operation by providing rubber mat-style isolation between racks and riser.
 - 1. Inspect all racks, consoles, and enclosures prior to installation. All rough or sharp edges that may cause injury to personnel must be deburred or a permanent protective coating applied.
 - 2. Design and provide ventilation adequate to keep temperature within the rack below 85 degrees Fahrenheit. This ventilation system must be temperature actuated.
 - 3. Provide blank rack-mount panels installed in all rack openings not occupied by equipment. Blank filler panels will not exceed five rack units in size. Install rack mounted equipment with black 10-32 Phillips head machine screws.
 - 4. Looking at the rack from the rear, locate AC power, digital control, DC control, and speaker wiring on the left; microphone, line level audio, and video wiring on the right. Panels or equipment mounted on the rear rack rails will not block access to any front mounted components.
 - 5. Provide security covers on non-user operated equipment having front panel controls. Install covers at the conclusion of Acceptance Testing.
 - 6. Install rack mounted equipment with black 10-32 button head machine screws.
 - 7. Panels or equipment mounted on the rear rack rails must not block access to any front mounted components. Front mounted equipment will be given ample space to allow for access to rear connection.

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8. Provide security covers on non-user operated equipment having front panel controls. Install covers at the conclusion of Acceptance Testing.
- H. The process of acceptance testing the System may necessitate moving and adjusting certain component parts - e.g., video monitors.
- I. AC Power and Grounding
 1. The Contractor will be responsible for the supply and installation of AC power connections and circuits within the equipment racks that are to be provided under this section. The Contractor is to provide a 6"x6" J-Box at the top of each rack with power circuit cabling terminating in 24" pig tails. The Electrical Contractor will provide all AC power and conduit to the equipment racks and will terminate AC power circuits within J-Boxes at bottom/top of racks.
 2. Install 3-conductor, 120 VAC outlets in each rack. Provide a minimum of two spare outlets in each rack. Label each outlet as to which AC circuit is feeding it and provide the same information in the circuit breaker panel.
 3. The A/V system technical ground will be bonded to the metal frame of all equipment racks by use of an uninsulated ground buss lug or bar mounted in each rack. When more than one rack exists, all equipment buss lugs will be bonded to one central equipment rack buss lug. This central equipment rack buss lug will be the only connection to the A/V system technical ground conductor. The ganging of racks together with mechanical fasteners is not an acceptable method of bonding the video system technical ground between racks.

3.02 DSP AND CONTROL SYSTEMS PROGRAMMING

- A. General.
 1. Programmers will have current manufacturer's certifications for all Control and DSP software.
 2. The contractor will develop signal flows and user interfaces for each system. Several levels of user access are expected.
 3. All programming is the property of the Owner and will be given to the Owner via flash drive at the end of the system warranty period.
 4. All passwords for devices and software will be provided to the Consultant.
 5. The Contractor will coordinate with the Owner's IT staff as necessary to interface with the facility LAN and Wi-Fi.
 6. Completed programming will be tested and operational prior to system calibration and verification.
 7. Three major owners requested revisions to functionality and user interface layouts will be incorporated during the first year of building operation.
 8. The lead programmer(s) will be present for 4 Owner designated events to provide event support and functionality verification.
- B. Control Systems Programming.
 1. Provide control of all AV equipment. Control utilizing a listed method or manufactures documented control process, plugin, or driver utilizing the following protocols:

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- a. TCP/IP
 - b. UDP/IP
 - c. HTTP
 - d. Serial
2. All controlled devices will provide real-time feedback for status and monitoring.
 3. Where a listed method of control is not present for an AV component, Contractor will provide a method of control.
 4. Custom control programming and scripting is required to control AV equipment.
 5. Spaces with user interfaces but without a dedicated processor will use resources from an available processor on the network.
- C. DSP Programming.
1. The audio for the systems described above will be processed by a combination of a standalone DSP and onboard amplifier processing. This will provide all equalization, cross-over settings, level control, muting, routing, level monitoring, etc.
 2. The audio signal flow through the DSP will be designed so that:
 - a. All processing, from input to output, for a space is on a single tab.
 - b. Multiple spaces may share a tab where each space is bordered by a clearly labeled frame.
 - c. A label, meter and mute control for each active input and output are provided on the schematic page.
 - d. Processing signals along a common signal path (input or output processing) is via n-input or multichannel processing blocks. Channel groups should not be used.
 - e. Controls for simple processing blocks, such as delays or high-pass filters, are copied to the schematic page.
 - f. Manufacturer's custom voicing profiles are loaded.
 - g. All controls addressed by scripts, user interfaces, or external control:
 - 1) Are notated by color and naming convention.
 - 2) Have text adjacent to the control noting the associated script or external device. For example:
 - a) "Fire Mute: controlled by GPI 1".
 3. When available, the Programmer will utilize the manufacturer's plugins for direct control of equipment, such as amplifiers.
 - a. Parameter status in devices will follow status in DSP and vice versa. For example, muting a group of speakers in the amplifier controller software will show the group as muted in DSP. Partial group muting will indicate a partial muting of that group in DSP.
- D. Graphical User Interface Programming.
1. Provide control and monitoring of display devices, playback devices, DSP, and other AV equipment as described below.
 2. User interfaces will be formatted and sized appropriately for display resolutions of the control screen displays. Multiple versions of the same GUI may be required for compatibility with different display resolutions.
 3. Control screen workflow will be activity/preset based and follow these guidelines:

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- a. Activities for each space will be coordinated with the Consultant and Owner.
 - b. User will select an activity, the technical system will configure for the selected activity, and only necessary control elements are available on the user interface.
 - c. Within each activity the control screen will be built around a single page layout with popups displaying control elements as needed.
 - d. When additional control elements are needed, the user will select the advanced operator control page.
 - e. The interface layout will be consistent across all activities with commonly used control items always shown such as source volume with mute.
4. User interfaces will control technical systems in each space. Each user interface will be tailored for the specific control needs based on the intended user and installed location:
- a. User control interface will have the following minimum functionality:
 - 1) Control screens:
 - a) Welcome Screen/Login Screen – Coordinate passwords and access levels with Owner.
 - b) Activity Preset Selection Screen – Allows selection of system presets and/or mode of operation and advances to the control screen corresponding to the activity selected.
 - c) Control Screens – For each activity, allow for real-time modification and feedback of routing, source selections, on/off status, muting, monitoring, and level adjustment.
 - 2) Advanced Operator Control Screens:
 - a) Overall Status Screen – System power on/off (with off confirmation), signal failover status and reset controls, overall equipment status, fire mute status.
 - b) Support Spaces – Allows source select, monitoring, level adjustment and muting of front and back of house spaces.
 - c) See below for additional advanced functionality.
 - 3) The following control buttons will be present on each screen except for the Welcome/Login screen.
 - a) Navigation to the activity preset selection screen.
 - b) Power Off (with confirmation) – Turns off all equipment associated with the space and returns to the Welcome/Login screen.
 - c) Logoff – Returns the panel to the Welcome/Login screen without affecting the activity currently in progress. Upon login, the panel should return to the activity's control screen.
 - d) Navigation to the Advanced Operator Control.
 - b. Additional Advanced Functionality. Advanced functions or activities will be tailored for the specific control needs based on the intended user and installed location:
 - 1) Rooms with Front of House Control Location.
 - a) Metering Screen – Shows primary inputs to the system from mixing console and primary outputs to the space.

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- b) Mute Screen – Allows muting of individual speakers and zones overlaid on a venue map.
- 2) Rooms with Audio/Video Conferencing.
 - a) Conferencing Screen – Shows feedback of all associated conferencing AV equipment.
 - b) Real-time modification and preview of camera equipment, PTZ controls, VOIP softphone integration, and single button push-to-start meeting automation for conferencing platforms.
- 3) Rooms with operable partitions.
 - a) Room Combining – Allows multiple rooms to operate as a single room and controls the combining state where routing, source selections, on/off status, muting, monitoring, and level adjustments are made across all combined rooms.
 - b) Logical preset room layouts will be available for selection to place the room into a combined state.
- 4) Rooms with video walls or LED screens.
 - a) Control and creation of preset video windowing layouts for automation of video display.
 - b) Source selection of each window within each preset video windowing layout.
 - c) Provide pop-up full screen live preview of input sources before adding them to the video display system or associated window.
 - d) Selection of audio source from windowed layout.
- 5) Rooms that require lighting and window shade controls.
 - a) Provide individual level, color, and zone control of lights and window shade systems.
 - b) Provide control and creation of presets for automation of lights and window shade systems.
- c. Facility wide moments of exclusivity.
 - 1) Moments of exclusivity will be coordinated with Consultant and Owner.
 - 2) Automate facility wide global control of associated AV equipment to execute specifically defined tasks related to modification of routing, source selections, on/off status, muting, monitoring, and level adjustments.
 - 3) Moments of exclusivity will be one of the following:
 - a) Momentary - Automation will be time defined and return the systems to the previous operational state after time has expired.
 - b) Latching – Automation will be deployed as latest takes precedence priority, allowing local controls to override the event after execution.
 - c) Lock-Out – Automation will be deployed as highest takes precedence priority, not allowing local controls to override event.

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3.03 CUSTOM CONSOLE AND WORK SURFACE DESIGN

- A. All consoles and casework items will be rigidly constructed and will allow for a minimum temporary additional load of 200 pounds on any horizontal surface without permanent deformation.
- B. Consoles will be steel frame construction using extruded hollow square and angle sections welded together to form the sub-frame. This sub-frame will form the structural support for all equipment loads, work surfaces and writing surfaces.
- C. The steel frame will be electrically arc welded or similar. Remove all spatter and grind off excess weld and burrs. Prepare for shop priming by power wire brushing to remove rust. Degrease, shop prime, and finish with paint finish as specified. Protect for transport and shop/site and apply touch up paint as necessary. All arc weld hardware will be degaussed after the completion of all welding to be done on the piece.
- D. All dimensions and profiles will be checked with all right-angles true and uniform. Use blank rack mount panels to confirm accuracy of mountings.
- E. All attachments to viewable surfaces will be concealed. Attachments through the finish face of painted sections will be countersunk 1/4" below the surface. A resilient packing 1/16" thick will be placed over the screw before the hole is filled with a 2-part epoxy and finish sanded. When fitting panels allow clearances for paint finished. All laminate will be accurately scribed and fitted to the profiles required. Joints will be glued and screwed using frets or glue blocks where possible to ensure rigidity of the panels independently of the steel frame.
- F. Perforated metalwork will be folded accurately to match adjacent profiles with 3/4" returns lapped and spot welded to form a rigid unit. Hinges and accessories will be chrome or brass, including screws.
- G. All consoles will have removable rear panels for rear access to installed equipment. Removable front "kick panel" doors will also be required. All panels will remove completely during installation and service to facilitate installation work. The panels when installed will present a neat and finished appearance and will have a secure mechanical latch mechanism to avoid any rattles or buzzes.
- H. Provide a suitable method of cable access through the bottom and between sections of consoles.
- I. Control interfaces and panels mounted in custom fitted cutouts will provide a non-gaping interface to the surrounding surface to within a 1/32" tolerance.
- J. Clearances: There will be a minimum of 1 inch clearance inside all consoles between the top equipment mounting space and the console top. This is to allow airflow above equipment mounted in the top mounting position. Provide adequate ventilation grilles to allow continuous cooling in consoles containing equipment. This should include both

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supply and exhaust grilles. Provide ventilation adequate to keep temperature within the rack below 85 degrees Fahrenheit. Provide whisper type ventilation fan in each rack if temperature in rack rises above 85 degrees. This ventilation system must be temperature actuated.

- K. All consoles and racks will have front and rear rack rails separated by at least 24 inches. The rails will be parallel and square and will conform to EIA RS-310C for 19-inch racks.
- L. Console work surfaces will be finished with a material and color selected by the Architect and Owner. Painted and metal panels will be finished with sprayed polyester lacquer, satin finish, and color as selected by the Architect and Owner. Steel frame finish will be black enamel.
- M. Painting:
 - 1. Surface Preparation: Preparation for painting will involve fine paper sanding and dusting to ensure a perfectly smooth substrate.
 - 2. Primer: Sealer undercoat will be spray applied and sanded back using 250 grit. Touch up as needed and re-sand.
 - 3. Finish coats will be spray finished in an appropriate spray booth with approved ventilation, humidity control, dust extraction, and lighting. Finished paint thickness will be 1 mil minimum and will be free from runs, orange peeling, blooming or other blemishes. Metal panels will have a similar finish using appropriate metal primer.

3.04 CABLING

- A. Execute wiring in strict adherence to "standard broadcast practices," as excerpted from "Recommended Wiring Practices," Broadcast Audio Equipment for AM, FM, Television (5th Edition), Radio Corporation of America (RCA), Camden, N.J. 1962, and Appendix II, "Recommended Wiring Practices", Sound System Engineering, (2nd Edition), D. Davis, and performed in accordance with standard professional practice.
- B. Take precautions to prevent and guard against electromagnetic and electrostatic hum. For line level audio signals, float cable shields at the output of source device. Shields not connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shields.
- C. Exercise care in wiring; damaged cables or equipment will not be accepted. Isolate cables of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation. Keep wiring separated into groups for microphone level circuits, line level circuits, loudspeaker circuits, power circuits, video circuits and control/data circuits.
- D. Route unbroken microphone, audio line, and control wiring from receptacle plate/chassis to patch panel/rack. Remove spliced cables and replace without additional charge to the Owner.

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- E. Wiring entering equipment racks will be run directly to equipment. Use of splices or connectors to extend cabling to equipment will not be accepted. All signal wiring will be continuous and unbroken from connector plate/chassis to chassis/patch panel. Use of intermediate connections for inter rack cables is not acceptable. Use of splices or connectors to extend cabling to equipment is not acceptable.
- F. Make joints and connections with rosin-core solder or with mechanical connectors approved by the Owner. Where spade lugs and BNC terminations are used, trim cable using manufacturer recommendations and crimp properly with ratchet type tools. Spade lugs mounted on 22 gauge or smaller cable to be soldered after crimping.
- G. Connect audio cable to active components through screw terminal connections and spade lugs whenever available. Make connections to speaker transformers with properly sized closed end connectors crimped with factory approved ratchet type tool. Wire nut or "Scotchlock" connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape.
- H. Connect loudspeakers electrically in phase, using the same wire color code for speaker wiring throughout the project.
- I. Wiring and connections will be completely visible and labeled in rack.
- J. All power cables will run on the left side of the equipment rack, as viewed from the rear. All other cables will be run on the right side on the equipment rack, as viewed from the rear. Where signal cabling and any cabling types carrying power must cross, they will do so at right angles. Vertical wiring will be run with a bundling and support system, to maintain a clear and organized appearance.
- K. Horizontally routed wiring to equipment will be neatly tied in manageable bundles with cable lengths cut to minimize excess but still allow ready access for service and testing. Provide horizontal support bars if cable bundles sag
- L. For equipment mounted on slides, additional service loops will be provided to accommodate the full range of travel of the slides. This includes all power, ground, control and signal cables.
- M. Neatly bundle excess AC power cables from rack-mounted equipment with plastic cable ties. Rack wiring to be bundled with plastic cable ties or lacing twine. Electrical tape and adhesive backed cable tie anchors are not acceptable. Cable tie and lacing installation will be accomplished using hand tools specifically designed to apply proper tension to the cable tie, and to cut it off flush with no protruding sharp edges. Cable ties will not be applied with excessive force, which may damage or deform sensitive and fragile cables.
- N. All cables in cable trays will be neatly installed with maintaining separation of the different cable types.

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- O. Required production room cable paths and lengths must be predetermined especially in instances where timing is a factor. The information that is essential for the implementation of this task is as follows:
 - 1. Site Survey
 - 2. Floor and Ceiling Plans
 - 3. Elevation Design
 - 4. Equipment List
 - 5. Video and Audio Schematics
 - 6. Cable Trays and Conduits
- P. Multiconductor Cables: Follow a uniform application of color codes for multiconductor cables throughout the Facility. Where there are unused conductors or pairs in a cable assembly, they can be insulated as a group, left long enough for future termination, and folded into the connector hood. Where this is impractical, they may be folded back along the outer jacket of the cable and covered with heat-shrinkable tubing.
- Q. Multipin Connectors: Where jumpers are indicated between pins of the same connector, they will be installed internal to the connector shell and will not have any cable number designations applied to the jumper.

3.05 CABLE HOOKS

- A. Whenever possible, cable and raceway routing paths will follow the logical structure of the building (e.g. follow hallways, aisles and corridors). Route all AV cables and raceways parallel to or perpendicular to the building structure. No diagonal runs will be permitted unless noted otherwise or pre-approved by the Architect and Consultant. Corridor crossovers will be kept to a minimum.
- B. The suspended ceiling and/or lighting fixture support wire or rod will not be utilized to support AV cables. Do not support cables from ductwork, plumbing lines, fire suppression or mechanical systems, etc. Do not lay AV cables on ductwork, piping, plumbing systems or on top of lay-in ceiling tile and lighting fixtures.
- C. Support spacing will not exceed 48". For spans longer than 48", the Contractor shall provide cable tray, channel, ladder, conduit, or other Consultant approved cable support.
- D. A maximum of 17 cables will be supported in a single hanger, no exceptions.
- E. An open ceiling distribution system will not be installed above inaccessible ceiling areas, such as "lock-in" type ceiling tiles, drywall or plaster. Adequate and suitable space will be available in the ceiling area for the distribution system. A minimum of 6" of clear space will be provided on all sides of the distribution system to accommodate installation and servicing.

3.06 LABELING

- A. General

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1. The attachment method for equipment identification plates will be designed for permanency unless otherwise described. All labels will be protected prior to installation and will not be installed if damaged or scratched. Follow manufacturer's recommended procedure for surface preparation, which must be free of any dust, dirt or film. Wiping with a manufacturer-approved solvent is required. If a label is in a place that might be susceptible to damage, it will be protected with a layer of clear plastic, 1/16" or thicker, taped down. Internal labels will be replaced only if they become illegible. External labels will be replaced if they become scratched or marred.
2. On black lamicaid panels or pushbuttons, letters will be white; on stainless steel or brushed natural aluminum plates, or light-colored pushbuttons, letters will be black.
3. Embossed labels are not acceptable.
4. Mount labels in a neat, plumb and permanent manner except where indicated.
5. Text heights will be as follows:
 - a. Rack designation labels will have 1" high block sans serif text.
 - b. Equipment labels will be 3/4" high block sans serif text.
 - c. Operator Control labels will be 1/4" high block sans serif text, this may be adjusted to fit available space.
 - d. Panel labels will be 1/8" high block sans serif text.
 - e. Patchbay, Cable and Connector labeling will be 10-point block sans serif text, this may be adjusted to fit available space.

B. Equipment Labels

1. Provide engraved lamicaid labels on the front and rear of active equipment mounted in racks. Front mounted equipment labels for the Production Suite video monitor wall monitors are to be mounted with Velcro. Equipment labels to have one line of engraving, giving the schematic reference of the device, and/or its production function, i.e. "VTR #4", "PA-29A".
2. Amplifier labels to include the schematic reference of the device as well as the loudspeaker being fed. Provide color coded labels for the different levels and types of speakers.
3. Unless equipment manufacturer has clearly labeled functions, provide an engraved label over each user-operated control that describes the function or purpose of the control.
4. If the manufacturer provides a protected labeling strip such as those used for switcher control panels and patch bays, then patch/routing point labels may be typed clearly on 80 pound paper stock.

C. Cable Labels

1. Cables and wiring to be logically, legibly and permanently labeled for easy identification. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style label. Hand-written or self-laminating type labels are not acceptable.
2. Wiring designations to be an alphanumeric code that is unique for each cable. Locate the cable designation at the start and end of each cable run and within 2 inches of the point of termination or connection. For cable runs that have

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intermediate splice points, the cable will have the same designation throughout with an additional suffix to indicate each segment of the run. Actual cable designation assignments to be determined by Contractor. Add cable designation codes to system schematic drawings included with Project Record Drawings.

3. Provide adhesive labels on the rear of equipment where cables attach to indicate the designation of the cable connected at that point.

3.07 ACCEPTANCE

- A. Provide a pre-commissioning system report to the Consultant two weeks prior to the scheduled systems commissioning proving all systems to be in full compliance. Report will include test results, date of each test, pertinent conditions such as control settings, etc., and test equipment employed. In addition, submit written notification that the installation has been completed in accordance with the requirements of the Contract Documents, and is ready for acceptance testing.
- B. Acceptance testing will include operation of each major system and any other components deemed necessary by the Consultant. Contractor will assist in this testing and provide required test equipment. Contractor will provide at least three technicians familiar with installation, available for the entire testing period (day and night), to assist in tests, adjustments, and final modifications. Tools and material required to make any necessary repairs, corrections, or adjustments will be furnished by the Contractor. The Contractor will keep a running list of all acceptance tests performed and submit a final copy of the results with the closeout submittals as listed in Part 1.6. Testing process is estimated to take 4 days up to 10 hours per day and may require multiple crews / shifts.
- C. During all consultant walkthroughs, the project manager will be present.
- D. If during acceptance testing it becomes evident that further adjustment or work may be required to bring the system into compliance, the Contractor will continue to work until the system is acceptable at no additional charge to the contract price. If approval is delayed because of defective equipment, poor installation, or failure of equipment to meet the requirements of these specifications, the Contractor will pay for additional time and expenses of the Consultant at the Consultant's standard rate in effect at that time, during any extension of the acceptance testing period. The Contractor will provide rental or loaner equipment to make the system operational in critical cases of equipment failure prior to contract completion.
- E. Provide five portable UHF business band radios for use during acceptance testing. Radios should have a transmission range enough to cover entire project. Radios to include rechargeable batteries and re-charger along with "holster" for wearing on belt. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance. Confirm that radio frequencies used are not in use elsewhere on project site.
- F. Verify the following before beginning actual tests and adjustments on the system:
 1. Electronic devices are properly grounded.

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2. Powered devices have AC power from the proper circuit and hot, neutral, and ground conductors are connected correctly.
3. Insulation and shrink tubing are present where required.
4. Dust, debris, solder, splatter, etc. is removed.
5. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.

G. Cabling Tests.

1. Submit printed test reports proving the systems to be in full compliance to the consultant as part of the pre-commissioning systems report.
2. After installation, and before termination, all wiring and cabling will be checked and tested with a megohmmeter to ensure there are no grounds, opens, or shorts on any conductor or shields.
3. Verify all audio lines are wired to maintain proper continuity and polarity.
4. Perform TDR measurements on all triax and coax video cables.
5. Perform sweep tests on all triax and coax cables with a spectrum analyzer. When documenting the results of these tests, include the calculated loss based on length of the video cable measured with the TDR. Correct cabling for any field readings that differ more than 20% from the calculated loss.
6. Test all CAT5E and CAT6 cables to verify they meet full specifications. Tests will use a certified tester that will confirm bandwidth, cable distance, and error and bit rate detection.
7. Optical Fiber Cable Testing
 - a. Test all fiber optic cable strands for continuity and performance before and after the cables are pulled and terminated.
 - b. Test link attenuation of all installed multimode fiber optic strands after splicing and termination in accordance with ANSI/TIA/EIA-568-C.1, Section 11.3.
 - 1) One direction with an optical light source and an optical power meter.
 - 2) Test at two wavelengths to account for attenuation differences due to wavelength:
 - 3) 850 nm and 1300 nm for multimode strands.
 - 4) 1310 nm and 1550 nm for singlemode strands.
 - 5) Test multimode strands in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper.
 - 6) For multimode strands, wrap reference jumper around mandrel to remove high-order mode transient losses as specified in ANSI/TIA/EIA-568-C.1, Section 11.3.3, Table 11-15.
 - 7) Test Singlemode strands in accordance with ANSI/EIA/TIA-526-7, Method A.1, One Reference Jumper.
 - a) The total attenuation budget for each fiber cable length (end-to-end) will equal the allowed attenuation for the fiber (0.2 dB per km times the length in km) plus the attenuation for each splice and connector. For example, a cable length of 3 km with 1 splice and 2 connectors would have an attenuation budget of (3 km x 0.2 dB/km) + (2 x 0.2 dB) = 1.2 dB.

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- c. Test all installed fiber optic strands after splicing and termination with an OTDR (Optical Time-Domain Reflectometer) per TIA/EIA-455-61:
 - 1) End-to-end bi-directional signature trace with fault finding, connection point reflection, fiber bend, pressure point location, etc.
 - 2) One wavelength, 1300 nm for multimode strands.
 - 3) One wavelength, 1550 nm for singlemode strands.
 - 4) Multimode fiber connector losses ≤ 0.5 dB at 850 nm
 - 5) Singlemode fiber connector losses ≤ 0.2 dB at 1310 nm
 - 6) Multimode fiber splice losses ≤ 0.3 dB at 850 nm
 - 7) Singlemode fiber splice losses ≤ 0.2 dB at 1310 nm
 - 8) Localized attenuation will not exceed 0.5 dB at any point
- d. Fibers that are broken or damaged will be replaced at no cost to the owner and replaced fiber optic cables will be re-tested.
- e. Provide test results in both PDF and in the native file format of the OTDR.
- 8. Loudspeaker System Tests. Perform the following tests and adjustments. Make corrections necessary to bring system(s) into compliance with the specifications.
 - a. Measure and record the impedance of each loudspeaker at the equipment rack with the amplifier disconnected. Measurements will be documented in a table that lists the impedance for each 1/3 octave band over the loudspeakers operating frequency. Measurements will be accurate to within one-tenth of an ohm. As an alternative, contractor may perform, and document full impedance sweeps over each individual device. Sweep to be performed over loudspeakers specified operating range.
 - b. Check polarity of loudspeakers with an electronic polarity checker and by applying music program or constant power per octave (pink noise) signal to system while walking through the transition areas of coverage from one loudspeaker to the next. Transition should be smooth with no apparent shift in source from one speaker to the next.
 - c. Apply sine wave sweep signal to each loudspeaker system, sweeping from 50 Hz to 5k Hz and at a level 10 dB below full amplifier output, and listen for rattles or noise. Correct if apparent.
- 9. Microphone, line level, and Tie Lines Systems. Confirm the following. Make corrections necessary to bring system(s) into compliance with the specifications.
 - a. Proper circuits appearing at each termination location.
 - b. Continuity of all conductors.
 - c. Proper polarity is maintained.
 - d. Absence of shorts between conductors.
 - e. Absence of shorts between conductors and conduit.

H. System Tests.

- 1. The following procedures will be performed by the Consultant:
- 2. Audio fidelity Verification: Driving the system with pink noise and measuring the response from 40 Hz to 16k Hz. Digital Signal Processing will be used to adjust the response of the system (s) to fit the requirements of the space.
- 3. Video Signal Verification: From all source inputs (for cameras, character generators, video tape units, etc.) through all VDAs, A/D and D/A converters, processors, switchers, etc., to all signal destinations. Verification of correct signal

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timing for each source via each path will be made using standard test patterns. Each processing device will be checked; the signal will pass through the device in the no processing mode such that unity luminance, chrominance, and signal timing and phasing conditions are achieved.

- a. Video.
 - 1) Volt (peak to peak) throughout video signal path
 - 2) S/N (peak to RMS), unweighted, DC to 4.2 MHz: 55 dB minimum
 - 3) Crosstalk, unweighted, DC to 4.2 MHz: 45 dB minimum
 - 4) Frequency Response: + 0.5 dB to 4.2 MHz
 - 5) Line and Field Tilt: 2% maximum
 - 6) Differential Gain: 2% maximum
 - 7) Differential Phase: 2 degrees maximum
 - 8) Signal level: within plus or minus 0.5 dB
 - 9) System timing: Sync coincidence within 20 nanoseconds
 - 10) Color timing: Within 1/2 degree at 3.58 MHz
- b. Digital Video.
 - 1) Verify strength of data signal throughout video signal path.
 - 2) Verify validity of data timing signals.
 - 3) Verify receiving device clock recovery
 - 4) Report input data errors
 - 5) Report transport layer errors
4. Control functions will be checked for proper operation, from controlling devices to controlled devices.
5. Adjust, balance, and align equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and record these settings, in the "System Operation and Maintenance Manual".
6. Installed and loose equipment will be inventoried for correct Qty.
7. Any other test on any piece of equipment or system deemed appropriate by Consultant.
8. The omission of a description of a device, function, signal path, or test in this document will not exempt the Contractor from responsibility for checking all devices and signal paths for appropriate compliance with Industry Performance Standards and making corrections necessary to bring system(s) into compliance with the applicable standards.
9. The process of acceptance testing the System may necessitate moving and adjusting loudspeaker aiming. Contractor to adjust loudspeaker aiming within parameters set in Part 2. Contractor to make changes without claim for additional payment, this includes the use of lifts, scaffold, etc. If the construction timeline or architecture interferes with the ability to make changes during acceptance testing, notify consultant in writing prior to loudspeakers becoming inaccessible so that final on-site aiming may be accomplished.
10. MATV System. The MATV system will be tested and verified that it meets the following requirements:
 - a. The MATV system design will provide for adjacent channel operation with bandwidth to at least 1 GHz. Bandwidth of amplifiers will be from 54 MHz to 1 GHz in the forward direction and 5 to 42 MHz in the reverse direction.

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- b. The MATV system will provide a minimum of 0 dBmV and a maximum of +10 dBmV at any frequency, at each MATV outlet faceplate
- c. Adjacent Channel Amplitude: Difference is not to exceed 3dB (CFR 47 §76.605(a)(4)(i).
- d. Amplitude Response for Entire Spectrum: Not to exceed 15 dB (CFR 47 §76.605(a)(4)(ii).
- e. Visual Carrier to Noise Ratio: Not less than 43 dB.
- f. Composite Triple Beat Ratio: Not less than 54 dB.
- g. Cross Modulation Ratio: Not less than 54 dB.
- h. Visual Carrier to Hum Modulation Ratio: Not less than 60 dB.
- i. RF Leakage: per (CFR 47 §76.605(a)(12).
- j. In the event that a specific device not meeting the above performance parameters is shown in the Contract Documents as included in the signal chain, the manufacturer's performance specifications of that device will prevail, with the exception of RF Leakage, which will not be waived.

3.08 TEST EQUIPMENT

- A. Provide the following equipment on site for final acceptance testing. Test equipment to be available for the entire period through final system acceptance. Prior to start of testing, provide a list to the Consultant of test equipment make and model numbers that will be used.
 - 1. Multimeter: Measurement range, DC to 20,000 Hz, 100 mV to 300 V, 10 ma to 10A. Acceptable: Fluke 75.
 - 2. Dual-trace oscilloscope: 20 MHz bandwidth, 1 mV/cm sensitivity.
 - 3. Sound Level Meter: ANSI S1.4-1971 Type S1A with digital or analog display. Meter to provide ranges of 40 to 120 dBA.
 - 4. Impedance Meter: Capable of testing audio lines at three frequencies, minimum, between 250 Hz and 4k Hz. Measurement Range: 1 ohm to 100k ohms.
 - 5. Audio Oscillator: bandwidth 20 Hz to 20k Hz +1 dB at 0 dBm output. Output to be balanced. Oscillator to include adjustable output level.
 - 6. Polarity checker for mic and line level signals.
 - 7. Polarity checker for loudspeakers.
 - 8. (2) full height weighted base mic stands
 - 9. Time Domain Reflectometer.
 - 10. Optical Time Domain Reflectometer: Fluke Optifiber, Corning OV1000, or equal.
 - 11. SDI Generator: Acceptable: Tektronix SDA601
 - 12. SDI Analyzer: Acceptable: Tektronix TSG601
 - 13. Digital Field Strength Meter: Acceptable: Blonder Tongue DFSM-10 or Tektronix RFM90
 - 14. CAT6 cable tester: Acceptable: Microtest Omniscanner 2.
 - 15. Acterna (Formerly Wavetek) SDA-5000 Sweep System
 - 16. Digital Field Strength Meter : Acceptable: Blonder Tongue DFSM-10 or Tektronix RFM90

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3.09 INSTRUCTION OF OWNER PERSONNEL

- A. Upon completion of the installation of the specified AV systems, and prior to any facility events, provide designated operating personnel training on the equipment operation. This training will be performed at the site by the Contractor's and the manufacturer's education staff.
- B. The System Reference and Service Manuals must be complete and on-site prior to the time of the first instruction.
- C. First Use. Provide trained personnel (one person) to be present at first five events where the specified systems are in use.
- D. Coordinate schedule of instruction with the Owner subject to availability of Owner's personnel. This may require scheduling instruction during weekends or evenings.
 - 1. Training will be provided in a series of classes to operations personnel to review all aspects of operation and maintenance of the system.
 - 2. Follow-up sessions to better enhance the operator's ability to expand or maximize the system will be made available.
- E. The system training will include 1 days or 8 hours of technical training covering the explanation of the system, including documentation, configuration, interfacing and diagnostics. Provide training of the system operators and maintenance personnel as follows:
 - 1. System Overview: Explanation of system includes documentation, configuration, interfacing and basic diagnosis.
 - 2. Operator Training General: Basic training in the use of system devices including powering, timing and general operation of overall system.
 - 3. Operator Training Specific: Advanced training in use of system devices including video on demand and ad insertion equipment.
- F. Where specified, training will be by manufacturer representatives.
 - 1. Manufacturer training and commissioning is specified in this document.
 - 2. The Contractor will cover expenses such as flight, hotel, rental car, and meals and include them as part of the bid pricing.

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SECTION 274134 - ATTACHMENT A

| Qty. | Manufacturer | Model Number | Description |
|------------------------------------|----------------------|--------------------|---|
| Add Alt - Cinema Audio | | | |
| A02 - Loudspeaker System | | | |
| 10 | L-Acoustics | X8i | 2-way passive coaxial enclosure: 8" LF + 1.5" HF diaphragm (installation version) |
| 10 | L-Acoustics | X8i-onCW | On-wall or on-ceiling mounting accessory with silent blocks for X8i |
| 2 | L-Acoustics | A10i WIDE | 2-way passive constant curvature WST® 30° enclosure: 10" LF+ 2.5" HF diaphragm (installation version) |
| 4 | L-Acoustics | 5XT | 2-way passive coaxial enclosure: 5" LF + 1" HF diaphragm |
| 1 | L-Acoustics | A10i FOCUS | 2-way passive constant curvature WST® 10° enclosure: 10" LF+ 2.5" HF diaphragm (installation version) |
| 1 | L-Acoustics | A10i-BUMP | Flying frame for vertical deployment of A10iW |
| 2 | L-Acoustics | LA2Xi US | Install-specific amplified controller 4 x 640 W / 4 Ohms, bridgeable. AVB. US version. |
| AV02 - Video | | | |
| 1 | Dolby | CP950 | DCI Cinema processor that supports 7.1 and 5.1 audio processing -inchø Includes an expansion slot for upgradability to Dolby Atmos |
| Add Alt - Cinema Video | | | |
| 1 | Digital Projection | M-Vision 21000 WU | 21,000 / 10,000:1 |
| Add Alt - Livestream System | | | |
| 3 | Panasonic | AW-UE150 | Panasonic AW-UE150KPJ 4K 60p Professional 12G-SDI PTZ Camera - Black |
| 1 | Marshall Electronics | CV568 | Miniature Global Camera (4.4mm) with Genlock |
| 1 | Blackmagic Design | VHUBSMAS12G2020 | Blackmagic Videohub 20x20 12G |
| 1 | Blackmagic Design | SWATEMSCN2/1ME1/HD | ATEM 1 M/E Constellation HD |
| 1 | AJA Video Systems | HELO-PLUS-R0 | H.264/MPEG-4 HD/SD Recorder and Streaming Appliance with 3G-SDI and HDMI Inputs/ Outputs. Record to USB drives/SD cards/Network shares, with Dual Live Streaming, PIP, Web-based GUI preview window |
| 1 | AJA Video Systems | 3G-AMA-R0 | 3G-SDI 4-Channel Analog Audio Embedder/Disembedder, bal. XLR |
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| Add Alt - Microphone Package | | | |
|------------------------------|------------------|------------------|--|
| 10 | König & Meyer | 21075.500.55 | Microphone Stand w/ telescopic boom arm - Black |
| 5 | König & Meyer | 25900.500.55 | Microphone Stand - Black |
| 10 | König & Meyer | 26075.500.55 | Stackable One-Hand Mic Stand - Black |
| 5 | Shure | KSM137/SL | Cardioid Studio Condenser Microphone (Champagne), Foam Windscreen and Carrying Case |
| 10 | Shure | SM58-CN BTS | SM58 + CABLE + STAND BUNDLE |
| 10 | Whirlwind | ENC6ASE010 | Cable - Ethernet, Cat6A Ethercon to Cat6A Ethercon, tactical Cat6a cable, shielded, 10' |
| 10 | Whirlwind | ENC6ASE025 | Cable - Ethernet, Cat6A Ethercon to Cat6A Ethercon, tactical Cat6a cable, shielded, 25' |
| 20 | Whirlwind | MKQ10 | Cable - Microphone, Quad, XLRf to XLRM, 10', Canare L4E6S, black [available in colors - email for quote] |
| 20 | Whirlwind | MKQ25 | Cable - Microphone, Quad, XLRf to XLRM, 25', Canare L4E6S, black [available in colors - email for quote] |
| 10 | Whirlwind | L10R | Cable - Instrument, Leader, 10', w/ 1 right angle male |
| Auditorium | | | |
| A01 - Infrastructure | | | |
| 1 | Middle Atlantic | BGR-4532 | 45SP/32D MULTIBAY BGR RK |
| 1 | Middle Atlantic | BSPN-45-32 | 45SP 32DP BGR SIDE PANELS |
| 1 | Middle Atlantic | UPS-S2200R | UPS STD 2200VA |
| 1 | Netgear | GSM4352-100NES | 52PT M4350-48G4XF MANAGED SWITCH |
| 4 | Custom | Large Wall Panel | Custom Wall Panel with audio, video, data, & fiber connectors and cabling to local AV Equipment Rack |
| A02 - Loudspeaker System | | | |
| 10 | JBL Professional | AC28/95 | AC28/95 - Dual 8" 2way |
| 1 | QSC | CORE 110f-v2 | Unified Core with 24 local audio I/O channels, 128x128 total network I/O channels with 8x8 Software-based Dante license included, USB AV bridging, dual LAN ports, POTS and VoIP telephony, no GPIO, 16 next-generation AEC processors, 1RU. |
| 1 | Allen & Heath | GX-4816 | Allen & Heath Expander Audio Rack; 48X16, for SQ |
| 1 | Allen & Heath | M-DL-DANTE64-A | Allen & Heath Dante 64x64 networking card, AES67 compatible, DDM ready, 96kHz/48kHz |
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| | | | |
|----------------------------|--------------------|-----------------------------|---|
| 4 | L-Acoustics | A10i WIDE | 2-way passive constant curvature WST® 30° enclosure: 10" LF+ 2.5" HF diaphragm (installation version) |
| 2 | L-Acoustics | A10i FOCUS | 2-way passive constant curvature WST® 10° enclosure: 10" LF+ 2.5" HF diaphragm (installation version) |
| 2 | L-Acoustics | A10i-BUMP | Flying frame for vertical deployment of A10iW |
| 2 | Fulcrum Acoustic | Sub215L | Dual 15 inch Direct-Radiating Subwoofer |
| 2 | L-Acoustics | LA2Xi US | Install-specific amplified controller 4 x 640 W / 4 Ohms, bridgeable. AVB. US version. |
| 1 | QSC | CX-Q 4K4 | 4-Channel 1000W/CH Q-SYS Network Amplifier, |
| A03 - FOH Equipment | | | |
| 1 | Tascam | SS-CDR250N | SOLID STATE RECORDER WITH NETWORKING, DUAL SD, CDR |
| 1 | Miscellaneous | Furniture | Forecast Consoles GCX-W Workstation |
| 1 | Allen & Heath | AVANTIS-W-DPACK | Allen & Heath 96kHz FPGA processing, 64 Input Channels, 24 Faders / 6 Layers, 42 Mix busses, Dual 15.6" Full HD capacitive touchscreen Digital Mixer, dPack included |
| 1 | Middle Atlantic | DTRK-1418 | 14SP/18D DSKTP RKNO DRS |
| 2 | JBL Professional | JBL-305PMKII | JBL 305P MkII Powered 5-Inch Two-Way Studio Monitor |
| A04 - Wireless Mics | | | |
| 1 | RF Venue | D-ARC | Diversity Architectural Antenna for Wireless Microphones |
| 4 | Sennheiser | EW-DX EM 4 DANTE (Q1- 9) | EW-DX EM 4 DANTE |
| 8 | Sennheiser | EW-DX SKM-S (Q1-9) | Handheld transmitter with switch. Includes (1) EW-DX SKM-S, (1) MZQ1 microphone clip, and (2) AA batteries, frequency range: Q1-9 (470.2 - 550 MHz) |
| 8 | Sennheiser | EW-DX SKM-S (Q1-9) | Handheld transmitter with switch. Includes (1) EW-DX SKM-S, (1) MZQ1 microphone clip, and (2) AA batteries, frequency range: Q1-9 (470.2 - 550 MHz) |
| 8 | Sennheiser | CHG 70N + PSU KIT | Network enabled charging set, including CHG 70N 2-bay charger and EW-D power supply |
| 2 | DPA Microphones | 4011ES | 4011ES Cardioid Mic, Side Cable, XLR |
| 2 | DPA Microphones | 4006ES | 4006ES Omni Mic, Side Cable, XLR |
| 8 | Point Source Audio | CO-8WD-XSH-BE | SERIES8 OMNIDIRECTIONAL Headset Microphone (water/sweat proof) for Shure. Color: Beige |

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| | | | |
|----------------------------------|-------------------------------------|------------------|--|
| 8 | Point Source Audio | CO-8WL-XMP-BL | IP 57 rated to protect against water, sweat and makeup. Includes microphone, cable clip, and standard size windscreen. Color: Black |
| 1 | Sennheiser | SENN-EW-DASATUVW | Sennheiser EW-D ASA (T-U-V-W) Active Antenna Splitter for use with Evolution Wireless Digital Systems |
| A05 - Monitor System | | | |
| 4 | Community Professional Loudspeakers | MX10-B | Monitor 2-Way 10-Inch Coax Black |
| A06 - Assistive Listening | | | |
| 8 | Williams AV | BAT 026-2 | Two (2) 1.2-volt AA rechargeable NiMH batteries. |
| 1 | Williams AV | FM T55 | FM Plus - Large-area Dual FM and Wi-Fi base transmitter with network control, OLED display, DSP audio processing, analog XLR input and line output. Includes: (1) ANT 025 antenna, (1) TFP 048 power supply, (1) WCA 013 audio cable, (1) WLC 004 line cord. FM operates in the 72-76 MHz band. Replaces PPA T45 / PPA T45 NET |
| 1 | Williams AV | RPK 005 | Rack panel kit. For one transmitter or modulator in one IEC rack space. |
| 1 | Williams AV | ANT 029 | Rubber ducky antenna, with F connector, mounting bracket and coaxial cable for use with large-area FM transmitters. |
| 8 | Williams AV | FM R38 | Multi-channel FM receiver with OLED display. (1) EAR 022 surround earphone, and (1) BAT 001-2 AA alkaline battery. |
| 8 | Williams AV | HED 024 | Stereo folding headphones. Stereo 3.5 mm plug |
| 2 | Williams AV | NKL 001-S | Neckloop. 18" cord. 3.5mm stereo plug. For use only with WaveCAST receiver (WF R1). |
| 1 | Williams AV | CHG 3512 PRO | Multi-bay, drop-in charger with case for 12 FM or infrared body-pack transmitters and/or receivers. Power Supply Included. |
| 1 | Williams AV | IDP 008 | ADA wall plaque. |
| A07 - Loose Inventory | | | |
| 1 | QSC | SLDAN-32-P | Q-SYS Software-based Dante 32x32 Channel License, Perpetual |
| 1 | QSC | SLQUD-110-P | Q-SYS Core 110 UCI Deployment Software License, Perpetual. |

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| | | | |
|-------------------------------|--------------------|-------------|--|
| 1 | QSC | SLQSE-110-P | Q-SYS Scripting Engine License |
| 4 | Whirlwind | SK503G12 | Cable - Speaker, NL4 Speakon to NL4 Speakon, 3', 12 AWG, wired 1+ / 1- |
| A09 - Audio Production | | | |
| 2 | Green-GO Digital | GGO-WAA | Wireless Active Antenna |
| 4 | Green-GO Digital | GGO-WBPX | Wireless Beltpack V4 |
| 1 | Green-GO Digital | GGO-BC6 | 6 Way Rack Mount Battery Charger |
| 1 | Green-GO Digital | GGO-SW81 | 8 PoE ports + 1 port ethernet switch in 19", 1U cabinet, V4 |
| 2 | Green-GO Digital | GGO-MCX | 32 Channel Key Panel, 1U Rack Mount |
| 1 | Green-GO Digital | GGO-DNTI | Dante Interface |
| 1 | Green-GO Digital | GGO-BEACON | Cue Light/Call Beacon |
| 1 | Green-GO Digital | GGO-GHSA05 | Telephone Style Handset, coiled cable with XLR4 |
| 2 | Clear-Com | CC-300-X4 | Single-ear standard HS XLR-4F: Single enclosed ear headset and on/ off switch in gooseneck microphone boom, includes HS-ES ear sock and headset bag - field removable four-pin female XLR for standard Clear-Com connection. |
| 4 | Clear-Com | CC-110-X4 | LW Single-ear standard HS XLR-4F: Premium lightweight single on ear headset and on/ off switch in gooseneck microphone boom, includes leatherette (fitted) and foam (option) ear pads and headset bag - field removable four-pin female XLR for standard Clear-Com connection. |
| AV02 - Video | | | |
| 3 | Extron Electronics | 60-1331-13 | DTP HDMI 4K 330 Rx, Long Distance HDMI Twisted Pair Receiver - 330 feet (100 m) |
| 4 | Extron Electronics | 60-1421-52 | DTP T HWP 4K 331 D, Long Distance DTP Transmitter for HDMI - Decorator-Style Wallplate, Black - 330 feet (100 m) |
| 1 | Tascam | BD-MP4K | 4K UHD BLU-RAY MULTIMEDIA PLAYER |
| 1 | Draper | 144006 | Ultimate Access XL E, 307", 16:10, Matt White XT1000E, 110 V |
| 1 | Epson | EB-PU2216B | no description available |
| AV03 - Control | | | |
| 1 | QSC | QIO-GP8x8 | Q-SYS peripheral providing control expansion with 8 logic inputs and 8 logic outputs. Up to 4 devices daisy-chainable. 1U-1/4W, powered over Ethernet or +24 VDC. Surface mountable, rack kit sold separately. |

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| | | | |
|------------------------------|--------------------|-------------------------|--|
| 1 | QSC | QIO-S4 | Q-SYS peripheral providing control expansion with 4 serial communication I/O. Up to 4 devices daisy-chainable. 1U-1/4W, powered over Ethernet or +24 VDC. Surface mountable, rack kit sold separately. |
| 1 | QSC | TSC-70-G3 | Q-SYS 7" PoE Touch Screen Controller for In-Wall Mounting. Color - Black only |
| 1 | QSC | TSC-710t-G3 | Table top mounting accessory for TSC-70W-G3 and TSC-101W-G3. |
| 1 | Extron Electronics | 60-1615-01 | IN1808 Standard Model |
| AV04 - Infrastructure | | | |
| 1 | Belden | Data Patchbay - 48 Port | 48 port data patchbay with modular connectors per specifications |
| 3 | FSR | PWB-CMU8 | 8"+ Block Wall Box - Two 2-GANGs with construction cover |

END OF ATTACHMENT

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- C. Post-survey, troubleshoot systems to maximize performance.
 - 1. Adjust data rates.
 - 2. Reduce SSIDs.
 - 3. Turn on WAPs that were not active during the initial survey.

3.05 PROJECT RECORD DRAWINGS

- A. Maintain separate sets of redlined drawings that show the exact placement and identification of as-built system components. They may be subject to weekly review by the General Contractor or Owner.

3.06 FINAL ACCEPTANCE

- A. Upon post-survey report analysis and modifications, perform final active survey. Submit final survey report for Owner's approval.

END OF SECTION

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SECTION 31 20 00 – EARTHWORK

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, the 2023 edition of the Caltrans Standard Specifications (CSS) and the project geotechnical report apply to this Section.

1.2 SUMMARY

- A. **EARTHWORK** - Earthwork shall be per Section 19 of the Standard Specification and these Special Provisions. The Contractor shall thoroughly inspect the site and shall satisfy himself as to the conditions to be encountered. No extra payment will be made for unusable material, nor for import of fill material.
- B. **EARTHWORK AND GRADING** - Grading should be conducted in accordance with applicable grading ordinances, the current California Building Code, and the CSS. The following recommendations are provided regarding specific aspects of the proposed earthwork construction.
- C. **THE CONTRACTOR** - The Contractor shall be solely responsible for performing the fine grading to prepare the site for building foundation construction and parking lot base and paving. The Contractor shall review and accept the plans, geotechnical report(s) and these Specifications prior to the commencement of fine grading. The Earthwork Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s).

1.3 DEFINITIONS

- A. **Backfill:** Soil material or controlled low-strength material used to fill an excavation.
 - 1. **Initial Backfill:** Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. **Final Backfill:** Backfill placed over initial backfill to fill a trench.
- B. **Base Course:** Aggregate layer placed between the subgrade and hot-mix asphalt or concrete paving.
- C. **Bedding Course:** Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

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- D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- E. Fill: Soil materials used to raise existing grades.
- F. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- G. Base Course: Aggregate layer placed between the subgrade and hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete curb, gutter or a cement concrete walk.
- H. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below base or topsoil materials.
- I. Utilities: On-site underground pipes, conduits, ducts, and cables.

1.4 ACTION SUBMITTALS

- A. Samples for Verification: For the following products, in sizes indicated below:
 - 1. Warning Tape
 - 2. Soil Material for fill
 - 3. Recycled Asphalt mix for aggregate base.
 - 4. Aggregate Base from offsite quarry

1.5 QUALITY ASSURANCE

- A. Geotechnical Testing Agency: The geotechnical consultant of record will provide materials testing services under separate contract with the owner.

1.6 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
- B. Utility Locator Service: Contact U.S.A. at 800-227-2600 for area where Project is located a minimum of 48 hours before beginning earth-moving operations.

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PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Existing soil excavated onsite can be used for fill where screened in accordance with the Geotechnical Report recommendations for the project.
- C. Aggregate Base Course: Aggregate Base shall conform to Section 26 of the Standard Specification and these Special Provisions.
 - 1. Aggregate base shall be Class 2 or Class 2 permeable (as specified on the plans) $\frac{3}{4}$ -inch maximum conforming to the requirements in Section 26 of the Standard Specifications and these Special Provisions. Refer to paragraph 26-1.02A Class 2 Aggregate Base. The Owner anticipates the contractor to use recycled asphalt and concrete materials. When recycled materials are used the Contractor may process the material to be either 1.5 inch or the $\frac{3}{4}$ inch aggregate mix gradation.
 - 2. A minimum of 6 inches of aggregate base shall be installed under all traveled asphalt and concrete surfaces, including gutters, driveways, parking areas, roadways, paths, etc...
 - 3. A minimum of 4 inches of aggregate base shall be placed under sidewalk and curb and gutter areas.
- D. Engineered Fill: If the rough graded surface must be brought to the proper subgrade elevation, onsite soil from foundation and utility trenching can be used provided the organics, oversized rock (greater than 6-inches in diameter) and deleterious materials are removed. Rocks greater than 6-inches and less than 2-feet in diameter can be placed in the bottom of deeper fills or approved areas provided they are selectively placed in such a manner that no large voids are created. All rocks shall be placed a minimum of 3-feet below finish grade elevation unless used for landscaping purposes or retaining walls. Any import soils shall be tested for suitability in advance by the project Geotechnical Engineer.
- E. Water Piping Bedding Material: Naturally or artificially graded mixture of natural or crushed granular material $\frac{3}{4}$ " maximum with more than 20% passing the #4 sieve.
- F. Storm Drain and Utility Trench Backfill: Material used for backfill shall be approved by the Geotechnical Engineer prior to placement. All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1-foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 95-percent of maximum from 1-foot above the top of the conduit to the surface.

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2.2 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
 - 1. Red: Electric.
 - 2. Orange: Telephone and other communications.
 - 3. Blue: Water systems.

PART 3 - EXECUTION

3.1 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade where rough graded elevations are above plan subgrade regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials as determined by the Geotechnical Consultant and rock, replace with satisfactory soil materials.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction.

3.2 EXCAVATION FOR WALKS AND PAVEMENTS

- A. If necessary, excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.3 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. Excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
 - 1. Clearance: 6" minimum to 12" maximum
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

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- D. Trench Bottoms: Excavate trenches to the required depths to allow for placement and compaction of the bedding course to the thickness required on the typical trench details. Hand-excavate deeper for bells of pipe.

3.4 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.5 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Removing concrete formwork.
 - 2. Removing trash and debris.
 - 3. Removing temporary shoring, bracing, and sheeting.
 - 4. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.6 UTILITY TRENCH BACKFILL

- A. Exterior trenches, paralleling a footing and extending below a 1:1 plane projected from the outside bottom edge of the footing, shall be compacted to a minimum of 95-percent per ASTM D1557-2000. All trenches in structural areas and under concrete flatwork shall be compacted to a minimum of 95-percent per ASTM D1557. All trenches in non-structural areas shall be compacted to a minimum of 85-percent per ASTM D1557-2000.

All material used for backfill shall be approved by the Geotechnical Engineer prior to placement. All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding and backfill materials shall conform to section.

Lift thickness of backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

- B. Regulations of the governing agency may supersede the above, and all trench excavations should conform to all applicable safety codes. The Contractor shall follow all OSHA and Cal/OSHA requirements for safety of trench excavations.

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- C. Warning Tape: Install warning tape directly above utilities, as required on the trench details shown on the project plans.

3.7 SOIL MOISTURE CONTROL.

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.8 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. After making the recommended removals and prior to fill placement, the exposed ground surface should be scarified to a depth of approximately 12-inches, moisture conditioned as necessary, and compacted to at least 90-percent of the maximum dry density obtained using ASTM D1557-2000 as a guideline. Surfaces on which fill is to be placed which are steeper than 5:1 (Horizontal to vertical) shall be benched so that the fill placement occurs on relatively level ground, four feet horizontal and 2 feet vertical.
- B. For the areas under existing pavement and other improvements excavation of existing pavement section and subsurface soil to subgrade is anticipated to be adequate prior to subgrade preparation. Depending on existing site subgrade conditions oversized rocks may need to be removed and backfilled below the subgrade. Areas to be excavated outside of existing pavement a one-foot removal is recommended depending on site conditions (i.e. depth of root zone, and depth of disturbance which may have locally deeper removal depths). The removal bottom should be observed (tested as needed) by the geotechnical consultant prior to placing fill soils. The upper 12-inches of subgrade material along with the Class II Aggregate Base and the Asphaltic concrete shall be compacted to a minimum of 95-percent of the materials maximum dry density as determined by ASTM D1557-2000. The subgrade and aggregate base shall be moisture-conditioned and compacted to 95-percent of the material's maximum dry density as determined by ASTM D-1557-2000 to a depth of 12-inches.
- C. All fill and backfill to be placed in association with the proposed construction should be accomplished slightly over optimum moisture content using equipment that is capable of producing a uniformly compacted product throughout the entire fill lift. Fill materials at less than optimum moisture should have water added and the fill mixed to result in material that is uniformly above optimum moisture content. Fill materials that are too wet can be aerated by blading or other satisfactory methods until the moisture content is as required. The wet soils may be mixed with drier materials in order to achieve an acceptable moisture content.

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- D. The fill and backfill should be placed in horizontal lifts at a thickness appropriate for equipment spreading, mixing, and compacting the material, but generally should not exceed eight inches in thickness.
- E. No fill soils shall be placed during unfavorable weather conditions. When work is interrupted by rains, freezing temperatures, or snow, fill operations shall not be resumed until the field tests by the geotechnical engineer indicate that the moisture content and density of the fill are as previously specified.

3.9 FINE GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Prepared Subgrade – Prepared subgrade shall be scarified to a 12" depth and re-compacted to 95%. The subgrade shall be smooth and uniform, and true to the required grade and cross section, and shall be within the tolerances specified in Section 19-1.03, or as shown on the Plans. The Contractor shall repair at his expense any damage to a prepared subgrade until the subgrade is in a condition meeting the requirements specified.
- C. Final Grade - The final grade (grading plane) shall be constructed smooth, uniform, even, to neat lines, and true to the required grade and cross section. It shall be within the tolerances specified in Section 19-1.03. The final grade will be visually inspected both for quality of line and quality of subgrade. The Town will perform compaction tests at locations determined by the inspector, at approximately 100-foot intervals to ensure compaction requirements are met. No fill, backfill, aggregate base, or street construction shall commence without prior Engineer approval of the subgrade. The Contractor shall repair at his expense any damage to a prepared subgrade until the subgrade is in a condition meeting the requirements specified.

3.10 BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place base course under pavements, curb and gutter and walks as follows:
 - 1. Shape base course to required crown elevations and cross-slope grades.
 - 2. Place base course in compacted thickness of 4" in a single layer.
 - 3. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D1557

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3.11 FIELD QUALITY CONTROL

- A. The Owner will perform compaction tests at locations determined by the inspector, at approximately 100 foot spacing to ensure compaction requirements are met. No fill, backfill, aggregate base or paving shall commence without prior Engineer approval of the subgrade.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

3.12 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

3.13 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

3.14 MEASUREMENT AND PAYMENT

- A. Measurement and payment for earthwork shall conform to all provisions for "Measurement" and "Payment" in Section 19, "Earthwork," of the Standard Specifications and these Special Provisions.
- B. Items of earthwork will be paid for under the specific item that they will be used and will be considered full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in earthwork – including earthwork and grading, site preparation, excavation, compaction, backfill, slopes, temporary excavations, storm drain and utility trench backfill, surplus material, relocate boulder, embankment, and blasting - complete in place, as shown on the plans and in conformance with the Standard Specifications and these Special Provisions and no additional compensation will be allowed therefore.
- C. Subgrade preparation will be considered as included in the price paid for the specific item which it is used and no separate payment will be made therefore.
- D. Final Grade preparation will be considered as included in the price paid for the specific item which it is used and no separate payment will be made therefore.

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- E. Structure excavation and backfill for the foundations will be considered as included in the price paid for the specific item in which it is used and no separate payment will be made therefore.
- F. Measurement and payment for all "Fine Grading" work shall be made per the lump sum price. The lump sum price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in erosion control in conformance with these specifications.
- G. Measurement and Payment of aggregate base will be per cubic yard and based on the dimensions shown on the drawings. No allowance will be made for aggregate base placed outside said dimensions, or in excessive amounts, unless otherwise ordered by the Engineer. The prices and payments per cubic yard shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in constructing aggregate base, complete in place, as shown on the plans, and as specified in these specifications and the special provisions and as directed by the Engineer. No allowance will be made for the removal of existing asphalt pavement.

END OF SECTION

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SECTION 32 12 16 – ASPHALT PAVING

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, Sections 37 and 39 of the 2023 Caltrans Standard Specifications (CSS) and the Town of Mammoth Lakes 2014 Standard Plan 006 shall apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cold milling of existing asphalt pavement.
 - 2. Hot-mix asphalt paving.
 - 3. Bituminous Seals.
- B. Related Requirements:
 - 1. Section 312000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.

1.3 UNIT PRICES

- A. Work of this Section is affected by AC Pavement

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at project site.
 - 1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
 - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include technical data and tested physical and performance properties.
 - 2. Job-Mix Design and material test reports or job mix design

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer approved by Caltrans.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

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- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Caltrans Standard Specifications for asphalt paving work.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet, if rain is imminent or expected before time required for adequate cure, or if the conditions of CSS Section 39-6.01 are not met.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. Aggregate: Shall be ½" maximum type B aggregate in accordance with Section 39-2.02 of the CSS.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: Asphalt Binder shall be PG 64-28 in conformance with Section 92 of the CSS.
- B. Fog Seal: Fog Seal shall be SS-1 or CSS-1 conforming to the requirements of Section 37-1 of the CSS.
- C. Water: Potable.

2.3 STORING, PROPORTIONING AND MIXING MATERIALS

- A. The hot mix asphalt shall be created in conformance with Section 39-3 of the CSS.

PART 3 - EXECUTION

3.1 PLACING HOT-MIX ASPHALT

- A. Placing hot-mix asphalt including but not limited to subgrade preparation, spreading and compacting of hot-mix asphalt and seal coat application shall be in conformance with the requirements of Section 39 of the CSS.

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MEASUREMENT AND PAYMENT

- A. Measurement and Payment of hot mix asphalt pavement shall be per square foot for all work and materials to place the specified thickness of the hot mix asphalt pavement on the finished base grade as shown on the plans and shall also include the fog seal application.

END OF SECTION

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SECTION 32 13 13 – CONCRETE PAVING

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, and Sections 73 and 90 of the 2023 Caltrans Standard Specifications (CSS) apply to this Section.

1.2 SUMMARY

- A. Section Includes Concrete Paving including the following:
 - 1. Curbs and gutters.
 - 2. Sidewalks.
 - 3. Pedestrian Access Ramps.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Concrete Design Mixture
- C. Concrete Design Mix compressive strength test results

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified ready mix concrete manufacturer.
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
- C. Material Test Reports: For each of the following:
 - 1. Concrete compressive strength tests to qualify concrete mix design
- D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Stamped Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

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- B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with Section 90 of the CSS.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete mix or provide test results from independent testing agency.

1.7 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete 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 uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F 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.
- C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to 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 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.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. Comply with Section 90 of the CSS

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves with a radius of 50 or less
- B. 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.

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2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, fabricated from galvanized steel wire into flat sheets.

2.4 CONCRETE MATERIALS

- A. Portland cement concrete shall be per Section 90 of the 2023 Standard Specifications and the following:
 - 1. Concrete shall be Class 1 concrete with a minimum 28-day compressive strength of 5,000 psi.
 - 2. Fibermesh fiber additive or approved equal shall be added for all concrete with an exposed wearing surface.
 - 3. Cement for all concrete in the project shall be Type II Portland cement.
 - 4. The maximum water cement ratio shall be 0.45 for Class 1 concrete.
 - 5. All concrete shall have an air entertainment between four (4) percent and six (6) percent. (+0.1%)
 - 6. Coarse aggregate for concrete shall be 1-inch minimum per Section 90-3.02.
 - 7. Work included in this section is considered incidental and included in the various other items of work and no additional payment will be made therefore.

2.5 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic in preformed strips.
- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. 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 I and II, nonload bearing for bonding hardened or freshly mixed concrete to hardened concrete.

2.6 CONCRETE MIX

- A. All sitework concrete shall be Portland cement concrete shall be per Section 90 of the 2023 Standard Specifications and the following:
 - 1. Concrete shall be Class 1 concrete with a minimum 28-day compressive strength of 5,000 psi.
 - 2. Fibermesh fiber additive or approved equal shall be added for all concrete with an exposed wearing surface.
 - 3. Cement for all concrete in the project shall be Type II Portland cement.
 - 4. The maximum water cement ratio shall be 0.45 for Class 1 concrete.

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5. All concrete shall have an air entertainment between four (4) percent and six (6) percent. (+0.1%)
6. Coarse aggregate for concrete shall be 1-inch minimum per Section 90-3.02.
7. Work included in this section is considered incidental and included in the various other items of work and no additional payment will be made therefore.

2.7 CONCRETE MIXING

- A. Concrete Mixing shall be in conformance with the requirements of Section 90-6 of the CSS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed base surface for compliance with requirements for dimensional, grading, compaction and elevation tolerances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted base surface immediately before placing concrete.

3.3 CONCRETE SIDEWALK

- A. Concrete Sidewalk shall be in conformance with Section 73 of the CSS using the concrete mix specified in Section 2.7 of this specification and these special provisions:
- B. Cement shall be Type II with a maximum water/cement material ratio of 0.45.
- C. Contraction joints shall be constructed with a maximum spacing of 12 feet, except as directed by engineer. Expansion joints shall be ½-inch wide and placed only as directed by engineer. Isolation joints shall be ½-inch wide and placed at each structure that is within the concrete sidewalk or curb. Weakened plane joints shall be aligned such that each isolation joint is intersected by at least one weakened plane joint. Sidewalk joints shall align with curb and gutter joints.
- D. "Concrete Sidewalks" shall not be placed until after approval of "Concrete Joint Plan".
- E. Concrete shall include fibermesh for all exposed surfaces.
- F. MEASUREMENT AND PAYMENT
 1. Full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved, including but not limited to the excavation, subgrade preparation, aggregate base, sheeting and shoring, furnishing and compacting of backfill, and placement for the construction of concrete sidewalk, as shown on the plans will be considered as included in the

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contract unit price per square foot for "Concrete Sidewalk" and no additional compensation will be allowed therefore.

3.4 CONCRETE CURBS AND GUTTER

- A. Concrete Curbs and Gutter shall be in conformance with Section 73 of the CSS using the concrete mix specified in Section 2.7 of this specification and the following special provisions:
- B. Contraction joints shall be constructed with a maximum spacing of 12 feet, except as directed by engineer. Expansion joints shall be ½-inch wide and placed only as directed by engineer. Isolation joints shall be ½-inch wide and placed at each structure that is within the concrete sidewalk or curb. Weakened plane joints shall be aligned such that each isolation joint is intersected by at least one weakened plane joint. Sidewalk joints shall align with curb and gutter joints.
- C. Concrete curb and gutter shall not be placed until after approval of "Concrete Joint Plan".
- D. Concrete shall include fibermesh for all exposed surfaces.
- E. Install steel reinforcement and Sch 40 PVC Snowpole sleeve every 50 feet and at all angle points in the curb or curb and gutter.
- F. MEASUREMENT AND PAYMENT
 - 1. Full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved, including but not limited to the excavation, subgrade preparation, aggregate base, sheeting and shoring, furnishing and compacting of backfill, and placement for the construction of concrete curb and gutter, as shown on the plans will be considered as included in the contract unit price per linear foot for "Concrete Curb or Curb and Gutter", and no additional compensation will be allowed therefore.

3.5 PEDESTRIAN ACCESS RAMP

- A. Pedestrian Access Ramps shall be constructed with the concrete mix specified in Section 2.7 of this specification and these special provisions.
- B. Detectable warning pavers shall be in conformance with 2013 CBC 11B-705, Town Standards and requirements and as approved by Public Work Director.
- C. Weakened plane joints shall be constructed with a maximum spacing of 10 feet, except as directed by engineer. Weakened plane joints shall be aligned such that each isolation joint is intersected by at least one weakened plane joint. Sidewalk joints shall align with curb and gutter joints.
- D. Concrete shall include fibermesh.

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- E. At each connection with existing concrete, 24" long #4 dowels shall be installed (drilled and epoxied) to 50% of their length into the existing concrete at 1-foot horizontal intervals.
- F. MEASUREMENT AND PAYMENT
 - 1. Full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved, including but not limited to the excavation, subgrade preparation, furnishing and compacting of backfill, aggregate base, woven filter fabric, sand base, detectable warning pavers, and placement for the construction of "Pedestrian Access Ramp", as shown on the plans will be considered as included in the contract unit price per Lump Sum for each ramp installed and no additional compensation will be allowed therefore.

END OF SECTION

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SECTION 32 17 23 – PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions Division 01 Specification Sections, American Disabilities Act and the 2023 edition of the Caltrans Standard Specifications (CSS) Section 84 apply to this Section.

1.2 SUMMARY

- A. Section includes painted markings applied to asphalt pavement.

PART 2 - PRODUCTS

2.1 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint: Shall conform to Section 84-2 of the CSS.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Handicapped Pavement Markings – Handicapped pavement markings shall be installed per CBC (2013) 11B-502 and 11B-503 regulations and Town of Mammoth Lakes requirements. Pavement Markings shall be installed in conformance with Section 84 of the Standard Specification and these Special Provisions.
- C. Striping - all striping shall applied where required on the project plans in accordance with Section 84 of the CSS.
- D. Measurement and Payment: - Measurement and payment for all “Pavement Marking” work shall be made per the lump sum price. The lump sum price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in the installation of traffic stripes, cross walk marking, handicapped marking, bicycle markings, arrows and pavement markings.

END OF SECTION

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SECTION 33 00 00 – SITE UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, and the Mammoth Community Water District (MCWD) Standards and Specifications apply to this Section.

1.2 SUMMARY

- A. This Section includes the following utilities to be installed from the connection point shown on the plans to the building.
 - 1. Site water facilities
 - 2. Site sewer

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications, data, and installation instructions for review.
- B. Certificates: Submit certificate in lieu of manufacturer's name and pressure rating marked on valve body of valves and gas cocks, as required.
- C. Record Survey:
 - 1. General: Prepared by registered Land Surveyor. Review and acceptance by Architect and Project Inspector required before placement of topsoil, site paving or building slabs.

1.4 QUALITY ASSURANCE

- A. Qualifications: Contractor shall have a Class A contractor's license with 5 years' experience installing utilities.

1.5 GUARANTEE

- A. Provide in required form for a period of 1 year from date of acceptance by Owner.

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PART 2 - PRODUCTS

2.1 PIPING

- A. Water:
 - 1. To Meter and Detector Check: Per applicable MCWD service regulations and standards.
 - 2. Potable (Domestic) Water shall be AWWA C900 PVC pipe conforming to ASTM D1785 and fitting conforming to ASTM D2467 and ASTM D2464.
 - 3. Fire Service shall be ductile iron pipe conforming to ANSI /AWWA C151 and shall be polyethylene encased per the requirements of MCWD.
- B. Sewer:
 - 1. Sewer piping shall be SDR 35 PVC Pipe conforming to ASTM-3034

2.2 WATER VALVES

- A. Shall be Mueller gate valves or MCWD approved equal in conformance with AWWA C153.
- B. Valve Boxes: As detailed. Precast concrete boxes with extensions and cast-iron frame and cover. Cover marked "Water."

2.3 DETECTABLE WARNING TAPE

- A. Acid and alkali resistant polyethylene film manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep.

2.4 BEDDING MATERIALS

- A. Refer to Section 31 20 00 - EARTHWORK.

2.5 FIRE HYDRANTS

- A. Fire hydrants shall be Mueller Super Centurion 250 dry barrel per Catalog #A-423; 5¼" valve opening.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before trenching, verify site conditions shown; verify locations of existing utilities by pot-holing. Report any discrepancies to Architect. Do not begin affected work until discrepancies have been resolved. Examine site for unidentified utilities and unidentified site conditions. Report all

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discovered conditions or utilities to the Architect. Do not proceed with affected work until any conflicts have been resolved.

3.2 PREPARATION

- A. Protection: Conform to "Trench Construction Safety Orders", California State Industrial Accident Commission.
- B. Water Main Depth: Pothole existing water main where required on the plans to determine depth.

3.3 INSTALLATION

- A. Install in conformance with MCWD standards, manufacturer's written directions, as shown, and as specified on plans.
- B. Lay out systems by instrument; verify location and elevation of points of utility service and existing crossing utilities prior to excavation; notify Architect of discrepancies noted.
- C. Lay pipe true to line and uniform grade commencing at point of utility service connection. Make connections to utility service and building systems.
- D. Excavation and Bedding:
 - 1. General: Per Section 31 20 00 -earthwork. Trench width to be a 6" minimum to 12 inches maximum wider than outside diameter of pipe, bottom smooth and free of irregularities or rock points.
- E. Water Piping:
 - 1. Fire Supply: Water piping shall be installed per ANSI/AWWA C601 and MCWD specifications.
 - 2. Potable Water Supply: Shall be installed per ASTM F1668 and ASTM D2774
 - 3. Thrust Blocks: Construct as detailed on project plans.
 - 4. Valves: Place at required locations, vertically plumb; set valve boxes to finish elevation.
 - 5. Utility Service Meter: Locate as shown.
 - 6. Hydrants: Install complete hydrant assembly per MCWD standards.
- F. Sewer Piping
 - 1. Install sewer piping per manufacturers recommendations
- G. Electrical and Communications Service: Per Division 26 - ELECTRICAL
- H. Backfilling:
 - 1. General: Per Section 31 20 00 - EARTHWORK; do not start backfill operations until required testing has been accomplished.

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2. Detectable Warning Tape: Install directly above utilities as shown. Verify that inscribed description is properly coordinated with identified utility.
3. Trenches and Excavations: Backfill with clean sand to 12 inches above top of pipe, filling both sides of the pipe at the same time, carefully tamping to hold pipe in place without movement. Place in 6-inch lifts; compact each layer to density of adjacent undisturbed soil in conformance with MCWD requirements. Jetting will not be allowed.

3.4 FIELD QUALITY CONTROL

- A. Testing:
 1. Pressure test water and sewer per MCWD specifications once all hydrants have been relocated
- B. Disinfection: Flush and disinfect per MCWD specifications
- C. Retesting: Make corrections to work that is not in conformance with specified requirements and retest at Contractor's expense.

3.5 CLEANING

- A. Keep premises free from accumulation of waste and debris. At completion of installation remove surplus materials and debris.

3.6 MEASUREMENT AND PAYMENT

- A. Fire Hydrant: full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the work involved, including but not limited to the excavation, piping, valving, thrust block installation, bedding, backfill and compaction and hydrant installation for each "Fire Hydrant Assembly" and no additional compensation will be allowed therefore.
- B. Water Lateral Installation: full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the work involved, including but not limited to the potholing, excavation, insulation installation, backfill and compaction to subgrade as shown on the plans will be considered as included in the contract unit price per linear foot for "Water Lateral Installation" and no additional compensation will be allowed therefore.
- C. Sewer Lateral Installation: full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the work involved, including but not limited to the potholing, excavation, insulation installation, backfill and compaction to subgrade as shown on the plans will be considered as included in the contract unit price per linear foot for "Sewer Lateral Installation" and no additional compensation will be allowed therefore.

END SECTION

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SECTION 33 41 00 – STORM DRAINAGE PIPING AND MISCELLANEOUS DRAINAGE FACILITIES

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, and the 2023 Caltrans Standard Specifications (CSS) apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Catch basins.
 - 3. Storm water inlets.
 - 4. Water Retention System.

PART 2 - PRODUCTS

2.1 STORM DRAINAGE PIPING

- A. Shall be in conformance with Section 64 and 66 of the CSS. Contractor can choose either Plastic Pipe or Corrugated Metal pipe as approved by engineer.

2.2 DROP INLETS.

- A. Drop inlets shall conform to Section 70 of the CSS and shall be installed as shown on the plans.
- B. Drop Inlets shall be precast concrete of the manufacturer specified on the plans or equal as approved by the engineer.
- C. Inlet grates shall be bicycle-proof and galvanized.

2.3 STORM WATER RETENTION SYSTEM

- A. The storm water retention system shall consist of 42" perforated HDPE pipe.
- B. Crushed rock shall be Class 1 permeable material, ½" to ¾" gradation, per Section 68 of the CSS.

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PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Section 312000 "Earthwork."

3.2 STORM DRAIN PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install Corrugated metal piping in accordance with Section 66 of the CSS.
- D. Install Plastic pipe in accordance with Section 64 of the CSS.
- E. Measurement and Payment: Measurement and payment of drainage piping shall be included per linear foot of "Storm Drain Pipe" for all work and materials including but not limited to installation of pipe, junctions, bends, trenching, bedding, backfill, compaction, subgrade finish, etc. and no separate payment shall be made thereof.

3.3 STORMWATER DROP INLET INSTALLATION

- A. Stormwater Drop Inlets shall be installed in accordance with Section 70 of the CSS and the manufacturer's recommendations.
- B. Measurement and Payment: Measurement and payment of "DROP INLET" shall be per each for all work and materials including but not limited to installation of Drop Inlet with grate, culvert, connections to catch basin, junctions, bends, trenching, bedding, backfill, compaction, subgrade finish, as required for a complete installation and no additional compensation shall be made therefore.

3.4 STORMWATER RETENTION SYSTEM

- A. Excavate hole to size required to install gravel base.
- B. Install $\frac{3}{4}$ " drain rock.
- C. Install 42" perforated pipe.

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- D. Connect storm drain piping.
- E. Install cleanouts.
- F. Backfill and compact to grade elevation per plans.
- G. Measurement and Payment: of retention system shall be per each for all work and materials including but not limited to excavation, installation of retention system complete as shown on the plans, and backfill of soil to grade as required for a complete installation and no additional compensation shall be made therefore.

3.5 GRADED EARTH SWALE

- A. The graded earth swale shall be graded to the dimensions shown on the plans
- B. Where connecting to the existing swale the contractor shall match the dimensions of the existing swale over a transition of five feet.
- C. The swale shall be hydroseeded as shown on the plans conforming to section 01 57 13 of the project specifications.
- D. Measurement and Payment of the graded earth swale shall be per linear foot of swale including shaping of swale to connect to existing drainage swale and no additional compensation shall be made therefore.

END OF SECTION