

PROJECT MANUAL

FOR

SGT. JOHN PINNEY MEMORIAL POOL REPLACEMENT

CITY OF RIDGECREST

Prepared by:

FLEWELLING & MOODY
architecture planning interiors

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Pasadena, CA 91101
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Flewelling & Moody Project No. 3055.0100

July 14, 2025

PROJECT MANUAL

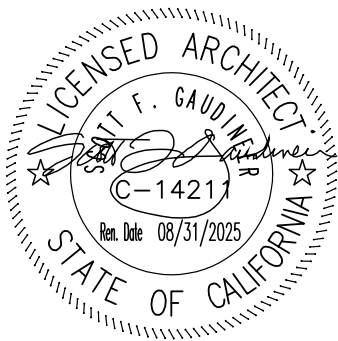
SGT. JOHN PINNEY MEMORIAL POOL REPLACEMENT

For

CITY OF RIDGECREST Ridgecrest, CA

Prepared by
FLEWELLING & MOODY ARCHITECTS
99 S. Lake Avenue
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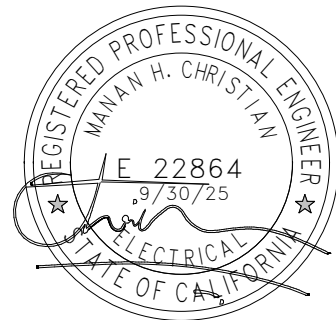
ARCHITECT
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ELECTRICAL ENGINEER
Manan H. Christian, E-22864
RGSE Structural Engineers

SECTION 01 09 00 REFERENCE STANDARDS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Reference Standards

1.02 ABBREVIATIONS AND ACRONYMS

- A. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where abbreviations and acronyms are used in the Specifications, they mean the recognized name of the trade association, standards-producing organization, authorities having jurisdiction, or other entity applicable to the context of the text provision.
- B. The names, addresses, and telephone numbers given in the List of Organizations are subject to change and are believed to be, but are not assured to be, accurate and up to date as of the issue date of this Section.
- C. List of Organizations: Certain Standards issued by the following organizations may be referenced in the Specifications. Copies may be obtained from the issuing organization.

1.03 REFERENCE STANDARDS

- AA Aluminum Association
(202) 862-5100
900 19th St., NW, Suite 300
Washington, DC 20006
- ABC Associated Air Balance Council
(202) 737-0202
1518 K St., NW, Suite 503
Washington, DC 20005
- AAMA American Architectural Manufacturer's Association
(847) 303-5664
1827 Walden Office Sq., Suite 104
Schaumburg, IL 60173
- ACI American Concrete Institute
(248) 848-3700
P.O. Box 9094
Farmington Hills, MI 48333-9094

TABLE OF CONTENTS

DIVISION 0 – BIDDING / CONTRACT REQUIREMENTS

00 00 01	Cover Page
00 00 05	Signature Page
00 00 10	Table of Contents

DIVISION 1 – GENERAL REQUIREMENTS

01 09 00	Reference Standards
01 20 00	Project Meetings
01 30 00	Submittals
01 31 00	Project Management and Coordination
01 32 16	Construction Schedule
01 34 00	Shop Drawings and Samples
01 41 00	Testing and Inspection Requirements
01 41 50	Testing Laboratory Services
01 43 00	Quality Control
01 50 00	Temporary Facilities
01 60 00	Material Equipment and Product Handling
01 63 00	Product Options and Substitutions
01 70 00	Contract Closeout
01 71 00	Cleaning
01 73 00	Operation and Maintenance Data
01 80 00	General Safety Requirements
01 91 13	General Commissioning Requirements

DIVISION 2 – EXISTING CONDITIONS

02 22 20	Excavation and Backfill for Structures
02 36 00	Termite Control
02 72 00	Portland Cement Concrete Paving
02 76 00	Pavement Markings and precast Concrete Bumpers
02 76 10	Cast In Place Detectable Warning Surfaces

DIVISION 3 – CONCRETE

03 31 00	Cast-In-Place Concrete
----------	------------------------

DIVISION 4 – MASONRY

04 21 15	Adhered Masonry Veneer
04 22 00	Concrete Masonry Unit (CMU)
04 22 23	Architectural Concrete Masonry

DIVISION 5 – METALS

05 12 00	Structural Steel
05 30 00	Metal Decking
05 50 00	Metal Fabrications
05 55 00	Miscellaneous Metals

DIVISION 6 – WOOD AND PLASTICS

06 10 00	Rough Carpentry
06 17 33	Wood I Joists
06 20 00	Finish Carpentry
06 41 00	Custom Casework

06 61 16	Solid Surfacing Fabrications
06 83 16	Fiberglass Reinforced Panels

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

07 17 75	Water Repellent
07 21 00	Building Insulation
07 41 00	Metal Roofing Panels
07 42 13	Metal Wall Panels
07 52 00	Modified Bituminous Roofing
07 62 00	Sheet Metal Flashing and Trim
07 63 10	Gutters and Downspouts
07 84 13	Penetration Fire Stopping
07 90 00	Joint Sealants

DIVISION 8 – DOORS AND WINDOWS

08 11 13	Hollow Metal Doors and Frames
08 20 00	Wood Doors
08 31 00	Access Doors and Panels
08 33 00	Rollup Service Door
08 41 13	Aluminum Framed Entrances and Storefronts
08 41 14	Glazed Aluminum Curtain Wall
08 43 33	Folding Glass Storefronts
08 51 13	Aluminum Windows
08 62 50	Tubular Daylighting Devices
08 71 00	Door Hardware
08 80 00	Glazing

DIVISION 9 – FINISHES

09 20 00	Drywall Suspension System
09 22 16	Non-Structural Metal Framing
09 24 00	Portland Cement Plaster
09 25 00	Gypsum Board
09 30 50	Tile Setting Materials and Accessories
09 31 00	Ceramic Tile
09 90 00	Painting
09 96 23	Anti-Graffiti Coating – Clear
09 65 13	Rubber Base
09 65 19	Luxury Vinyl tile

DIVISION 10 – SPECIALITIES

10 14 00	Identifying Devices
10 16 05	Solid Polymer Toilet Compartments
10 20 00	Exterior Wall Louvers
10 44 00	Fire Extinguishers and Cabinets
10 80 00	Toilet Accessories

DIVISION 11 – EQUIPMENT

11 52 10	Assistive Listening System
----------	----------------------------

DIVISION 13 – SPECIAL CONSTRUCTION

13 11 00	Swimming Pool General Requirements
13 11 01	Swimming Pool Excavation
13 11 02	Swimming Pool Concrete

13 11 03	Swimming Pool Shotcrete
13 11 04	Swimming Pool Ceramic Tile
13 11 05	Swimming Pool Plaster
13 11 06	Swimming Pool Equipment
13 11 07	Swimming Pool Mechanical
13 11 08	Swimming Pool Electrical

DIVISION 21 – SPRINKLER SYSTEM

21 13 13	Fire Suppression Sprinkler System
----------	-----------------------------------

DIVISION 22 – PLUMBING

22 05 00	Common Work Results for Plumbing
22 05 13	Basic Plumbing Materials and Methods
22 05 53	Plumbing Identification
22 07 00	Plumbing Insulation
22 10 00	Plumbing

DIVISION 23 – MECHANICAL

23 00 00	Heating, Ventilation, and Air Conditioning
23 05 00	Common Work Results for HVAC
23 05 29	Hangers and Supports
23 05 48	HVAC Sound Vibration Seismic Control
23 05 53	HVAC Identification
23 05 93	TAB
23 07 00	HVAC Insulation
23 08 00	HVAC Systems Commissioning
23 09 00	HVAC Instrumentation Controls
23 30 00	Air Distribution
23 37 13	Diffusers, Registers, and Grilles
23 80 00	HVAC Equipment
23 80 01	Heat Pump Variable Refrigerant Flow Equipment
23 80 03	Heat Recovery Variable Refrigerant Flow Equipment

DIVISION 26 – ELECTRICAL

26 05 13	Basic Electrical Materials and Methods
26 05 19	Low Voltage Wires
26 05 26	Grounding and Bonding
26 05 33	Raceways, Boxes, Fittings and Supports
26 08 00	Electrical Systems Commissioning
26 09 23	Lighting Control Systems
26 10 00	Service Entrance
26 22 00	Low Voltage Transformers
26 24 13	Switchboards
26 25 16	Panel Boards Signal Terminal Cabinets
26 26 53	Electrical Vehicle Chargers
26 50 10	Solid State (LED) Lighting
26 56 17	Parking Lot LED and Site Lighting

DIVISION 27 – LOW VOLTAGE

27 00 00	Low Voltage Requirements
----------	--------------------------

DIVISION 28 – FIRE ALARM

28 31 00	Fire Detection and Alarm System
----------	---------------------------------

DIVISION 31 – EARTHWORK

31 10 00	Site Clearing
31 20 00	Earthwork
31 23 33	Trenching and Backfilling

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 11 23	Aggregate Base Course
32 12 16	Asphalt Concrete Paving
32 16 00	Curbs, Gutters, Sidewalks
32 31 19	Ornamental Metal Fences and Gates
32 80 00	Landscape Irrigation
32 90 00	Landscape Planting
32 92 00	Turf Sodding
32 93 00	Hydroseeding

DIVISION 33 – UTILITIES

33 10 00	Water Utilities
33 30 00	Sanitary Sewerage Utilities
33 40 00	Storm Drainage Utilities

SPECIAL PROVISIONS

Signing, Striping, and Pavement Markers

APPENDICES

- A. PPB Assembly
- B. Pedestrian Hybrid Signal (HAWK) Pedestrian Crosswalk System
- C. Geotechnical Investigation for Sgt. John Pinney Memorial Pool Replacement

END OF SECTION

- AGA American Gas Association
(703) 841-8400
1515 Wilson Blvd.
Arlington, VA 22209
- AHA American Hardboard Association
(847) 934-8800
1210 W. Northwest Hwy
Palatine, IL 60067-1897
- AI Asphalt Institute
(606) 288-4960
Research Puk Dr.
P.O. Box 14052
Lexington, KY 40512-4052
- AIA The American Institute of Architects
(202) 626-7300
1735 New York Ave., NW
Washington, DC 20006-5292
- AISC American Institute of Steel Construction
(800) 644-2400
One East Wacker Dr., Suite 3100
Chicago, IL 60601-2001
- AITC American Institute of Timber Construction
7012 South Revere Parkway, Suite 140
Engelwood, CO 80112
- AISI American Iron and Steel Institute
(202) 452-7100
1101 17th St., NW
Washington, DC 20036-4700
- ALSO American Lumber Standards Committee
(301) 972-1700
P.O. Box 210
Germantown, MD 20875
- AMCA Air Movement and Control Association International, Inc.
(847) 394-0150
30 W. University Dr
Arlington Heights, IL 60004-1893
- ANSI American National Standards Institute
(212) 642-4900
25 West 43rd Street, Fourth Floor
New York, NY 10036-8002

- APA APA-The Engineered Wood Association
(206) 565-6600
(Formerly: American Plywood Association)
P. O. Box 11700
Tacoma, WA 98411-0700
- APA Architectural Precast Association
(941) 454-6989
P.O. Box 08669
Fort Myers, FL 33908-0669
- ARI Air-Conditioning and Refrigeration Institute
(703) 524-8800
4301 Fairfax Dr., Suite 425
Arlington, VA 22203
- ASA Acoustical Society of America
(516) 576-2360
500 Sunnyside Blvd.
Woodbury, NY 11797
- ASC Adhesive and Sealant Council
(202) 452-1500
1627 K St., NW, Suite 1000
Washington, DC 20006-1707
- ASCE American Society of Civil Engineers
(800) 548-2723
World Headquarters
(703) 295-6000
1801 Alexander Bell Dr.
Reston, VA 20191-4400
- ASHRAE American Society of Heating, Refrigerating
(800) 527-4723
and Air-Conditioning Engineers
(404) 636-8400
1791 Tullie Circle, NE
Atlanta, GA 30329-2305
- ASLA American Society of Landscape Architects
(202) 686-2752
4401 Connecticut Ave., NW, 5th Floor
Washington, DC 20008-2369
- ASME American Society of Mechanical Engineers
(800) 434-2763
Three Park Avenue
(212) 705-7722
New York, NY 10016-5990

ASSE American Society of Sanitary Engineering
 901 Canterbury, Suite A
 Westlake, OH 44145

ASTM American Society for Testing and Materials
 (610) 832-9500
 100 Barr Harbor Dr.
 West Conshohocken, PA 19428-2959

AWI Architectural Woodwork Institute
 (703) 733-0600
 1952 Isaac Newton Sq.
 Reston, VA 20190

AWWPA American Wood Preservers' Association
 (817) 326-6300
 3246 Fall Creek Hwy, Suite 1900
 Grandbury, TX 76049-7979

AWS American Welding Society
 (800) 443-9353
 550 NW LeJeune Rd.
 (305) 443-9353
 Miami, FL 33126

AWWA American Water Works Association
 6666 Quincy Avenue
 Denver CO 80235

BHMA Builders Hardware Manufacturers Association
 (212) 661-4261
 355 Lexington Ave., 17th Floor
 New York, NY 10017-6603

BIA Brick Institute of America
 (703) 620-0010
 11490 Commerce Park Dr.
 Reston, VA 22091-1525

CRI Carpet and Rug Institute
 (800) 882-8846
 310 S. Holiday, Ave.
 (706) 278-3176
 Dalton, GA 30722-2048

CRSI Concrete Reinforcing Steel Institute
 (847) 517-1200
 933 N. Plum Grove Rd.
 Schaumburg, IL 60173-4758

- CTI Ceramic Tile Institute of America
(310) 574-7800
12061 West Jefferson Blvd.
Culver City, CA 90230-6219
- DHI Door and Hardware Institute
(703) 222-2010
(Formerly: National Builders Hardware Association)
14170 Newbrook Dr.
Chantilly, VA 20151-2223
- EIMA EIFS Industry Members Association
(800) 294-3462
402 N. Fourth St., Suite 102
(509) 457-3500
Yakima, WA 98901-2470
- EJMA Expansion Joint Manufacturers Association
(914) 332-0040
25 N. Broadway
Tarrytown, NY 10591-3201
- FCICA Floor Covering Installation Contractors Association
(Formerly: Floor Covering Installation Bond) (706) 226-5488
P.O. Box 948
Dalton, GA 30722-0948
- FM Factory Mutual System
(781) 762-4300
1151 Boston-Providence Turnpike
P.O. Box 9102
Norwood, MA 02062-9102
- GA Gypsum Association
(202) 289-5440
810 First St., NE, Suite 510
Washington, DC 20002
- GANA Glass Association of North America
(913) 266-7013
(Formerly: Flat Glass Marketing Association)
3310 SW Harrison St.
Topeka, KS 66611-2279
- HMA Hardwood Manufacturers Association (412) 829-0770
(Formerly: Southern Hardwood Lumber)
Manufacturers Association)
400 Penn Center Blvd., Suite 530
Pittsburgh, PA 15235-5605

- HPVA Hardwood Plywood and Veneer Association
(703) 435-2900
1825 Michael Farraday Dr.
P.O. Box 2789
Reston, VA 22195-0789
- ICC International Code Council
(703) 931-4533
5203 Leesburg Pike, Suite 708
Falls church, VA 22041
- ICBO International Conference of Building Officials
5360 Workman Mill Road
(800) 423-6587
Whittier, CA 90601-2298
- IIDA International Interior Design Association
(312) 467-1950
341 Merchandise Mart
Chicago, IL 60654-1104
- INCE Institute of Noise Control Engineering
(914) 462-4006
P.O. Box 3206, Arlington Branch
Poughkeepsie, NY 12603
- ISA ISA - International Society for Measurement and Control
P.O. Box 12277
(919) 549-9411
67 Alexander Dr.
Research Triangle Park, NC 27709
- ISS Iron and Steel Society
(412) 776-1535
410 Commonwealth Dr.
Warrendale, PA 15086-7512
- KCMA Kitchen Cabinet Manufacturers Association
(703) 264-1690
(Formerly: National Kitchen Cabinet Association)
1899 Preston White Dr.
Reston, VA 22091-4326
- LGSI Light Gage Structural Institute
(972) 625-4560
c/o Loseke Technologies, Inc.
P.O. Box 560746
The Colony, TX 75056
- LMA Laminating Materials Association
(201) 664-2700
(Formerly: American Laminators Association)
Hillsdale, NJ 07642-2730

MBMA Metal Building Manufacturer's Association
(216) 241-7333
c/o Thomas Associates, Inc.
1300 Sumner Ave.
Cleveland, OH 44115-2851

MCAA Mechanical Contractors Association of America
(301) 869-5800
1385 Piccad Dr.
Rockville, MD 20850-4329

MFMA Metal Framing Manufacturers Association
(312) 644-6610
(Formerly: Wood and Synthetic Flooring Institute)
401 N. Michigan Ave.
Chicago, IL 60611

MIA Marble Institute of America
(440)-250-9222
28901 Clemens Road, Suite 100
Cleveland, Ohio 44145 USA

MIA Masonry Institute of America
(213) 388-0472
2550 Beverly Blvd.
Los Angeles, CA 90057

ML/SFA Metal Lath/Steel Framing Association
(312) 456-5590
(A Division of the NAAMM)
8 South Michigan Ave., Suite 1000
Chicago, IL 60603

NAAMM National Association of Architectural Metal Manuf.
8 South Michigan Ave., Suite 1000
(312) 456-5590
Chicago, IL 60603

NAIMA North American Insulation Manufacturers Assoc.
(703) 684-0084
(Formerly: Thermal Insulation Manufacturers Association)
44 Canal Center Plaza, Suite 310
Alexandria, VA 22314

NAPA National Asphalt Pavement Association
(301) 731-4748
NAPA Building
5100 Forbes Blvd.
Lanham, MD 20706-4413

NBGQA National Building Granite Quarries Asson.
800-557-2848
1220 L. Street, NW, Suite 100-167
Washington, DC 20005

NCMA National Concrete Masonry Association
(703) 713-1900
2302 Horse Pen Rd.
Herndon, VA 20171-3499

NECA National Electrical Contractors Association
(301) 657-3110
3 Bethesda Metro Center, Suite 1100
Bethesda, MD 20814-5372

NEI National Elevator Industry
(201) 944-3211
185 Bridge Plaza North, Suite 310
Fort Lee, NJ 07024

NEMA National Electrical Manufacturers Association
(703) 841-3200
1300 N 17th St., Suite 1847
Rosslyn, VA 22209

NFPA National Fire Protection Association
(800) 344-3555
One Batterymarch Park
(617) 770 3000
P.O. Box 9101
Quincy, MA 02269-9101

NHLA National Hardwood Lumber Association
(901) 377-1818
P.O. Box 34518
Memphis, TN 38184-0518

NLGA National Lumber Grades Authority
(604) 524-2393
#46-First Capital Pl.,
960 Quayside Dr.
New Westminster, BC V3M 6G2

NPA National Particleboard Association
(301) 670-0604
18928 Premiere Court
Gaithersburg, MD 20879-1569

NPCA National Paint and Coatings Association
(202) 462-6272
1500 Rhode Island Ave., NW
Washington, DC 20005-5597

NRCA National Roofing Contractors Association
(800) 323-9545
O'Hare International Center
(847) 299-9070
10255 W. Higgins Rd., Suite 600
Rosemont, IL 60018-5607

NRMCA National Ready Mixed Concrete Association
(301) 587-1400
900 Spring St.
Silver Spring, MD 20910

NUSIG National Uniform Seismic Installation Guidelines
12 Lahoma Ct.
(510) 946-0135
Alamo, CA 94526

NWWDA National Wood Window and Door Association
(800) 223-2301
(Formerly: National Woodwork Manuf. Assoc'n)
(847) 299-5200
1400 E. Touhy Ave., G-54
Des Plaines, IL 60018 (See WDMA)

PCA Portland Cement Association
(847) 966-6200
5420 Old Orchard Rd.
Skokie, IL 60077-1083

PCI Precast/Prestressed Concrete Institute
(312) 786-0300
175 W. Jackson Blvd., Suite 1859
Chicago, IL 60604

PDCA Painting and Decorating Contractors of America
(800) 332-7322
3913 Old Lee Hwy, Suite 33-B
(703) 359-0826
Fairfax, VA 22030

PEI Porcelain Enamel Institute
(615) 385-5357
4004 Hillsboro Pike, Suite 224-B
Nashville, TN 37215

RFCI Resilient Floor Covering Institute
(301) 340-8580
966 Hungerford Dr., Suite 12-B
Rockville, MD 20850-1714

- RMA Rubber Manufacturers Association
(800) 220-7620
1400 K St., NW, Suite 900
(202) 682-4800
Washington, DC 20005
- SAE SAE International
(412) 776-4841
400 Commonwealth Dr.
Warrendale, PA 15096-0001
For publications: Call (412) 776-4970
- SDI Steel Door Institute
(216) 889-0010
30200 Detroit Rd.
Cleveland, OH 44145-1967
- SHLMA Southern Hardwood Lumber Manufacturers Association
(See HMA)
- SIGMA Sealed Insulating Glass Manufacturers Association
401 N. Michigan Ave.
(312) 644-6610
Chicago, IL 60611-4267
- SJI Steel Joist institute
(803) 626-995
3127 10th Ave., North Ext.
Myrtle Beach, SC 29577-6760
- SMACNA Sheet Metal and Air Conditioning
(703) 803-2980
Contractors' National Association, Inc.
4201 Lafayette Center Dr.
P.O. Box 221230 Chantilly, VA 20151-1209
- SPIB Southern Pine Inspection Bureau
(904) 434-2611
4709 Scenic Hwy
Pensacola, FL 32504-9094
- SPRI Single Ply Roofing Institute
(617) 444-0242
175 Highland Ave.
Needham Heights, MA 02194-3034
- SSPC Steel Structures Painting Council
(412) 281-2331
40 24th St., 6th Floor
Pittsburgh, PA 15222-4643

SWRI Sealant, Waterproofing and Restoration Inst.
(816) 472-7974 2841 Main
Kansas City, MO 64108

TCA Tile Council of America
(864) 646-8453
100 Clemson Rescue Blvd.
Anderson, SC 29625

UL Underwriters Laboratories Inc.
(800) 704-4050
333 Pfingsten Rd.
(847) 272-8800
Northbrook, IL 60062

WA Wallcoverings Association
(312) 644-6610
401 N. Michigan Ave.
Chicago, IL 60611-4267

WCLIB West Coast Lumber Inspection Bureau
(503) 639-0651
P.O. Box 23145
Portland, OR 97281-3145

WDMA Window and Door Manufacturers Association
(800) 223-2301
(Formerly: National Woodwork Manuf. Assoc'n)
(847) 299-5200
1400 E. Touhy Ave., G-54
Des Plaines, IL 60018

WWPA Western Wood Products Association
(503) 224-3930
Yeon Building
522 SW 5th Ave.
Portland, OR 97204-2122

GOVERNMENT AGENCIES:

DOT Department of Transportation
(202) 366-4000
400 Seventh St., SW
Washington, DC 20590

EPA Environmental Protection Agency
(202) 260-2090
401 M St., SW
Washington, DC 20460

GSA General Services Administration
(202) 708-5082
F St. and 1 8th St., NW
Washington, DC 20405

NIST National Institute of Standards and Tech.
(301) 975-2000
(U.S. Department of Commerce)
Building 101, #AI 134,
Rte. I-270 and Quince Orchid Rd.
Gaithersburg, MD 20899

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not used

END OF SECTION

SECTION 01 20 00 PROJECT MEETINGS

1.00 – GENERAL

1.01 DESCRIPTION

- A. Work included: To enable orderly review during progress of the Work, and to provide for systematic discussion of problems, the CONSTRUCTION MANAGER will conduct project meetings throughout the construction period.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, the Conditions of the Contract and Sections in Division 1 of these Specifications.
 - 2. The CONTRACTOR'S relations with his subcontractors and materials suppliers, and discussions relative thereto, are the CONTRACTOR'S responsibility and normally are not part of project meetings content.
 - 3. Project Meetings: 01 31 00, PROJECT MANAGEMENT AND COORDINATION

1.02 QUALITY ASSURANCE

- A. For those persons designated by the CONTRACTOR to attend and participate in project meetings, CONTRACTOR shall provide required authority to commit the CONTRACTOR to solutions agreed upon in the project meetings.

1.03 SUBMITTALS

- A. Agenda items: To the maximum extent practicable, advise the CONSTRUCTION MANAGER at least twenty-four (24) hours in advance of project meetings regarding items to be added to the agenda.
- B. Minutes:
 - 1. The CONSTRUCTION MANAGER will compile minutes of each project meeting, and will make available required copies to the CONTRACTOR and required copies to the OWNER, ARCHITECT and INSPECTOR.
 - 2. Recipients of copies may make and distribute such other copies at their discretion.

2.00 – PRODUCTS (NOT USED)

3.00 – EXECUTION

3.01 MEETING SCHEDULES

- A. Except as noted below for Pre-Construction Meeting, project meetings will be held weekly.
- B. Coordinate as necessary to establish mutually acceptable schedule for meetings.

3.02 MEETING LOCATION

- A. The ARCHITECT in conjunction with the CONSTRUCTION MANAGER will establish meeting location. To the maximum extent practicable, meetings will be held at the job site.

3.03 PRECONSTRUCTION MEETING

PURPOSE: The purpose of the meeting is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established.

- A. Pre-Construction Meeting will be scheduled by the CONSTRUCTION MANAGER and held a minimum of seven (7) days prior to commencement of the work at the site.
 - 1. Provide attendance by authorized representatives of the CONTRACTOR including the Contractor's PROJECT MANAGER and its onsite FIELD SUPERINTENDENT and major subcontractors. (Major subcontractors pre-approved by the CONSTRUCTION MANAGER)
 - 2. The CONSTRUCTION MANAGER will advise other interested parties, including the OWNER, ARCHITECT, ARCHITECT'S Consultants, Inspector, Testing Lab and request their attendance. In all cases, the meetings shall be coordinated by the CONSTRUCTION MANAGER to maximize meeting input and minimize the number of meetings required.
- B. Minimum Agenda: Data will be distributed and discussed on at least the following items.
 - 1. Organizational arrangement of CONTRACTORS forces and personnel, and those of subcontractors, materials suppliers, ARCHITECT, and CONSTRUCTION MANAGER.
 - 2. Channels and procedures for communication.
 - 3. Construction schedule, including sequence of critical work.
 - 4. Contract Documents, including distribution of required copies of original Documents and revisions.
 - 5. Notification of residents prior to starting any work and keeping them informed throughout the project.
 - 6. Processing of Shop Drawings and other data submitted to the ARCHITECT through the CONSTRUCTION MANAGER for review.

7. Documentation of existing conditions.
8. Processing of Bulletins, field decisions, Work Orders, and Change Orders.
9. Use of project site, office and storage areas, security, housekeeping, and City needs.
10. Rules and regulations governing performance of the work.
11. Procedures for safety and first aid, security, quality control, housekeeping, and related matters.
12. Format and procedures for submitting "Application and Certificate for Payment" and "Schedule of Values" forms.
13. Major equipment deliveries and priorities.
14. Traffic control and access.
15. Maintaining record documents.

3.04 PROJECT MEETINGS

The meeting location, day of the week, and time of day will be mutually agreed to by the City of Ridgecrest, the CONSTRUCTION INSPECTOR, and the CONTRACTOR.

A. Attendance:

1. The CONTRACTOR will assign the same person or persons to represent the CONTRACTOR at the mandatory project meetings throughout progress of the Work.
2. Subcontractors, materials suppliers, and others may be invited to attend those project meetings in which their aspect of the Work is involved, as pre-approved by the CONSTRUCTION MANAGER.

B. Minimum Agenda:

1. Review, revise as necessary, and approve minutes of previous meetings.
2. Review contract working days summary.
3. Two week look ahead schedule. CONTRACTOR shall provide a 2-Week Look Ahead schedule for each meeting. The Look Ahead schedule shall communicate the Contractor's (and subcontractors') daily planned activities for the upcoming two-week period, including any major deliveries.
4. Review progress of the Work since last meeting, including status of long-lead submitted material and equipment.

5. Identify problems which impede planned progress.
6. Develop corrective measures and procedures to regain planned schedule.
7. Review status of RFIs and Submittals. Review approved change orders and potential change orders.
8. Complete other current business.
9. Revisions to minutes.
10. Unless published minutes are challenged in writing prior to the next regularly scheduled progress meeting (meetings are scheduled every seven (7) days, they will be accepted as properly stating the activities and decisions of the meeting.
11. Persons challenging published minutes shall reproduce and distribute copies of the challenge to all indicated recipients of the particular set of minutes.
12. Challenge to minutes shall be settled as priority portion of "old business" at the next regularly scheduled meeting.

END OF SECTION

SECTION 01 30 00 SUBMITTALS

1.00 – GENERAL

1.01 WORK INCLUDED

- A. Whenever possible throughout the Contract Documents, the minimum acceptable quality of workmanship and materials has been defined, either by manufacturer's name and catalog number, or by reference to recognized industry standards.
- B. To ensure that the specified products are furnished and installed in accordance with design intent, procedures have been established for advance submittal of design data, and for review and acceptance or rejection by the ARCHITECT.

1.02 RELATED WORK

- A. Submittal Procedures: 01 34 00, SHOP DRAWINGS AND SAMPLES

2.00 – PRODUCTS

2.01 SHOP DRAWINGS, PRODUCT DATA, SAMPLES AND COLOR SELECTION

- A. See Section 01 34 00 - Shop Drawings and Samples.

2.02 CERTIFICATES OF COMPLIANCE AND TESTING REPORTS

- A. See Section 01 41 00

2.03 MAINTENANCE AND OPERATING MANUALS

- A. See Section 01 70 00 - Contract Close-out
- B. See Section 01 73 00 - Operating and Maintenance Data.

2.04 PROJECT RECORD DRAWINGS

- A. See Section 01 70 00 - Contract Close-out.

2.05 GUARANTIES, WARRANTIES AND BONDS

- A. See Section 01 77 40 – Warranties, Guaranties and Bonds.

2.06 SCHEDULE OF VALUES

- A. Submit to CONSTRUCTION MANAGER as required by the General Conditions within seven (7) calendar days after issuance of the Notice to Proceed.

2.07 PROGRESS SCHEDULE

- A. Submit to the CONSTRUCTION MANAGER as required by Specification Section 01 30 00 and the General Conditions within seven (7) calendar days after issuance of Notice of Award.

2.08 CONTRACTOR SAFETY PLAN

- A. Contractor shall submit to the Construction Manager their Company Safety Plan within seven (7) calendar days after issuance of the Notice of Award.

2.09 SEQUENCE OF OPERATIONS PLAN

- A. Submit a Sequence of Operation Plan which will address the implementation steps necessary to accomplish the Work specified Summary of Work. The Sequence of Operation Plan shall include the following:
 - 1. A step-by-step plan showing the overall sequence of the Work. This written work plan is separate from the Baseline Construction Schedule and is intended to communicate the CONTRACTOR's sequence of Work to the ENGINEER. The details of the plan, such as start and end dates and durations, shall be contained in the CONTRACTOR's Baseline Construction Schedule.
 - 2. All sequencing constraints imposed by this section.
 - 3. Temporary shoring and protection of existing utilities and facilities.

3.00 – EXECUTION

3.01 COORDINATION OF SUBMITTALS

- A. General: Prior to submittal to CONSTRUCTION MANAGER for ARCHITECT'S review, use all means necessary to fully coordinate all materials, including the following procedures:
 - 1. Determine and verify all field dimensions and conditions, materials, catalog numbers, and similar data.
 - 2. Coordinate as required with all trades and with all public agencies involved.
 - 3. Secure all necessary approvals from public agencies and others, and signify by stamp, or other means, that they have been secured.
 - 4. CONSTRUCTION MANAGER and ARCHITECT to furnish shop drawing and submittal registry for CONTRACTOR to comply with. As a Reference only: this does not relieve the CONTRACTOR from complying with all submittals and Shop Drawings as required by Contract Documents)
- B. Grouping of Submittals: Unless otherwise specifically permitted by the ARCHITECT, make all submittals in groups containing all associated items. The

ARCHITECT will reject partial submittals as not complying with the provisions of the Contract Documents.

- C. Color Selection: The ARCHITECT requires that all items requiring a color selection must be submitted before any color selection is issued.
- D. Minimum of seven (7) copies of each submittal is required.

3.02 IDENTIFICATION

- A. Completely identify each submittal and submit using forms provided and showing the following minimum information:
 - 1. Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.
 - 2. Complete name of Project.
 - 3. Drawings number and Specifications Section number to which the submittal applies.
 - 4. Whether this is an original submittal or resubmittal. Resubmittals are to be clearly marked using original number with "Revision # ____"
 - 5. Date submittal was prepared or revised.
 - 6. Stamp affixed with signature that the submitted or resubmitted item or items meet prime CONTRACTOR'S approval.

3.03 TIMING OF SUBMITTALS

- A. All material submittals and shop drawings must be delivered to CONSTRUCTION MANAGER within fourteen (14) calendar days after issuance of Notice to Proceed. If the CONTRACTOR fails to respond to this submittal schedule, the CONTRACTOR shall be subject to damages. Parties agree that delays in submittal and Shop Drawings will constitute a probable delay in Project completion.
- B. Project construction schedule and schedule of values must be delivered to CONSTRUCTION MANAGER within seven (7) calendar days after issuance of Notice to Proceed.
- C. Contractor shall allow for twenty (20) working day review period for each submittal/resubmittal by ARCHITECT and/or CONSTRUCTION MANAGER.

END OF SECTION

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination drawings.
 - 2. Requests for Information (RFIs).
 - 3. Project meetings.

1.2 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information from each other during construction.

1.3 COORDINATION

- 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 obtaining 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. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. 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. Pre-installation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.
9. Project closeout activities.

1.4 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, where installation is not completely shown 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 the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire protection, fire alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.

6. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility.

1.5 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 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. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. 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: AIA Document G716 or 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 working 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 RFIs will be returned without action:

- a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. 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 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 Division 1 Section 01 32 16 "Construction Schedule."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Owner's Project Manager in writing within **10** 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 and Owner's Project Manager within seven days if Contractor disagrees with response.
 - F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly.
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect.
 - 4. RFI number including RFIs that were dropped and not submitted.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.6 PROJECT MEETINGS

- A. General: Construction Manager will schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, and Architect, within three working days of the meeting.
- 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, Contractor and its superintendent. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - 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 and existing building.
 - 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 that requires 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, and Owner's Project Manager, of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.

- p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
- 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.
 - 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: Architect will conduct progress meetings at weekly intervals.
- 1. Attendees: Representative of Owner, Architect and Contractor. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. 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) Status of submittals.

- 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of proposal requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - 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)

END OF SECTION

SECTION 01 32 16 CONSTRUCTION SCHEDULE

PART 1 – GENERAL

1.1 DESCRIPTION

A. The Work specified in this section includes preparation, submittal, and use of a Construction Schedule as a portion of the CONTRACTOR's mobilization and progress reporting. Its subsequent updates and revisions, as reviewed and allowed by the ENGINEER, shall be a required part of each progress payment application submitted as provided in the Contract Documents.

B. The Work shall be planned and proceed with such progress as required to prevent any delay to this Contract and to other work planned at the site. This includes planning and proceeding with Contract Milestone dates and constraints, time requirements, all activities of Subcontractors, equipment vendors, and Suppliers including submittals and re-submittals within the specified times and constraints and general completion of the Work as defined in the Contract Documents.

C. THE CONTRACTOR's failure to furnish required deliverables in the time and manner specified in this section may be construed by City of Ridgecrest as a material breach of the Contract.

PURPOSE

A. This section stipulates requirements and procedures for the CONTRACTOR to use in preparation of cost-loaded construction schedule and reports. The purpose of the schedule and reports shall be to:

1. Ensure adequate planning and timely execution of the Work by the CONTRACTOR.
2. Facilitate coordination and interfacing of the CONTRACTOR's Work with others as needed.
3. Establish a Baseline Construction Schedule to which subsequent periodic schedule updates will be compared to determine overall progress and performance toward satisfactory completion of the Contract.
4. Periodically record the as-built condition of the Contract.
5. Assist the ENGINEER in monitoring progress.
6. Establish the amount of the progress period payment to be made to the CONTRACTOR.
7. Evaluate proposed changes to the Contract and resultant effects on the Construction Schedule.
8. Effectively determine time effects on overall Contract completion.

MOBILIZATION AND PROGRESS PAYMENTS

A. The City of Ridgecrest's administration of the Contract, its construction program, internal resource coordination, and operations planning may be severely impeded if adoption of the

schedule is delayed. Consequently, and as provided elsewhere in the Contract Documents, payment for mobilization may not be approved until the schedule(s) required herein are accepted by the ENGINEER.

B. Progress payment applications may be deemed improper and may not be accepted and processed for payment by City of Ridgecrest without periodic Construction Schedule updates submitted and subsequently accepted by the ENGINEER in the time and manner required by this section.

1.2 QUALITY ASSURANCE

A. CONTRACTOR Qualifications

1. Provide a construction scheduler, proficient in the use of Microsoft Project software, who shall have a minimum of three years of verifiable experience in construction work sequencing, productivity, preparation, and maintenance of detailed construction schedules for individual contracts of \$5 Million and larger in constructed value.
2. Submit the construction scheduler's resume along with the CONTRACTOR's management team resumes to the ENGINEER as provided elsewhere in the Contract Documents. It shall be accompanied by personal references from at least two owner-representatives familiar with the construction scheduler's work on previous similar contracts. The ENGINEER may reject the proposed scheduler based on poor references, lack of qualifications as defined in this section, or poor performance history on previous City of Ridgecrest contracts including late schedule submittals, lack of responsiveness to requested clarifications, corrections, re-submittals, and time analysis.
3. The CONTRACTOR's scheduler shall attend all meetings, including progress and special meetings pertaining to scheduling of the Work. The scheduler, along with the CONTRACTOR's management team shall work closely with the ENGINEER to comply with and deliver the requirements of this section.
4. It is the specific intent of this section that the CONTRACTOR and its scheduler shall be wholly responsible for developing, maintaining, updating, checking and providing an accurate and comprehensive representation of the workplan in the required software, related databases and reports to achieve the purposes set forth in the Contract Documents

A. The ENGINEER will review schedule submittals in accordance with this section and the other Contract Documents for the administrative purposes described herein. However, the ENGINEER's review, comments, or consent to use the CONTRACTOR's schedule shall not be construed as validation or endorsement of the CONTRACTOR's Work plan and approach nor shall it relieve the CONTRACTOR of any and all responsibility, liability, or risk related to its Work plan, its Work plan as represented by the schedule, or requirements of the Contract.

1.4 SCHEDULING CONFERENCE AND WORKSHOPS

A. The ENGINEER will conduct a scheduling conference as a component of the pre-construction meeting to review requirements of this and related sections to facilitate development of the Baseline Construction Schedule as described in this section. As part of its presentation, discuss the following documents proposed:

1. Work plan and approach to the Work including its methods, means, and sequencing.

2. Work Breakdown Structure (WBS), Activity Coding Structure and Activity Identification numbering system for labeling all Work Activities, correlated with the Schedule of Prices. At a minimum, provide the data detailed in Appendices B and C of this section.

3. Critical path methodology (CPM) and its cost and quantity loading approach.

B. The ENGINEER will formalize its meeting review comments including remarks about the WBS, Activity Coding Structure, and Activity Identification System and return them for incorporation into its Baseline Construction Schedule.

C. Include the modifications requested by the ENGINEER and prepare a draft Work plan and Baseline Construction Schedule that represents its comprehensive approach to all of the Work.

D. Project stakeholders will then review the draft before the CONTRACTOR presents it at a workshop to be arranged by the ENGINEER to resolve stakeholder concerns and discuss finalization of the Baseline Construction Schedule.

E. Make final edits and present the final Baseline Construction Schedule at a workshop to be arranged by the ENGINEER to review the final Baseline Construction Schedule.

F. Conform the final Baseline Construction Schedule as discussed at the workshop and use the schedule to record progress of the Work as described in this section. Do not commence Work in the field without the ENGINEER's authorization to use the Baseline Construction Schedule.

1.5 GENERAL SCHEDULE REQUIREMENTS

A. Develop, maintain, update, revise, check, and present the Work plan in the form of a CPM Construction Schedule for use by the ENGINEER in meeting the purposes described in the Contract Documents. Provide all information concerning methods, means, sequencing, logic, and duration of all activities as well as providing all CPM logic network diagram and tabular report data.

B. Use Microsoft Project or approved equal. Submit electronic files compatible with the required software, and pdf format, and coordinate use of subsequent releases with City of Ridgecrest to ensure data compatibility. Use a hardware system commensurate with the size of the Contract, capable of handling, processing, printing, and plotting all data required to satisfy the requirements of this section.

C. The Work activities comprising the Construction Schedule shall be of sufficient detail to assure adequate planning and execution of the Work such that it increasing the working hours or any other method, manner, or procedure to recover from delays to the Construction Schedule be considered justification for Contract modification for Extra Work. provides an appropriate basis for predicting, monitoring, evaluating, and recording the progress of the Work. Work Activities shall conform to the following requirements:

1. Describe Work Activities using consistent terminology such that the Work is readily identifiable for assessment of progress and completion.

2. Subdivide the Work into activities of duration no longer than 15 uninterrupted workdays each, except as to non-construction activities, such as procurement and delivery of materials and equipment, and any other activities for which the ENGINEER may accept a longer duration in writing.

3. The construction time, as determined by the schedule, from early start to late finish for any sub-phase, phase, or the entire Contract shall not exceed the Contract Duration

specified or shown in the Contract Documents. One day shall be the smallest time unit shown.

4. Except as provided for in Appendix B for milestones, activities labeled "start," "continue," or "completion" shall not be allowed. Logic relationships between activities shall be limited to finish-to-start (FS) type relationships and the use of lags or durations between activities shall not be permitted.

5. Do not constrain the schedule with artificial logic ties and/or constraint dates and/or use any other scheduling techniques that may distort the activity float and total float associated with the critical path activities and the schedule in general. The only allowable constraint shall be "Finish on or Before" for Contract Milestone dates.

6. Each Work Activity shall contain the following information as elaborated in Appendix B of this section:

A. WBS coding, activity coding and a unique Activity Identification number consistent with the structure and system agreed to by the ENGINEER.

B. Performance responsibility; General Contractor or Subcontractor trade code; GEN, MECH, ELEC, CARP, PLAST, etc.

C. Work location code and description of the physical plant area involved.

D. Duration in workdays using the appropriate Activity Calendar from the CONTRACTOR's Project calendar pool. Do not use calendars from its Global calendar pool.

E. Cost data as mandated herein

D. The ENGINEER may require the CONTRACTOR, at any time during the Contract, to develop a more detailed schedule or Fragment than depicted in the Construction Schedule to clearly illustrate the effort needed to complete a specific area or task.

E. The Construction Schedule shall contain the following standard milestones; Notice to Proceed; Mobilization; Construction Start; Specified Contract Milestones for each phase of Work as identified in the Contract Documents; Substantial Completion; and Final Completion.

F. Activity Cost Loading:

1. The Construction Schedule shall incorporate cost-loaded activities equal to the Contract Total Price and Sub-Totals set forth in the Contract Agreement 'Exhibit "A" Schedule of Prices' and as further detailed in the General Conditions section entitled "Payment – Itemized Breakdown of Contract Lump Sum Prices."

2. Divide prices to determine and substantiate a fair allocation of costs to each activity of Work in the schedule that is physically incorporated into the facility.

3. Do not unbalance the activity cost loading and, except for mobilization costs, shall prorate overhead and profit on all activities for the entire Contract Duration. Furnish the minimum data required in Appendix G of this section to the ENGINEER for review and agreement prior to integrating cost data into the schedule.

4. Procurement, submittal preparation and submittal review activities shall not be cost-loaded. Payment for material and equipment shall be made in accordance with the Contract Documents.

5. The payment application and all periodic payment requests shall be based upon, but may not be limited to, the cost-loaded Construction Schedule update; the Contract Agreement 'Exhibit "A" Schedule of Prices'; and the General Conditions section entitled "Payment – Itemized Breakdown of Contract Lump Sum Prices".

6. Proposed changes to the authorized cost-loaded Construction Schedule may only be made with the written acceptance by the ENGINEER.

G. The Construction Schedule shall begin with the effective date of the Notice to Proceed and not exceed the maximum Contract Duration provided in the Contract. It shall include, but not be limited to, the following items as appropriate to this Contract:

1. All administrative tasks.
2. Type of Work to be performed, sequences, and labor trades involved, including performance responsibility and trade code.
3. Quantity loading of activities showing, at a minimum, unit price Bid Items, estimated quantities to be installed or removed as indicated in the Contract Documents and as determined by the CONTRACTOR in preparation of its Bid, and any additional information required by the ENGINEER.
4. All submittal preparation and reviews including ENGINEER reviews, and acceptance of shop drawings and material samples shall provide a 25-day minimum duration as specified for the ENGINEER's review of submittals, unless the submittal is of the type requiring a longer period of time as specified in the Contract Documents for shop drawing submittals.
5. All manufacturer factory tests, material and equipment deliveries, field tests, readiness tests, and installation activities that the CONTRACTOR intends to seek payment for, including stored materials.
6. Delivery, installation, check-out/testing, and startup of City of Ridgecrest-furnished equipment and materials in accordance with the schedule dates set forth in the Specifications or as furnished by the ENGINEER.
7. Approvals required by regulatory agencies or other third parties, including CONTRACTOR obtained permits.
8. Identification of all subcontract Work and assignments of responsibility for performing specific activities.
9. All temporary utilities and construction required by the CONTRACTOR to perform the Work.
10. Access to and availability of Work areas including all bypass pumping.
11. All interruptions, shutdowns and connections to existing plant systems and equipment.
12. Timing of the phased or total takeover of the Work by THE CITY OF RIDGECREST as may be required by the Contract.
13. As provided in the Contract Documents, regular days and hours are comprised of 5 days per week, 8 hours per day, unless specified otherwise.

14. Clearly identify all non-workdays, such as THE CITY OF RIDGECREST holidays, and other non-work periods in Project calendars. To avoid fractional durations, all Project calendars shall use the same 8-hour period each day. Non-standard work times shall be noted in the activity name only.

15. Identification of any work force, material, or equipment restrictions, as well as any activity requiring unusual shift work, such as two shifts, 6-day weeks, overtime, or work at times other than regular days or hours, shall be clearly identified in the Construction Schedule.

16. CONTRACTOR activities that will be coordinated with City of Ridgecrest ongoing activities.

17. Material and equipment installation including installation, check-out, start-up, testing, equipment service manual submittal and acceptance, training lesson plan(s) submittal and acceptance, and the City of Ridgecrest staff training and assistance required by the Contract Documents.

18. CONTRACTOR-prepared drawings and diagrams such as shoring diagrams.

19. Specific Work activities, including but not limited to, site Work, underground piping and electrical duct banks, structural excavation, soil testing, backfill, placement of sheeting, pile driving, formwork erection, rebar placement, placing of concrete, stripping forms, concrete curing, installation of process piping, electrical conduits and wiring, instrumentation and controls conduits and wiring, terminations, other materials and plant equipment, and cleanup.

20. Include an activity for ground disturbance and protection of affected drains, if applicable.

21. The City of Ridgecrest has included an allowance in the Contract Duration to offset Inclement Weather delays to the Work. Provide an Inclement Weather activity in the Schedule with a duration as provided in the Contract Documents, based on its 5- day project activity that shall conform to the following requirements:

A. The Inclement Weather predecessor activity shall be the last construction activity that occurs before Substantial Completion.

B. The Inclement Weather successor activity shall be the Substantial Completion milestone.

C. Notify the ENGINEER in writing within 7 days of a lost workday that has occurred due to Inclement Weather. Correspondingly reduce the Inclement Weather activity duration as weather days occur, are recognized and accepted by the ENGINEER.

D. Notify the ENGINEER in writing to request a non-compensable extension of time if the number of actual Inclement Weather delay days exceeds the number of Inclement Weather delay days identified in the Contract Documents. Such delays shall not entitle the CONTRACTOR to additional compensation.

22. Punch lists.

23. Final cleanup.

24. Specific information required by the Specifications.

25. Required inspections by the ENGINEER.

26. Progress period updating of As-Built Drawings and final submittal of As-Built Drawings at Final Completion, or as directed by the ENGINEER.

BASELINE CONSTRUCTION SCHEDULE REQUIREMENTS

A. Submit a detailed written plan for the Work and a corresponding Baseline Construction Schedule that incorporates all applicable elements of this section and the other Contract Documents sufficient to meet its purposes as described therein. It shall demonstrate the final level of detail for each activity, all required relationships completely identified, and the duration of each activity correctly depicted. It shall be developed as follows:

1. The Baseline Construction Schedule shall be unstated, and the data date shall be the effective date of the Notice to Proceed.

2. The Baseline Construction Schedule shall clearly indicate the Longest Critical Path of activities from Notice to Proceed to the Contract completion date.

3. Procurement activities including shop drawings and sample submittals, approval, and realistic fabrication/delivery dates of key and long-lead procurement elements, and all deferred approval items.

4. The Baseline Construction Schedule shall contain all cost information assigned to each discrete activity at the final level of detail. Each activity shall be cost-loaded to permit generation of cash flow curves and progress payment amount.

5. Collect data and information from Subcontractors, Suppliers, and equipment manufacturers for incorporation into the Baseline Construction Schedule. The Baseline Construction Schedule submittal shall include signed certification letters from Subcontractors, Suppliers, and vendors that they have reviewed, discussed and agreed to the schedule as it relates to their Work.

6. The Baseline Construction Schedule shall contain no Contract changes or delays which may have been incurred during the schedule development period. These changes will be entered at the first update after the Baseline Construction Schedule has been accepted by the ENGINEER and a change to the Contract Duration made as part of an approved Change Order in accordance with the Contract Documents.

7. Once the Baseline Construction Schedule is accepted by the ENGINEER it shall become the schedule of record and shall be the basis for future schedule updates.

8. After adoption of the Baseline Construction Schedule, no changes shall be made therein, including changes to logic, sequence and/or duration, without the acceptance of the ENGINEER.

B. After acceptance by the ENGINEER, the Baseline Construction Schedule shall represent the CONTRACTOR's methods, means, logic, sequencing, and durations of the Work and include the CONTRACTOR's estimated costs for each discrete activity as required to meet the purposes of this section and the other Contract Documents.

1.5 PROGRESS OF THE WORK

A. Once the Baseline Construction Schedule is accepted by the ENGINEER, prepare and submit periodic progress update information in the form of a progress report concurrent with the progress

payment application cycle established for the Contract. At a minimum the progress report and schedule update shall include:

1. Narrative Progress Report.
2. Updated Construction Schedule.

B. On a date determined by the ENGINEER, meet with the ENGINEER to review the progress payment application and its required supporting documents, including its Narrative Progress Report and its Construction Schedule update.

i. Appendix E of this section outlines the update preparation and review sequence to be used for preparation, submittal and review of the Narrative Progress Report and Construction Schedule update.

ii. The CONTRACTOR and the ENGINEER will review the draft submittal, discuss its content and the ENGINEER will authorize modifications, as appropriate, to facilitate approval of the payment application.

iii. Following the review meeting, only those revisions authorized by the ENGINEER shall be incorporated into the electronic file entitled "Update" which shall then be submitted as the record schedule for the progress period update.

iv. The ENGINEER shall be allowed 7 days after the meeting to review and determine the acceptability of the Narrative Progress Report and Construction Schedule update. This variance from the typical submittal review period is made specifically to facilitate timely processing of the CONTRACTOR's progress payment application.

v. Narrative Progress Report and Construction Schedule updates marked "Revise & Resubmit" or "Not Acceptable" shall constitute a deficient payment application that may not be processed for payment until the schedule report is acceptable to the ENGINEER.

vi. Narrative Progress Report and Construction Schedule updates returned marked "Revise & Resubmit" or "Not Acceptable" shall be resubmitted to the ENGINEER within 7 days, at which time a new seven-day review period will begin for the ENGINEER.

C. The Narrative Progress Report shall summarize the schedule status and be organized as follows:

1. The CONTRACTOR's transmittal letter, containing its transmittal number.
2. Contents sheet.
3. Identification of the update including the data date, update period and the schedule file names as defined in Appendix D to this section.
4. Update summary including the variance between Contract Milestone dates and their predicted completion dates; Contract completion variance for the reporting period; the number of days ahead or behind schedule; weather days taken and remaining from the Contract allowance and tables summarizing the status of Contract finances and time. At a minimum provide the data required by the example in Appendix G of this section.
5. Analysis of Critical Path and each negative Float Path describing the nature of the Critical Path, its effect and that of any negative float path on other activities, milestones and completion dates.
6. All current and anticipated time constraints describing the origin of each event; corrective action and schedule adjustments to correct it; recommendations to recover

from it and the effect that it may have on other activities, milestones and completion dates.

7. Pending status of outstanding issues such as permits, if any; Contract modifications, Requests for Change and / or Requests for Proposals containing requests for time adjustment; long-lead procurement items; safety reports and any code violations or warnings.

8. Narrative discussion of Contract status including highlights of the Work by area, progress, completion, impediments, changes to the Work plan, issues and concerns accompanied by City of Ridgecrest Activities and Schedule Change Tables. At a minimum provide the data required in Appendix G of this section.

D. Progress Period Schedule Updates:

1. Prepare and submit updated schedules, related reports and diagrams, as part of its periodic update report.

2. The Construction Schedule update shall measure and record only those facts that have occurred to the Work including physical percent complete type, actual start and finish dates, and duration changes. Modifications to logic, durations of activities not started or to actual dates already recorded in previous updates shall not be allowed. An electronic file shall be created and entitled "Pure Progress" and included with the update.

3. With each update identify any changes to the schedule, such as field change orders, accepted time adjustment requests, new activities, constraint changes, deleted activities, activity duration changes, activity description changes, and changes in logic relationships between activities in a Schedule Change Table as level of effort to bring the Work back on schedule. Incorporate the recovery plan into the next Construction Schedule update. With each update identify any changes to the schedule, such as field change orders, accepted time adjustment requests, new activities, constraint changes, deleted activities, activity duration changes, activity description changes, and changes in logic relationships between activities in a Schedule Change Table as detailed in Appendix G of this section. Logic changes shall be described with an explanation of the rationale for the change provided in the report. Such revisions may be incorporated into an electronic file entitled "Draft Update" for target comparison with the "Pure Progress" update. Provide printed diagrams of the target comparisons as part of its presentation to the review meeting.

4. All progress period schedule updates shall be compared to the Baseline Construction Schedule. In addition, each current progress period update shall be compared to the previous period update. Each update shall be labeled with the City of Ridgecrest Project number, data date and title abbreviation identified on the hard copy and electronic file.

5. The schedule shall be updated with actual start and finish dates for every in- progress or completed activity, as documented by the CONTRACTOR's Daily Reports and Three-Week Look-Ahead schedules. No other basis, including automated software calculations or default mechanisms shall be allowed. Failure by the CONTRACTOR to ensure that documented dates as specified herein are incorporated into the schedule update shall constitute cause for disapproval of the update and the inability of the ENGINEER to accurately evaluate the CONTRACTOR's progress for payment purposes.

6. Activities that have reported progress without predecessor activities being completed such as Finish to Start (FS) Relationships with out of sequence progress will not be allowed except on a case-by-case basis with the written acceptance by the ENGINEER. A written explanation of each such activity shall be included with each update in the Schedule Change Table as detailed in Appendix G of this section. The ENGINEER may

direct those changes in schedule logic be made to correct any or all out-of-sequence Work.

7. Change Order Work shall be identified in the schedule as a new activity inserted into the affected schedule logic. The scheduled activity shall only be added after the Change Order is approved for payment by the City of Ridgecrest.

1.6 CONSTRUCTION SCHEDULE REVISION

A. If the CONTRACTOR decides to make major changes to the sequencing and logic of the accepted Work plan it shall prepare and submit a schedule reflecting its proposed changes separately and apart from the periodic schedule updates.

B. The submittal shall be made in accordance with the requirements of the Contract Documents and the ENGINEER will have a maximum of 25 days for review before scheduling a meeting with the CONTRACTOR.

C. A revised schedule that results in a predicted milestone completion date later than the Contract completion date shall be rejected unless the delay is deemed to

D. The ENGINEER will then arrange a meeting with the CONTRACTOR to review the submittal, discuss its content, and authorize modifications required to allow its integration into the Construction Schedule.

AS-BUILT CONSTRUCTION SCHEDULE

A. As a condition precedent to Final Completion, submit the As-Built Construction Schedule. The As-Built Construction Schedule shall reflect the manner in which the Contract was actually constructed including start and completion dates, and all activities, sequences, and logic ties.

B. This schedule submission shall be accompanied by a certification, signed by an officer of the CONTRACTOR's company, the CONTRACTOR's Project Manager and Construction Scheduler, stating "To the best of our knowledge, the accompanying As- Built Construction Schedule accurately reflects the actual start and completion dates and logical relationships of all activities contained herein and represents an accurate depiction of the way in which the Contract was constructed."

WEEKLY THREE-WEEK LOOK-AHEAD

A. Submit an electronic copy of the Three-Week Look-Ahead schedule to the ENGINEER no later than 48 hours prior to the weekly construction progress meeting. The Three- Week Look-Ahead schedule shall be developed maintained and provided using MS Excel software, shall be in the form shown in Appendix G and include at a minimum activity ID, actual performance for the previous week compared to the planned Work for the previous week, planned Work for the current week and planned Work for the 2 weeks following the current week.

B. Each weekly Three-Week Look-Ahead schedule shall be based on the current Construction Schedule update Four-Week Look Ahead Report and fully correlated to the activities planned in its Primavera counterpart, including submittal reviews, procurement, fabrication and delivery of Contract deliverables.

C. Use the Three-Week Look-Ahead schedule actual performance record in preparing its Construction Schedule update.

FLOAT OWNERSHIP AND EARLY COMPLETION

A. Total float, free float, independent float, near-critical float, critical path float, slack time, or contingency within the overall Construction Schedule is not for the exclusive use of either the City of Ridgecrest or the CONTRACTOR but is jointly owned by both and is an expiring resource available to and shared by both as needed to meet Contract Milestones and the Contract completion date.

B. Pursuant to the float sharing requirements of the Contract, use of float suppression techniques such as preferential sequencing, special lead/lag logic restraints, extended activity times, or imposed dates shall be cause for rejection of the Construction Schedule and any revisions or updates thereto.

C. Within 15 days of the effective date of the Notice to Proceed, formally notify the ENGINEER in writing of CONTRACTOR's intent to finish the Work earlier than the Contract completion date. Agreement between the ENGINEER and the CONTRACTOR to adopt an early completion Baseline Construction Schedule shall include agreement by both parties to amend the Contract Milestones, completion dates, and associated Liquidated Damages to those dates contained in the agreed to schedule.

TIME EXTENSION REQUESTS

A. Requests for time extension shall be submitted in the time and

B. Delays in the Critical Path not associated with proper requests for time extension in accordance with the Contract Documents shall be deemed the responsibility of the CONTRACTOR.

REMEDIAL MEASURES AND RECOVERY SCHEDULE

A. Mitigate any potential delay to the Work as efficiently and economically as possible regardless of cause. Where practical, do so without added cost or adverse time constraint. Prior to initiating any action for which it expects THE CITY OF RIDGECREST to be liable, notify the ENGINEER in writing and receive written authorization to proceed.

B. If the CONTRACTOR believes the delay may result in a predicted completion date later than the Contract completion date, it shall review all uncompleted activities on the Critical and near Critical Paths to assess mitigation options and, within 7 days of discovering the potential delay it shall submit a written statement to the ENGINEER describing its plan to recover, including a statement that it has verified the accuracy of all critical and near critical paths. Following acceptance by the ENGINEER, the CONTRACTOR shall incorporate its recovery plan into the next schedule update.

C. Whenever it becomes apparent to the ENGINEER that the current schedule update shows a delay to the Critical Path, that these delays are through no fault of THE CITY OF RIDGECREST and hence, the Contract completion date will not be met, or when so directed by the ENGINEER, submit to the ENGINEER for review a written statement of the steps it intends to take to remove or arrest the delay to the schedule and promptly provide the requisite

D. A Recovery Schedule that results in a predicted completion date later than the Contract completion date will be rejected unless the ENGINEER determines that the delay is the responsibility of THE CITY OF RIDGECREST or is excusable and authorizes a time extension in writing.

E. The ENGINEER may require the CONTRACTOR to provide reasonable additional resources to recover from any schedule delay, however under no circumstances will the addition of equipment or construction forces, manner specified in the Contract Documents, as described herein and further illustrated in Appendix F of this section.

END OF SECTION

SECTION 01 34 00
SHOP DRAWINGS AND SAMPLES

1.00 - GENERAL

1.01 SCOPE

- A. These provisions amend Shop Drawings, Product Data and Samples, of the General Conditions of the Contract for Construction, by establishing submittal procedures for shop drawings and samples required by the various technical sections.

1.02 GENERAL REQUIREMENTS

- A. Prior to submission to the Architect through the Construction Manager, all shop drawings, brochures, and other such construction data shall be checked for quantity, size, and dimensions by the Contractor's personnel especially assigned for this purpose. The Architect will answer questions raised by the Contractor, and will make all determination regarding quality of material and equipment, design and arrangement decisions, and color selections, but will not be responsible for quantity, size, or dimensional errors on the shop drawings. In cases of omission and obvious error, and in cases of conflict, either between details on the contract drawings, or specifications, such questions shall be called to the Architect's attention, and the Architect will give prompt answers to such questions.
 - 1. Colors and textures to be selected shall be selected from all available colors and textures, regardless of the price ranges. For instance: Where the first manufacturer listed has 20 colors or color ways available, that is the minimum number that shall be available for selection. The products of other manufacturers may be submitted, but the cost of colors, considered special, shall be included in the base bid, if their number is less than 20. When colors or textures are custom from any manufacturer, they shall be identified.
- B. Carefully review the Subcontractors' submittals for completeness and correctness, and stamp and acknowledge such review on submittals, prior to transmitting them to the Architect.
- C. Close adherence to these requirements is necessary to avoid delay in the processing of the shop drawings by the Architect. Deviation from these requirements may result in rejection of the submittal. The Contractor will be held responsible for delays resulting from improper submittals.
- D. Obtain approvals from required agencies, prior to submittal to the Architect, for all revisions, substitutions of materials or design, including all structural deviation from the design as shown and as specified.

1.03 SUBMITTALS

- A. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Shop drawings shall not be based 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 is specified
 - 2. Sheet size: Except for templates, patterns, and similar full-size drawings, submit shop drawings on sheets at least 8-1/2 x 11 inches (215 by 280) but no larger than 30 by 42 inches (750 by 1067 mm)

1.04 SUBMITTAL PROCEDURES

- A. All submittals shall be identified with the job name, location, and the Architect's job number. They shall be reviewed, stamped with an approximately 3" x 1/2" identification stamp, and have the signed approval of the Contractor, prior to submission to the Architect. Each sheet of drawings, both prints and transparencies, shall be so identified and signed.
- B. Bound sets of brochures, catalog sheets, specifications and materials lists shall include an Index Sheet, completely identifying the entire contents of the submittal in sequential order. At his option, the Contractor may identify, stamp and sign only this Index Sheet.
- C. In lieu of signing each brochure, the Contractor may indicate on the Letter of Transmittal that he has reviewed and approved all the material included. This does not eliminate the requirements for identification stamp information.
- D. The Architect will return to the Contractor one copy of the vellum transparency of the drawings and two brochures, stamped and signed with the corrections, if any. If the Contractor desires additional copies returned, then he must so request and submit the extra copies.

- E. Handle re-submittals the same as the original submittals, but identify as such and use the Architect's original shop drawing number.
- F. Each submittal shall be accompanied by a Letter of Transmittal containing a complete itemized and numbered list of the submitted material together with the subcontractor's name. A separate Letter of Transmittal shall accompany each submittal from different Subcontractors and different categories (trade and building units).
- G. Shop drawing submittals shall be segregated and submitted separately for each building unit comprising the entire project. The submittals shall be made as though each building unit and the site are separate projects.

1.05 SAMPLES

- A. Labeling: Identify each sample with at least a 3" x 4" label with the following information.
 - 1. Complete identification stamp information in accordance with Submittals Procedure Paragraph 1.04.A above.
 - 2. Name, finish, and composition of the material.
 - 3. Location or intended use on the project.
- B. Size of Samples: Provide samples of sufficient size to show all salient features of the material or item, and which are truly representative of the extremes of variation in color, texture, finish, and construction to be expected in the installed work. Samples of framing materials shall include a corner joint. Allow space for a 5" x 3" Architect's review stamp.
- C. Mock-Ups: Various specification sections may require mock-ups of proposed construction elements, using actual materials and full-size components. Such mock-ups shall be included in the contract sum.
- D. Review of Samples: Upon review, the samples will be stamped or labeled to indicate their review, and one of the samples will be returned to the Contractor. The samples retained by the Architect will constitute the standard of quality and appearance of all materials of the type represented by the sample. In the event samples are rejected, the Contractor will be given the reasons for rejection and he shall resubmit samples until, in the opinion of the Architect, they comply with the contract requirements.
- E. At the option of the Owner or Architect, samples may be subject to testing. In such event, additional samples as may be required shall be supplied by the Contractor at no additional cost.

2.00 – PRODUCTS (NOT USED)

3.00 - EXECUTION

3.01 CONTRACTOR'S REVIEW

- A. The CONTRACTOR shall check and coordinate the Drawings and data, verify all field measurements, stamp with CONTRACTOR'S approval, and submit submittals and Shop Drawings to the ARCHITECT, through the CONSTRUCTION MANAGER, within fourteen (14) calendar days after issuance of Notice of Award. Parties agree that delays in submittals and Shop Drawings will constitute a probable delay in Project.
- B. The CONTRACTOR shall make any corrections required by the ARCHITECT and resubmit the required number of corrected copies within five (5) days of receipt of returned items, through the CONSTRUCTION MANAGER. Parties agree that delays in submittals and Shop Drawings.

3.02 ARCHITECT'S REVIEW

- A. The ARCHITECT will review shop drawings within fourteen (14) calendar days and drawings, only for conformance and compliance with the design concept of the Project per information given in the Contract Documents.
- B. The ARCHITECT'S review of such drawings or data shall not relieve the CONTRACTOR from responsibility for deviations from Drawings or Specifications. CONTRACTOR shall call to the ARCHITECT'S and OWNER'S attention, through the CONSTRUCTION MANAGER, all deviation and have secured written approval. Approval shall not relieve CONTRACTOR from responsibility for errors in Shop Drawings or data.

END OF SECTION

SECTION 01 41 00
TESTING AND INSPECTION REQUIREMENTS

1.00 – GENERAL

1.01 SUMMARY

- A. OWNER will employ and pay for the services of an Independent Testing Laboratory to perform specified testing.
 - 1. CONTRACTOR shall cooperate with the Laboratory and shall in no way relieve CONTRACTOR'S obligation to perform the Work of the Contract.
 - 2. Employment of the Laboratory shall in no way relieve CONTRACTOR'S obligations to perform the Work of the Contract.

1.02 RELATED WORK

- A. Related Requirements in other parts of the Project Manual:
 - 1. Inspections and testing required by laws, ordinances, rules, regulations, orders or approval of public authorities: General Conditions.
- B. Related Requirements Specified in Other Sections:
 - 1. Certification of Products: The respective section of this Specification.
 - 2. Test, Adjust, and Balance of Equipment: The respective section of this Specification.
 - 3. Laboratory Test Required, and Standards for Testing: The respective sections of this Specification.

1.03 OWNER INSPECTOR

- A. An Inspector, employed by the OWNER in accordance with the requirements of the State of California Code of Regulation, Title 24, will be assigned to the Work. His duties are specifically defined in Title 24, Part 1, Section 4-342.
- B. The work of construction in all stages of progress shall be subject to the personal continuous observation of the Inspector. He shall have free access to any or all parts of the Work at any time. The CONTRACTOR shall furnish the Inspector reasonable facilities for obtaining such information as may be necessary to keep him fully informed respecting the progress and manner of the work and the character of the materials. Inspection of the Work shall not relieve the CONTRACTOR from any obligation to fulfill this Contract.

1.04 QUALIFICATION OF LABORATORY

- A. Meet "Recommended Requirements for Independent Laboratory Qualification," published by American Council of Independent Laboratories.

- B. Meet basic requirements of ASTM E 329, "Standards for Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction."

1.05 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

- A. Laboratory is not authorized to:
 - 1. Release, revoke, alter or enlarge on requirements of Contract Documents.
 - 2. Approve or accept any portion of the Work.
 - 3. Perform any duties of the CONTRACTOR.

1.06 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with Laboratory personnel and provide access to Work and to manufacturer's operations.
- B. Secure and deliver to the Laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.
- C. Provide to the Laboratory the preliminary design mix proposed to be used for material mixed which require control by the testing Laboratory.
- D. Furnish incidental labor and facilities:
 - 1. To provide access to Work to be tested.
 - 2. To obtain and handle samples at the project site or at the source of the product to be tested.
 - 3. To facilitate inspections and tests.
 - 4. For storage and curing of test samples.
- E. Notify Inspector a minimum of two working days in advance of operations to allow for Laboratory assignment of personnel and scheduling of tests.
 - 1. When tests or inspections cannot be performed after such notice, reimburse OWNER for Laboratory personnel and travel expenses incurred due to CONTRACTOR'S negligence.
- F. Make arrangements through the CONSTRUCTION MANAGER and INSPECTOR and pay for additional samples and tests required for CONTRACTOR'S negligence.
- G. The OWNER shall pay and back charge the CONTRACTOR for additional testing of all failed tests for this project and special testing required which may be required due to any failed test samples.

- H. CONTRACTOR shall pay for all tests and inspections of materials which require testing of material outside of the State for where this Project is constructed to include providing travel expenses, lodging expenses. tools or testing devices, etc., for the testing laboratory personnel.

1.07 SUBMITTALS (NOT USED)

END OF SECTION

SECTION 01 41 50
TESTING LABORATORY SERVICES

1.00 – GENERAL

1.01 DESCRIPTION

- A. Work included:
 - 1. Cooperate with the OWNER'S selected testing and inspection agency and all others responsible for testing and inspecting the Work.
 - 2. Provide such other testing and inspecting as are specified to be furnished by the CONTRACTOR in this Section and/or elsewhere in the Contract Documents.
 - 3. The CONTRACTOR shall be responsible for scheduling this Work and shall notify the Inspector. The Inspector shall notify the testing agency at least two working days in advance to allow sufficient time for completion of their Work.
- B. Related Work
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, the Conditions of the Contract and Section in Division 1 of these Specifications.
 - 2. Requirements for testing and inspections as described in Section 01 41 00.
 - 3. Where no testing requirements are described, but the OWNER decides that testing is required, the OWNER may require such testing to be performed under current pertinent standards for testing. Payment for such testing will be made as described in this Section.
- C. Work not included:
 - 1. Selection of testing laboratory: The OWNER will select a pre-qualified independent testing laboratory.
 - 2. Payment for initial testing: The OWNER will pay for all initial services of the testing laboratory except as further described in Article 2.1 of this Section.

1.02 QUALITY ASSURANCE

- A. The testing laboratory will be qualified to the OWNER'S approval in accordance with ASTM E329 and approved by Architect and Structural Engineer.
- B. Testing will be in accordance with all pertinent codes and regulations, and with selected standards of the American Society for Testing and Materials and the City's Quality Assurance Program.

1.03 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01 60 00.
- B. Testing Agency shall promptly process and distribute required copies of test reports and related instructions to assure necessary retesting and replacement of materials with the least possible delay in progress of the Work.

2.00 – PRODUCTS

2.01 PAYMENTS FOR TESTING INVOLVING NON-COMPLIANCE

- A. When initial tests indicate non-compliance with the Contract Documents, the costs of subsequent tests as well as costs of subsequent retesting occasioned by the non-compliance will be paid by the OWNER and the amount deducted from the Contract sum.
- B. Local legally constituted public authorities having jurisdiction over this construction and the OWNER or their designated representative shall be the only authorized persons empowered to direct tests to be made when it appears to be necessary to determine compliance or non-compliance to the requirements of the Work.

2.02 SPECIFIC TESTS AND INSPECTIONS

- A. Provide all tests and inspections required by 2022 C.B.C., with 2016 California Amendments, Title 24, Part 1, and Title 24, Part 2, Chapters 19 and 22 and Specification Standards for Public Works, required by provisions of the Contract Documents, and such other tests and inspections as are dictated by the ARCHITECT.
- B. Tests include, but are not necessarily limited to, those described in detail in Part 3 of this Section.

2.03 PAYMENTS FOR TESTING AND INSPECTIONS - GENERAL

- A. Except for tests involving non-compliance or defective materials, and special conditions herein specified, the cost of tests and inspections will be borne by the OWNER as required by Title 24, C.C.R. These shall include but not be limited to:
 - 1. Concrete mix design.
 - 2. Structural Steel Material Lists.
 - 3. Structural Steel welding.
 - 4. Earthwork Compaction tests.
 - 5. Concrete compression tests.

6. Concrete block test.
 7. Mortar and grout compression tests. (If required)
- B. For tests, inspections and services involving the following, the amount will be paid for by the OWNER and deducted from the Contract sum;
1. Any added costs due to failure in scheduling tests and inspections.
 2. Any added costs due to failure of original materials to meet Specification requirements or due to defective workmanship.
 3. The costs of test or inspections ordered especially by authorized persons for the purpose of proving the existence of faulty materials or workmanship, if same is proved faulty, shall be borne by the CONTRACTOR. If faulty conditions are not proved from such tests or inspections, the cost of same will be paid for by the OWNER.
- C. Direct payments by the CONTRACTOR to a testing agency is expressly prohibited by code.
- D. If the CONTRACTOR elects to change source of concrete and/or aggregates after said mix has been established, the CONTRACTOR shall reimburse the OWNER for all costs incurred in the re-testing of the aggregates and the re-design of the mix.

3.00 – EXECUTION

3.01 TAKING SPECIMENS

- A. All specimens and samples for testing, unless otherwise provided in the Contract Documents, shall be taken by the testing personnel. All sampling equipment and personnel will be provided by the testing laboratory. All deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory.

3.02 COOPERATION WITH TESTING LABORATORY

- A. Provide access to the Work at all times and at all locations where the Work is in progress. Provide facilities for such access to enable the laboratory to perform its functions properly.

3.03 OWNER NOTIFICATION

- A. The CONTRACTOR shall notify the OWNER'S representative at least one week time in advance of the manufacture of material to be supplied by him for sources within California and at least two weeks in advance for sources outside of California under the Contract Documents, which must by terms of the Contract be tested, in order that the OWNER may arrange for the testing of same at the source of supply.

- B. Any materials and samples furnished and/or shipped by the CONTRACTOR from the source of supply and/or any other source prior to having satisfactorily passed such testing and inspection by the Testing Engineer or Laboratory or prior to the receipt of notice from said representative that such testing and inspection will not be required, shall not be incorporated in the job without the express written approval of the OWNER.

3.04 TEST REPORTS

- A. Two copies of all test reports shall be forwarded to owner by the testing agency. Such reports shall include all tests made, regardless of whether such tests indicate that the material is satisfactory or unsatisfactory. Samples taken but not tested shall also be reported. Records of special sampling operations as required shall also be reported. The reports shall show that the material or materials were sampled and tested in accordance with the requirements of Title 24 and with the approved specifications. Test reports shall show the specified design strength. They shall also state definitely whether or not the material or materials tested comply with requirements of the Contract Documents.
- B. The reports will be distributed as follows:

ARCHITECT	1 Copy
STRUCTURAL Engineer	1 Copy
CONSTRUCTION MANAGER/OWNER	1 Copies
CONTRACTOR	2 Copies
- C. The reports shall state that the tests were made under the responsible charge of a testing engineer holding a license to practice civil engineering in the State of California; that the material and/or materials were tested in accordance with the provisions of these Specifications and Title 24, Part 2, C.C.R., and that the material and/or materials tested passed or failed to pass the requirements of these Specifications.
- D. Upon completion of the building or buildings, the testing laboratory shall deliver a certificate to the Owner, certified to in the presence of a notary public, stating that the tests for this Work were made in accordance with the provisions of these Specifications and with the provisions of Title 24, Part 2, C.C.R., and further, that all such tests and reports were made for the job reported.

3.05 VERIFICATION OF TEST REPORTS

- A. Each testing agency shall submit to the Owner a verified report in duplicate covering all of the tests which are required to be made by that agency during the progress of the Project. Such report shall be furnished each time that work on the Project is suspended, covering the tests up to that time, and at the completion of the project, covering all tests.

3.06 SOIL INSPECTING, TESTING, EXCAVATING, FILL INSPECTION FOR FOUNDATION.

- A. The Soils Engineer shall make required inspections and tests including, but not limited to:
 - 1. Visually inspect on-site and imported fill and backfill, making such tests and retests as are necessary to determine compliance with the Contract requirements and suitability for the proposed purpose;
 - 2. Make field density tests on samples from in-place material as required;
 - 3. As pertinent, inspect and test the scarifying and recompact of cleaned subgrade; inspect the progress of excavating, filling, and grading; make required specified density tests at fills and backfills; and verify compliance with provisions of the Contract Documents and governmental agencies having jurisdiction.
- B. Make and distribute necessary reports and certificates.

3.07 CONCRETE TESTING AND INSPECTIONS

- A. General: Concrete Testing and Inspection shall comply with the following.
- B. Portland cement:
 - 1. Secure from the cement manufacturer Certificates of Compliance delivered directly to the concrete producer for further delivery directly to the testing laboratory.
 - 2. Require the Certificates of Compliance to positively identify the cement as to production lot, bin or silo number, dating and routing of shipment, and compliance with specified standards.
 - 3. If so required by the ARCHITECT, promptly provide such other specific physical and chemical data as requested.
 - 4. One sample shall be taken for each 100 tons of cement except that when used in bulk loading ready mix plants where separate bins for pre-tested cement are not available, grab samples shall be taken for each shipment of cement placed in the bin with not less than one sample being taken for each day's pour and such samples shall be subsequently tested in accordance with Sec. 2628(a) if required by the ARCHITECT, Structural Engineer or the Owner.
- C. Aggregate:
 - 1. Provide one test unless character of material changes, material is substituted, or additional test is requested by the ARCHITECT.

2. Sample from conveyor belts or batching gates at the ready-mix plant:
 - a. Sieve analysis to determine compliance with specified standards and grading;
 - b. Specific gravity test for compliance with specified standards.
- D. Laboratory design mix:
 1. After acceptance of aggregate, and whenever character or source of materials is changed, provide mix design in accordance with ACI 613.
 2. Provide designs for all mixes prepared by a licensed Civil Engineer registered in the State of California.
- E. Molded concrete cylinders:
 1. Provide three test cylinders for each 50 cu yd., or fraction thereof, of each class of concrete of each day's placement.
 2. Test one cylinder at seven days, one at 28 days, and one when so directed.
 3. Report the mix, slump, gage, location of concrete in the structure, and test results.
 4. Take specimens and make tests in accordance with the applicable ASTM standard specifications.
- F. Core tests:
 1. Provide only when specifically so directed by the ARCHITECT because of low cylinder test results.
 2. Cut from locations directed by the ARCHITECT, securing in accordance with ASTM C42, and prepare and test in accordance with ASTM C39.
 3. Cores shall be of a diameter determined by the Testing Laboratory but no less than 4" in diameter.
- G. Placement inspections:
 1. Placement of concrete shall be inspected by the OWNER'S Inspector.
 2. Throughout progress of concrete placement, make slump tests to verify conformance with specified slump.
 3. Using all required personnel and equipment, throughout progress of concrete placement verify that finished concrete surfaces will have the level or slope that is required by the Contract Documents.

4. A project record shall be kept on the time and date of placing concrete in each portion of the structure. Such record shall be kept until the completion of the structure and shall be open to inspection by the Owner.

H. Batch plant inspections:

1. The quality and quantity of materials used in transit mixed concrete and in batched aggregate shall be continuously inspected at the location where materials are measured by a specifically approved inspector.

3.08 MORTAR AND GROUT TESTS

- A. At the beginning of all masonry work, at least one test sample of the mortar and grout shall be taken on three successive working days and at least one week intervals thereafter. The samples shall be continuously stored in moist air until tested. They shall meet the minimum strength requirement given in Sec. 2103A.3 & A.4 and (d) for mortar and grout, respectively.
- B. Additional samples shall be taken whenever any change in materials or job conditions occur, or whenever in the judgment of the ARCHITECT, Structural Engineer or the Owner, such tests are necessary to determine the quality of the material.

3.09 CONCRETE REINFORCEMENT INSPECTION AND TESTING

- A. Prior to use, test all reinforcement steel bars for compliance with the specified standards.
 1. Where samples are taken from bundles delivered from the mill, with the bundles identified as to heat number, and provided the mill analysis to accompany the report, then, one tensile test and one bend test shall be made on a specimen from each 10 tons or fraction thereof for each size of reinforcing steel.
 2. Tag identified steel at the supplier's shop. When steel arrives at the job site without such tags, test it as unidentified steel.
- B. Unidentified Steel:
 1. Have the testing laboratory select samples consisting of two pieces, each 18" long, of each size.
 2. Have the testing laboratory make one tensile test and one bend test for each 2-1/2 tons or fraction thereof of each size of unidentified steel.
 3. Costs of tests for unidentified steel will be paid by the OWNER and deducted from the Contract sum.
- C. Provide continuous inspection for all welding of reinforcement steel.

3.10 STRUCTURAL STEEL INSPECTING AND TESTING

- A. Prior to use, test all structural steel for compliance with the specified standards.
 - 1. Material identified by mill test reports and certified by the testing laboratory, does not require additional testing. Require the supplier to furnish mill test reports to the laboratory for certification.
 - 2. Tag identified steel at the supplier's shop in accordance with Sec. 2203A (b), Title 24, C.C.R. When steel arrives at the job site without such tags, test it as unidentified steel.
- B. Unidentified steel:
 - 1. Have testing laboratory make one tensile test and one bend test for each five tons or fraction thereof of each shape and size of unidentified structural steel.
 - 2. Costs of tests for unidentified steel will be paid by the OWNER and deducted from the Contract sum.
- C. Welding inspection: Inspection of all shop and field welding operations shall be made by a qualified welding inspector, approved by the Division of the State Architect. The OWNER will pay for the cost of such inspections. Welding inspection procedures shall conform to Section 2231.A.5, Title 24, C.C.R.
- D. Fabrication inspection: Where fabrication is done on the premises of a fabricator, the entire cost of fabrication inspection will be paid by the OWNER, and the amount deducted from the contract sum.

3.11 SCHEDULES FOR TESTING

- A. Establishing schedule:
 - 1. By advance discussion with the testing laboratory selected by the OWNER, determine the time required for the laboratory to perform its tests and to issue each of its findings.
 - 2. Provide all required time within the construction schedule.
- B. Adherence to schedule: When the testing laboratory is ready to test according to the established schedule, but is prevented from testing or taking specimens due to incompleteness of the Work, all extra charges for testing attributable to the delay may be back-charged to the CONTRACTOR and shall not be borne by the OWNER.

3.12 INSPECTION BY THE OWNER

- A. The OWNER or CONSTRUCTION MANAGER shall at all times have access to the shops where in Work is being fabricated or assembled and inspection is required. The CONTRACTOR shall provide safe access for such inspection.

3.13 OWNER'S INSPECTOR

- A. An inspector employed by the OWNER in accordance with the requirements of California Code of Regulations, Title 24, Part 1, will be assigned to the Work. His duties are specifically defined in Article 6, Section 4-342 of Title 24, Part 1, C.C.R. The work of construction in all stages of progress shall be subject to the personal continuous observation of the Inspector. He shall have free access to any or all parts of the Work at any time. The CONTRACTOR shall furnish the Inspector reasonable facilities for obtaining such information as may be necessary to keep him fully informed respecting the progress and manner of the work and the character of the materials. Inspection of the work shall not relieve the CONTRACTOR from any obligation to fulfill this Contract. The Inspector and/or OWNER shall have authority to stop the Work whenever the provisions of the Contract Documents are not being complied with and the CONTRACTOR shall instruct his employees accordingly.
- B. All overtime costs required for Testing & Inspection shall be paid by OWNER and deducted from monies due the CONTRACTOR.

END OF SECTION

SECTION 01 43 00
QUALITY CONTROL

1.00 – GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Quality Control, General.
- B. Replacement of Non-Conforming Work.
- C. Coordination.
- D. Reference Standards for Products.
- E. Control of Substitutions.
- F. Workmanship.
- G. Manufacturer's License or Franchise.
- H. Manufacturer's Instructions.
- I. Manufacturer's Certificates.
- J. Manufacturer's Field Services
- K. Inspection by Contractor or Subcontractor.
- L. Observations and Inspections by Architect and Engineer.
- M. Inspections and Observations by D.S.A. Inspector.
- N. Horizontal and Vertical Control.
- O. Mockups.
- P. Field Finishes.

1.02 RELATED WORK

- A. Related Requirements in other parts of the Project Manual: Inspections and testing required by laws, ordinances, rules, regulations, orders or approval of authorities and General Conditions.
- B. Related Requirements Specified in Other Sections:
 - 1. Certification of Products: The respective section of this Specification.

2. Test, Adjust, and Balance of Equipment: The respective section of this Specification.
3. Laboratory Test Required, and Standards for Testing: Section 01 41 00.

1.03 OWNER INSPECTOR

- A. An Inspector employed by the OWNER in accordance with the requirements of the State of California Code of Regulation, Title 24, will be assigned to the Work. His duties are specifically defined in Title 24, Part 1, Section 4-342.
- B. The work of construction in all stages of progress shall be subject to the personal continuous observation of the Inspector. He shall have free access to any or all parts of the Work at any time. The CONTRACTOR shall furnish the Inspector reasonable facilities for obtaining such information as may be necessary to keep him fully informed respecting the progress and manner of the work and the character of the materials. Inspection of the Work shall not relieve the CONTRACTOR from any obligation to fulfill this Contract.

1.04 QUALITY CONTROL, GENERAL

- A. Require subcontractors, installers, suppliers or manufacturers to provide, products, services, site conditions, and workmanship, necessary to produce work conforming to requirements of Contract Documents.

1.05 NON-CONFORMING WORK

- A. Replace work not conforming to requirements of Contract Documents.

1.06 COORDINATION

- A. Coordinate work of the various sections of Specifications to assure efficient and orderly sequence of installation of construction elements without jobsite interference and without overlap or gaps between the scope of work of the various trades.
- B. Schedule construction progress as specified in Section 01 31 00.
- C. Coordinate the efficient, orderly installation of sleeves and various anchorage inserts to permit later work to pass through or anchor to preceding construction.
 1. Blocking out for such items and subsequent filling shall be done only with Architect/Engineer's permission.
- D. Verify characteristics of elements of interrelated operating equipment are compatible.
 1. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service such equipment.

- E. Coordinate space requirements and installation of mechanical and electrical work that are indicated diagrammatically on Drawings.
 - 1. Assign levels, elevations, spaces to permit installation of mechanical and electrical work within the indicated space.
 - 2. Follow routing shown for pipes, ducts, conduits as closely as practicable.
 - a. Make runs parallel with lines of building.
 - b. Make horizontal runs level U.N.O. Make vertical runs plumb except for required offsets.
 - c. Make vertical runs on and attached to elements of structure unless pipe, duct or conduit is otherwise made structurally sufficient to resist seismic or impact stress.
 - 3. Utilize spaces efficiently to maximize accessibility of each trades installations for maintenance or repair.
 - 4. Coordinate locations of fixtures and outlets with other elements of finish.
- F. In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring in the construction. Consult Architect regarding acceptable method of achieving furring required but not indicated.

1.07 REFERENCE STANDARDS FOR PRODUCTS

- A. For products specified by association, trade, governmental or military standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. The date of the standard is that in effect as of Bid date, or date of Owner or Contractor Agreement when there are no bids, except when a specific edition of the standard is indicated.
- C. Obtain copies of standards when required by Contract Documents. Maintain copy at jobsite during progress of the affected work.
- D. Provide products of the quality and in the manner specified in Section 01 60 00.

1.08 CONTROL OF SUBSTITUTIONS

- A. Permit substitution of products only in conformity with restrictions specified in Section 01 63 00.

1.09 WORKMANSHIP

- A. Provide and require subcontractor and installers to provide knowledgeable, skilled supervision and labor in the quantity required to achieve completion within the Contract Time.

- B. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- C. Comply with manufacturer's instructions. Should instructions conflict with other Contract Requirements, request clarification from Architect before proceeding.
- D. Perform work using persons capable of producing workmanship of indicated quality.
- E. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

1.10 MANUFACTURER REQUIREMENTS

- A. When specified in technical specification section, require manufacturers to provide the following information and services. Make submittals accompanying, and in quantity required for Product Data as specified in Section 01 34 00, unless otherwise indicated.
 - 1. Manufacturer's License or Franchise: Submit certification by manufacturer that subcontractor or installer is licensed or franchised to install manufacturer's product.
 - 2. Manufacturer's Instructions: Submit manufacturer's printed instructions or recommendations for delivery, storage, handling, assembly, installation, finishing, start-up, adjustment, maintenance, all as appropriate to product.
 - 3. Manufacturer's Certificates: Submit manufacturer's certification that product meets or exceeds requirements of Contract Documents.
 - 4. Manufacturer's Field Services:
 - a. Require manufacturer provide qualified personnel to observe field conditions, acceptability of as-built surfaces or work to receive manufacturer's product, quality of installation workmanship, start-up and/or test, balance, adjust manufacturer's equipment or product, and to make appropriate recommendations.
 - b. Require manufacturer's representative submit written report listing observations and recommendations. Submit to Owner, Architect or Engineer and Contractor within 10 days of manufacturer's field observation.

1.11 TESTING AND INSPECTIONS

- A. Provide for, perform or cause to be performed all testing and inspections of the work required by statute and/or by Contract Documents as specified in Section 01 41 00.

- B. Provide lighting and acceptable access for inspection as required and as directed.
- C. Inspections by Contractor or Subcontractor.
 - 1. Prior to proceeding with the work of each trade, inspect area of installation and status of related work.
 - 2. Report conditions preventing proper execution.
 - 3. Do not proceed in areas adversely affected until deficiencies are corrected.
- D. Observations or Inspections by Architect or Engineer: Arrange or schedule specified or requested observations and inspections by Architect or Engineer.

1.12 HORIZONTAL AND VERTICAL CONTROL

- A. Provide and pay for field engineering for control of horizontal and vertical layout as required. Field Engineering services performed by the Surveyor/Civil Engineer of record. No substitutions will be accepted.
- B. Field Engineering
 - 1. Provide control of horizontal and vertical layout and alignment of site and building(s).
 - 2. Control datum for the Work is that shown on above noted Control Drawings.
 - a. Locate and protect established control and reference points, maintain them during construction and, unless indicated otherwise, leave them securely in place upon completion.
 - b. Repair, restore or replace established control or reference points displaced as result of Work of the Contract.
 - 3. Layout the Work.
 - a. Verify that existing site conditions agree with the grades, elevations, lines and levels shown.
 - b. Provide monuments and bench marks as needed for horizontal and vertical control to facilitate installation of the work in compliance with Contract requirements.
 - c. Record monuments and bench marks on layout survey drawing.
 - 4. Maintain monuments and bench marks until no longer needed for the work.
 - 5. As each stage of work requiring layout is constructed, perform a survey to determine if the grades, elevations, lines, levels, and vertical alignment, as constructed, comply with Contract requirements.

1.13 MOCKUPS

- A. When specified in technical specification section, erect complete, full-scale mockup of assembly at Project site. Remove mockup when Architect/Engineer or Inspector agrees it is no longer needed. Mockups may remain as part of the work only if designed and accepted for such use.

1.14 FIELD FINISHES

- A. When specified in technical specification section, provide field installed sample(s) of finish(es). Retain accepted sample(s) until Architect and Owner have accepted the work as matching the sample. Retain sample in completed work only if no joint or break in finish is apparent.

2.00 – PRODUCTS (NOT USED)

3.00 – EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 50 00
TEMPORARY FACILITIES**

1.00 – GENERAL

- A. Furnish materials and perform labor required to execute this work as indicated on the drawings, as specified herein, and as necessary to complete the Contract.

1.01 SAFETY

- A. Guard machinery, equipment, and all hazards in accordance with the safety provisions of the latest edition of the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America, to the extent that such provisions are not in contravention of applicable law. Protect all hazards with adequately constructed guard rails or barricades and provide lanterns, warning lights, and the like, as necessary. Eliminate all attractive nuisance from the work and the room site. To this end, dispose, store, guard, and protect the premises and all work materials, equipment and both permanent and temporary construction so as to preclude the unauthorized use thereof by children or others and particularly to eliminate possible consequent injury to all persons.
- B. Structural design of all items used in the construction of the building and not a permanent part thereof, including, shoring for concrete and masonry work, the temporary bracing for structural steel, and the shoring of cut earth banks, its the sole responsibility of the Contractor.

1.02 SCAFFOLDING AND HOISTS

- A. Furnish and maintain hoists, staging, rigging, scaffolding, and runways required in the prosecution of the work. Erect, equip and maintain such temporary work in accordance with statutes, laws, ordinances, rules or regulations of the State of California or other authorities and Insurance Companies having jurisdiction.

1.03 DUST CONTROL

- A. During the life of the Contract, provide effective means of dust control both within the structure and on the surrounding site. Obtain the Architect's approval before use of any means except water.

1.04 MAINTENANCE OF TRAFFIC

- A. Maintain traffic on all streets adjacent to or leading to the site. Where construction operations interfere with the free movement of traffic, provide traffic controls, flagmen or similar devices to efficiently control traffic movement. Provide a traffic control permit from the local authorities if required.

1.05 DEWATERINGS

- A. Furnish and maintain all pumps or other dewatering devices where may be required by this work.

1.06 PROJECT OFFICE

- A. Provide and maintain, for the duration of the Contract, a project office, complete with heat, light, ventilation and convenience outlets. The office shall be of sufficient size for the Contractor's personnel and operators and shall provide desk space for use of the Construction Manager and for inspection personnel. Construction Manager and Inspector shall either have separate office trailers or the shared trailer provided shall include a separate room with a door. The trailer shall also have a meeting area with tables/chairs for holding weekly construction meetings.

1.07 TELEPHONE AND DATA

- A. Provide and pay for all necessary temporary telephones and computer data lines. Maintain telephones and data lines in continuous service on the project site during the course of the work and make available at all times, free and unrestricted, to the Architect's and Owner's representative for their use in direct connection with the work.

1.08 TEMPORARY TOILETS

- A. Provide temporary toilets facilities for all personnel employed on the project. Maintain toilets in a clean and sanitary condition at all times. Remove at project completion.

1.09 CONSTRUCTION WATER AND POWER

- A. Make arrangements for all water and power required for the project. Provide all temporary lines. The Owner pay for the monthly charges. Remove temporary facilities at project completion.

1.10 FENCES AND BARRICADES

- A. Around the construction site, erect fences, screening, and barricades as required by local governing authorities. Maintain in good condition until completion of the project.

1.11 JOB SIGN DESCRIPTION

- A. Furnish and erect on 96" x 48" job sign, painted and lettered to identify the project, the Architect, and the Contractor. Mount on posts and brace as indicated

by the Architect. Sign shall be lettered by a professional sign painter, and the layout shall be as indicated by the Architect.

END OF SECTION

SECTION 01 60 00
MATERIAL, EQUIPMENT AND PRODUCT HANDLING

1.00 – GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Products.
- B. Proprietary Specifications.
- C. Scheduling.
- D. Coordination.
- E. Manufacturer Requirements.
- F. Manufacturers' Warranties.
- G. Delivery and Off-loading.
- H. Handling and Inspection.
- I. Storage and Protection.

1.02 RELATED REQUIREMENTS

- A. Information for Bidders: Owner-furnished Products, if any.
- B. Section 01 30 00 - Submittals: Scheduling submittals.
- C. Section 01 34 00 - Shop Drawings and Samples: Submittal requirements and procedures.
- D. Section 01 40 00 - Quality Control.
 - 1. Manufacturers Instructions.
 - 2. Manufacturers Certificates.
 - 3. Reference Standards.
- E. Section 01 63 00 - Product Options and Substitutions.
- F. Section 01 70 00 - Contract Closeout.
- G. Section 01 73 00 - Operating and Maintenance Data.
- H. Section 01 74 00 - Warranties.

1.03 PRODUCTS

A. Definition.

1. "Products" is defined in Section 01 63 00.
2. "Products" includes in its meaning materials, manufactured items, assemblies, equipment, systems, processes and procedures installed or to be installed in the Work.

B. Minimum Requirements.

1. Products, characteristics and performance as specified in contract documents.
2. Reference Standards as specified in Section 01 40 00.

C. Provide only products complying with contract requirements.

D. Replace non-conforming products.

E. Supply interchangeable components of single manufacture when contract documents require multiple numbers of an item.

F. Products shall be new unless otherwise indicated.

G. Electrical components of products and their total assembly within products shall be UL tested, listed and labeled.

H. Products supplied under Allowance: As indicated.

I. Products furnished by Owner: As indicated.

1.04 PROPRIETARY SPECIFICATIONS

A. Furnish products specified in proprietary manner, as by trade name, model number, manufacturer, vendor or unique combination of characteristics, whether or not followed by an "or (approved) equal" clause, unless a substitution has been authorized as specified in Section 01 63 00.

B. Determination of equivalency is not a Contractor's option.

1.05 SCHEDULING

A. Schedule as specified in Section 01 31 00: Submittal of shop drawings, product data and samples in manner indicated in Section 01 34 00.

1.06 COORDINATION

A. Coordinate the interrelationship of the various products in the manner indicated.

1.07 MANUFACTURER REQUIREMENTS

- A. When specified, require manufacturers or suppliers to provide the following:
 - 1. Written certification of product conformity in the manner indicated in Section 01 41 00.
 - 2. Drawings, product data, samples, mock-ups, in the manner indicated in Section 01 34 00.
 - 3. Written instructions and recommendations concerning installation of their product in the manner indicated in Section 01 63 00.
 - 4. Operation and maintenance data in the manner indicated in Section 01 73 00.

1.08 MANUFACTURER'S WARRANTIES

- A. Provide warranties as specified in Section 01 74 00.

1.09 TRANSPORTATION AND OFF-LOADING

- A. Transport products using methods to avoid product damage. Contractor is responsible for replacement of damaged products at his expense.
- B. Deliver in dry and undamaged condition in manufacturer's unopened containers or packaging.
- C. Off-load products generally in manner specified for handling.

1.10 HANDLING AND INSPECTION

- A. Provide equipment and personnel to handle products using methods to prevent damage or soiling.
- B. Promptly inspect shipments to assure that products comply with contract requirements, quantities are correct, and products are undamaged.

1.11 STORAGE AND PROTECTION

- A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible.
- B. Store sensitive products in weather-tight enclosures maintained within temperature and humidity ranges recommended by manufacturer's.
- C. For exterior storage of fabricated products, place on sloped supports above ground.

1. Cover products subject to deterioration with impervious sheet covering.
2. Provide ventilation to avoid condensation.
- D. Store loose granular materials on solid surfaces in a well-drained area.
 1. Prevent mixing with foreign matter.
- E. Arrange storage to provide access for inspection.
- F. Periodically inspect to assure products are undamaged, and are maintained under required conditions.
- G. After installation, provide coverings to protect products from damage from construction traffic and operations. Remove when no longer needed.

2.00 – PRODUCTS (NOT USED)

3.00 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 63 00
PRODUCT OPTIONS AND SUBSTITUTIONS

1.00 – GENERAL

1.01 WORK INCLUDE

- A. Whenever in the Specifications any material, article or process is indicated or specified by trade, patent, or proprietary name or name of manufacturer, such specification shall be deemed to be followed by the words, "Or equal, as approved in writing by the ARCHITECT", except as noted.
- B. Where more than one proprietary name is specified, the CONTRACTOR may provide materials or equipment of any one of the manufacturers specified, only if full compliance with other portions of the Specification can be provided.

1.02 MATERIALS

- A. Unless otherwise specifically provided in this Contract, all equipment, material, and articles incorporated into the Work of this Contract shall be new and suitable for the purpose intended.
- B. Reference to any equipment, material, article or patented process, by trade name, or catalog number shall not be construed as limiting competition. In those cases where the Specifications designate a material, product, thing or service by specific brand or trade name and there is only one brand or trade name listed, the item involved is:
 - 1. Required to be used since it is a unique or novel product application.
 - 2. Used as a standard of quality which must be satisfied without compromise.
 - 3. The only brand or trade name known to the OWNER and ARCHITECT.
- C. Construction shall be in compliance with the equivalent Report for the material specified.

1.03 SUBSTITUTIONS

- A. Should the CONTRACTOR wish to substitute an item he considers equal to the one specified, he must, within **fourteen (14)** calendar days after issuance of Notice of Award, furnish to the ARCHITECT through the CONSTRUCTION MANAGER, on the form provided, the name of the manufacturer, the model number, and other pertinent data and information respecting the "or equal" item which has been proposed in his bid and which the CONTRACTOR contemplates incorporating in the Work. The burden of establishing that a proposed substitution is equal in quality, service, and ability to the item specified in the drawings and specification shall be upon the Bidder. If the "or equal" item is not founded by the ARCHITECT to be in fact, equal or better, the CONTRACTOR must resubmit within five (5) calendar days an alternate product.

- B. When required by this Contract or when called for by the OWNER, the CONTRACTOR shall furnish full information concerning the material or articles which he contemplates incorporating in the Work. Testing of a proposed substitute material to assure compliance with the Specifications may be required by the OWNER at the CONTRACTOR'S expense. When so directed, samples shall be submitted for approval. Equipment, material, and articles installed or used without required approval shall be at the risk of subsequent rejection. Where additional D.S.A. review is required for substitution of items beyond standard of the industry, CONTRACTOR shall pay the OWNER for all additional costs.
- C. Substitutions shall, without exception, be manufactured of the most basic materials and shall comply with or exceed all specifications, requirements of dimensions, function, structure, durability, and appearance of Product specified in the Contract Documents. Use of approved substitutions shall in no way relieve the CONTRACTOR from responsibility for compliance with the Drawings and Specifications using approved substitutions to assume all extra costs caused by the use of such substitutions where they affect other work or trades.
- D. Failure to place orders for specified equipment or material sufficiently in advance of his schedule date of installation will not be considered as a valid reason upon which the CONTRACTOR may base his request for any substitutions, additional time, or for any deviations from the Drawings and Specifications.
- E. In the event the CONTRACTOR requests changes or revisions requiring drawings or services of the ARCHITECT or his consultants to facilitate installation or erection of any portion of the Work, he shall accept the responsibility to hire, and pay for the consultant's services. A flat hourly rate, as agreed upon, shall be paid by the CONTRACTOR whether the change is approved or rejected. In the event the change is approved, this fee shall be deducted, and paid, from the CONTRACTOR'S portion of the saving. Items submitted which require Division of State ARCHITECT'S (D.S.A.) approval(s) the CONTRACTOR shall pay for all plan check fees or fees required to obtain their approvals and in addition to, the CONTRACTOR shall pay the ARCHITECT and his Consultants for all services rendered for drawings, calculations, review time, plan check time for each substitute item(s) for approval(s).

(See attached Substitution Request Form)

END OF SECTION

SUBSTITUTION REQUEST FORM

TO: _____

PROJECT: _____

SPECIFIED ITEM:

Section	Page	Paragraph	Description
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The undersigned requests consideration of the following:

PROPOSED SUBSTITUTION: _____

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request. Applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents which the proposed substitution will require for its proper installation.

The undersigned certifies that the following paragraphs, unless modified by attachments are correct:

1. The proposed substitution does not affect dimensions shown on drawings:
2. The undersigned will pay for changes to the building design, including engineering design, detailing, and construction costs caused by the requested substitution.
3. The proposed substitution will have no adverse affect on other trades, the construction schedule, or specified warranty requirements.
4. Maintenance and service parts will be locally available for the proposed substitution.
5. The proposed substitution is submitted within seven (7) calendar days after issuance of the Notice of Intent to Award.

The undersigned further states that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item.

Submitted by: _____ (For use by the design consultant:)

Signature _____ ☐ Accepted ☐ Accepted as noted

Firm _____ ☐ Not Accepted ☐ Received too late

Address _____ By _____

_____ Date _____

Date _____ Remarks _____

Telephone _____ Attachments:

Fax: _____

**SECTION 01 70 00
CONTRACT CLOSEOUT**

1.00 – GENERAL

1.01 SECTION INCLUDES

- A. Closeout procedures
- B. Final cleaning
- C. Adjusting
- D. Project record documents
- E. Operation and maintenance data
- F. Warranties
- G. Spare parts and maintenance materials
- H. Instructions to Personnel

1.02 CLOSEOUT PROCEDURES

- A. All close-out data to be submitted no later than 10 days of completion of construction schedule. Parties agree that delays to Punch List and Close-out would constitute a delay in Project completion and, therefore, entitles Owner to withhold and retain potential liquidated damages per the Contract Documents from Contractor's progress payments.
- B. Partial Occupancy and substantial Completion - Each Contractor shall:
 - 1. Conform to Part 1, Title 24, Section 4-336 CCR, Requirements for Verified Reports and Close-out Procedures.
 - 2. In conjunction with the Project Inspector, prepare a list of items to be completed or corrected. List may be developed by areas, when approved by the ARCHITECT.
 - 3. Within a reasonable time after receipt of the list, the ARCHITECT and the CONSTRUCTION MANAGER will inspect to determine status of completion.
 - 4. Should the ARCHITECT determine that Work is not substantially complete:
 - a. The ARCHITECT through the CONSTRUCTION MANAGER will promptly notify the CONTRACTOR in writing, giving the reason for his determination.

- b. CONTRACTOR shall remedy the deficiencies and notify the CONSTRUCTION MANAGER when the Work is ready for re-inspection.
 - c. The ARCHITECT and CONSTRUCTION MANAGER will re-inspect the Work.
 - 5. When the ARCHITECT and the CONSTRUCTION MANAGER concur that work is substantially complete
 - a. The ARCHITECT will prepare a "Certificate of Substantial Completion" on AIA Form G704, accompanied by the CONTRACTOR'S list of items to be completed or corrected as verified by the ARCHITECT.
 - b. The ARCHITECT will submit the Certificate to the OWNER and to the CONTRACTOR for their written acceptance of the responsibilities assigned to them in the Certificate.
- C. Final Completion - Each Contractor shall:
 - 1. Prepare and submit a notice that Work is ready for final inspection and acceptance.
 - 2. Verify the Work is complete.
 - 3. Certify that:
 - a. Work has been inspected by all governing agencies and is in compliance with Contract Documents,
 - b. Work has been inspected for compliance with the Contract Documents.
 - c. Work has been completed in accordance with the Contract Documents.
 - d. Equipment and systems have been tested as required and are operational.
 - e. Work is completed and ready for final inspection.
 - 4. The ARCHITECT and CONSTRUCTION MANAGER will make an inspection to verify status of completion.
 - 5. Should the ARCHITECT determine the Work is incomplete or defective work.
 - a. The ARCHITECT and the CONSTRUCTION MANAGER will promptly notify the CONTRACTOR in writing, listing incomplete or defective Work.
 - b. CONTRACTOR shall remedy the deficiencies promptly and notify the ARCHITECT and CONSTRUCTION MANAGER when ready for reinspection.
 - 6. When the ARCHITECT determines the Work is acceptable under the Contract Documents, he will request the CONTRACTOR to make close-out submittals.

- D. Closeout submittals include, but are not necessarily limited to - Each Contractor shall:
1. Project Record Documents
 2. Operation and maintenance data for items so listed in pertinent Sections these Specifications and for other items when so approved by the ARCHITECT and CONSTRUCTION MANAGER.
 3. Warranties
 4. Keys and keying schedule.
 5. Spare parts, materials, extra stock to be turned over to the OWNER.
 6. Evidence of compliance with requirements of governmental agencies having jurisdiction, including, but not limited to:
 - a. Date of final inspection and list of persons in attendance.
 - b. List of any items that do not conform to the Contract Documents.
 - c. Certificates of Inspection.
 - d. Certificates of Occupancy.
 7. Evidence of payment and release of liens, when requested by the OWNER.
 8. List of SUBCONTRACTORS, service organizations and principal vendors including names, addresses and telephone numbers, when contacted for emergency service at all times, including nights and holidays.
- E. Final Payment - Each Contractor shall:
1. Submit a Final Payment Request, showing all adjustments to the Contract Sum.
 2. Retention will be released no sooner than 35 days after Notice of Completion has been filed with the Owner, and the Owner has complied with County recording requirements.

1.03 FINAL CLEANING (See Section 01 71 00)

- A. Execute final cleaning prior to final inspection.
- B. Clean glass and surfaces exposed to view; remove temporary labels, stains and foreign substances.
- C. Polish transparent and glossy surfaces.
- D. Vacuum carpeted and soft surfaces.
- E. Wax and polish resilient floor surfaces.
- F. Wash and polish ceramic surfaces.

- G. Clean machinery equipment.
- H. Clean plumbing fixtures to a sanitary condition. Use non-corrosive, non-abrasive cleaning materials. Replace filters of operating equipment.
- I. Clean and polish light fixtures.
- J. Clean and polish hardware and metal surfaces.
- K. Clean walls and ceilings of dust, dirt, stains, handmarks, paint spots, plaster drops and like defects.
- L. Clean construction site; sweep paved areas, rake clean all landscaped surfaces.
- M. Clean out and flush all drains from all construction debris, flood test prior to occupancy.
- N. Remove waste and surplus materials, rubbish, and construction facilities from the site. Do not use own OWNER'S waste removal system or any system belonging to OWNER of adjacent properties.

1.04 ADJUSTING - Each Contractor shall:

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

1.05 RECORD DOCUMENTS - Each Contractor shall:

- A. OWNER will provide one set of blueline OR blackline drawings and one copy of the Project Specification for use during construction to record changes made during construction.
- B. Record in concise and neat manner and on a weekly basis all actual revisions to the work:
 - 1. Changes made on the Drawings, including Clarification Drawings.
 - 2. Changes made to the Specifications.
 - 3. Changes made by Addenda.
 - 4. Changes made by Instruction Bulletins.
 - 5. Change Orders or other authorized Modifications to the Contract.
 - 6. Revisions made to shop drawings, product data and samples.
- C. Store Record documents separate from documents used for construction. Replace soiled or illegible documents.
- D. Record information concurrent with construction progress.

- E. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
1. Manufacturer's name, trade name, Product model and number and supplier.
 2. Authorized product substitutions or alternates utilized.
 3. Changes made by Addenda and Modifications.
- F. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured depths of foundations in relation to finish first floor.
 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements. Identify drains and sewers by invert elevation.
 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work. Identify ducts, dampers, valves, access doors and control equipment wiring.
 4. Field changes of dimension and detail.
 5. Details not on original Drawings.
- G. Obtain Inspector's signed certification that Record Documents have been fully updated prior to submitting monthly payment requests. Compliance is mandatory before payment will be made.
- H. Submit Inspector's certified documents to CONSTRUCTION MANAGER with claim for final Application of Payment. Fully complete record drawings are a prerequisite to final payment.
- I. The OWNER requires the preparation of a final reproducible 'RECORD SET' of drawings. The record set shall incorporate all changes made during the construction process including all change orders, addenda, field orders and "As Built" conditions noted on the CONTRACTOR'S prepared record documents.
1. Contractor shall continuously maintain a separate set of drawings on site, according to items 1.05 A-H above.
 2. At the end of the project, submit the marked-up blue-line record drawings signed by the Contractor authorized representative and transmit to the Construction Manager.
 3. Construction MANAGER, Inspector, and Architect shall review the blue-line record drawings requesting contractor changes as required.

4. Architect will take the record drawing blue lines and transfer data onto the Architect's office originals.
5. Architect will then make a reproducible set of the originals using four (4) millimeter vellum. The vellums plus one set of bluelines will be sent to the Owner.

1.06 OPERATION AND MAINTENANCE DATA

- A. See Section 01 73 00 for procedure
- B. Submit One copy of completed volumes in final form prior to final inspection. This copy will be returned with ARCHITECT comments. Revise content of documents as required prior to final submittal.
- C. Submit final volumes revised within ten days after final inspection.

1.07 WARRANTIES, GUARANTEES AND BONDS

- A. See Section 01 74 00 for procedure.
- B. Submit prior to final Application for Payment.
- C. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.08 SPARE PARTS AND MAINTENANCE MATERIALS - Each Contractor shall:

- A. Provide products; spare parts, maintenance and extra materials in quantities specified in individual specification Sections.

1.09 INSTRUCTIONS TO OWNER PERSONNEL

- A. Instruct the OWNER personnel in proper operation and maintenance of all systems, equipment and similar items which were provided as part of the Work.
- B. CONTRACTOR shall provide a schedule to the OWNER for approval for each of the instruction periods required.
 1. Organize the instruction sessions into group sizes and schedule the elapsed time for instruction in a manner to Provide complete coverage of the subject matter, prior to occupancy.
- C. Instruction sessions will be held in a OWNER designated area on the project site and CONTRACTOR to coordinate date and time with CONSTRUCTION MANAGER and OWNER.
- D. Instructions shall be qualified by the product manufacturer in the subject matter presented at each session.

1. Submit names of instructors and qualifications to the ARCHITECT, CONSTRUCTION MANAGER, and OWNER for approval, 30 days prior to each scheduled session.
2. Substitution of instructors will not be permitted without prior approval of ARCHITECT, CONSTRUCTION MANAGER and OWNER.

2.00 – PRODUCTS (NOT USED)

3.00 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 71 00 CLEANING

1.00 – GENERAL

1.01 SUMMARY

- A. Section Includes: Cleaning throughout the construction period, and final project cleaning prior to the acceptance tour.
- B. Related Work Described Elsewhere: In addition to standards specified herein, comply with requirements for cleaning up as described in other sections of these Specifications.

1.02 QUALITY ASSURANCE

- A. Inspection: Conduct daily inspection, and more often if necessary to verify that requirements of cleanliness are being met.
- B. Codes and Standards: In addition to the requirements specified herein, comply with pertinent requirements of authorities having jurisdiction.

2.00 – PRODUCTS

2.01 CLEANING MATERIALS AND EQUIPMENT

- A. Provide required personnel, equipment, and materials needed to maintain the specified standard of cleanliness.

2.02 COMPATIBILITY

- A. Use cleaning materials and equipment, which are compatible with the surfaces being cleaned, as recommended by the manufacturer of the material to be cleaned.

3.00 – EXECUTION

3.01 PROGRESS CLEANING

- A. General
 - 1. Retain stored items in an orderly arrangement allowing maximum access, not impeding drainage or traffic, and providing the required protection of materials.
 - 2. Do not allow the accumulation of scrap, debris, waste material, and other items not required for construction of this work. Debris shall be removed from the site and disposed of in a lawful manner. Disposal receipts or dump tickets shall be furnished to the Project Manager upon request.

3. At least twice each month, and more often if necessary, remove scrap, debris, and waste material from the job site.
4. Provide adequate storage for items awaiting removal from the job site, observing requirements for fire protection and protection of the ecology.

B. Site

1. Daily, and more often if necessary, inspect the site and pick up all scrap, debris and waste material. Remove items to the place designated for their storage. Combustible waste shall be removed from the site. Flammable waste shall be kept in sealed metal containers until removed from the site.
2. Weekly, and more often if necessary, inspect, arrangements of materials stored on the site; restack, tidy, or otherwise service arrangements to meet the requirements specified above.
3. Maintain the site in a neat and orderly condition.

C. Structures

1. Weekly, and more often if necessary, inspect the structures and pick up scrap, debris, and waste material. Remove items to the place designated for their storage.
2. Weekly, and more often if necessary, sweep interior spaces clean.
 - a. "Clean", for the purpose of this subparagraph, shall be interpreted as meaning free from dust and other material capable of being removed by use of reasonable effort and a handheld broom, i.e., 'broom-clean".
3. As required preparatory to installation of succeeding materials, clean the structures of pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material, using equipment and materials required to achieve the required cleanliness.
4. Following the installation of finish floor materials, clean the finish floor daily, and more often if necessary, and while work is being performed in the space in which finish materials have been installed.
 - a. "Clean", for the purpose of this subparagraph, shall be interpreted as meaning free from foreign material which, in the opinion of the Project Manager, may be injurious to the finish floor material, i.e., "vacuum clean".

3.02 FINAL CLEANING

- A. Definition: Except as otherwise specifically provided, "clean", for the purpose of the Article, shall be interpreted as meaning the level of cleanliness generally provided by skilled cleaners using commercial quality building maintenance equipment and materials, i.e., "scrub and polish clean".

- B. General: Prior to completion of the work, remove from the job site all tools, surplus materials, equipment, scrap, debris, and waste, conduct final progress cleaning as described above.
- C. Site: Unless otherwise specifically directed by the Project Manager, water and broom clean paved areas on the site and public paved areas directly adjacent to the site. Remove resultant debris.
- D. Structures:
 - 1. Exterior: In areas affected by the work under this contract, visually inspect exterior surfaces and remove traces of soil, waste material, smudges, and other foreign matter. Remove traces of splashed material from adjacent surfaces. If necessary to achieve a uniform degree of exterior cleanliness, hose down the exterior of the structure.
 - 2. In the event of stubborn stains not removable with water, the Project manager may require light sandblasting or other cleaning at no additional cost to the Owner.
 - 3. Interior: In areas affected by the work under this contract, visually inspect interior surfaces and remove traces of soil waste material, smudges, and other foreign matter. Remove traces of splashed materials from adjacent surfaces. Remove paint drippings, spots, stains, and dirt from finished surfaces. Use only the cleaning materials and equipment instructed by the manufacturer of the surface material. Vacuum carpeted and soft surfaces. Wax and polish resilient floor surfaces. Wash and polish ceramic surfaces. Clean machinery equipment. Clean plumbing fixtures to a sanitary condition. Use non-corrosive, non-abrasive cleaning materials. Replace filters of operating equipment. Clean and polish light fixtures. Clean and polish hardware and metal surfaces.
 - 4. Glass: Clean glass inside and outside.
 - 5. Polished Surfaces: On surfaces requiring the routine application of buffed polish, apply the polish recommended by the manufacturer of the material being polished. Glossy surfaces shall be cleaned and shined as intended by the manufacturer.
- E. Timing: Schedule final cleaning as accepted by the Project manager to enable the Owner to accept a completely clean project.

3.03 CLEANING DURING THE OWNER'S OCCUPANCY

- A. Should the Owner occupy the work or any portion thereof prior to its completion by the Contractor and acceptance by the Owner, the Project Manager in accordance with the General Conditions of the Contract shall determine responsibilities for interim and final cleaning of the occupied spaces.

END OF SECTION

SECTION 01 73 00
OPERATING AND MAINTENANCE DATA

1.00 – GENERAL

1.01 WORK INCLUDED

- A. Work includes the following:
 - 1. Compilation of product data and related information appropriate for Owner's maintenance and operation of products furnished under the Contract.
 - 2. Instruction of Owner's personnel in the maintenance of products and in the operation of equipment and systems.

1.02 RELATED WORK

- A. Related Work Specified Elsewhere:
 - 1. Section 01 34 00 - Shop Drawings, Product Data and Samples.
 - 2. Section 01 70 00 - Contract Close-out.

1.03 QUALITY ASSURANCE

- A. Preparation of data shall be done by personnel:
 - 1. Trained and experienced in maintenance and operation of the described products.
 - 2. Familiar with requirements of the Section specified.
 - 3. Skilled in technical writing to the extent required to communicate essential data.
 - 4. Skilled as draftsmen competent to prepare required drawings.

1.04 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 30 00.
- B. Preliminary: Submit two copies of a preliminary draft of the proposed Manual or Manuals to the CONSTRUCTION MANAGER for ARCHITECT review and approval.
 - 1. Show general arrangement, nature of contents in each portion, probable number of drawings and their size, and proposed method of binding and covering.

2. Secure the Architect's approval through the CONSTRUCTION MANAGER prior to proceeding.
- C. Final: Complete the Manuals in strict accordance with the approved preliminary drafts and the Architect's review comments.
 1. Submit three copies of the final Manual to the Architect through the CONSTRUCTION MANAGER at least TEN (10) days prior to final inspection or acceptance.
- D. Revisions:
 1. Following the indoctrination and instruction of operating and maintenance personnel, review all proposed revisions of the Manual with the Architect.
 2. Submit specified number of copies of approved data in final form ten (10) days after final inspection or acceptance.

2.00 – PRODUCTS

2.01 INSTRUCTION MANUALS

- A. Prepare data in the form of an instructional manual for use by Owner's personnel.
- B. Format:
 1. Size: 8-1/2 inches by 11 inches.
 2. Paper: 20 pound minimum, white, for typed pages.
 3. Text: Manufacturer's printed data, or neatly type-written.
 4. Drawings:
 - a. Provide reinforced punched binder tab. Bind drawings in with text.
 - b. Fan fold larger drawings to the size of the text pages, for easy fold out.
 - c. Photographically reduce larger drawings, if necessary, to fit binder. Maintain readability.
 5. Fly-leaf for each separate product, or each piece of operating equipment:
 - a. Provide brief description of product and major component parts of equipment.
 - b. Provide indexed tabs.
 - c. Type on colored paper.
 6. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:
 - a. Title of Project.
 - b. Identity of separate structure as applicable.
 - c. Identity of general subject matter covered in the manual.

7. Measurements: Provide U.S. standard units.

C. Binders:

1. Commercial quality three-ring binders with durable and cleanable plastic covers. Provide D-ring type binders.
2. Maximum ring size: 1-1/2 inch.
3. When multiple binders are used, correlate the data into related consistent groupings.

D. Covers: Provide front and end spine labels for each manual, using durable material, and clearly identified with at least the following information:

OPERATING AND MAINTENANCE INSTRUCTIONS

(_____ Name and address of Work _____)

(_____ Name of Contractor _____)

(_____ General subject of this Manual _____)

(_____ Space for approval date _____)

3.00 – EXECUTION

3.01 CONTENT OF MANUAL

A. Neatly typewritten table of contents for each volume, arranged in a systematic order.

1. Contractor, name of responsible principal, address and telephone number.
2. A list of each product required to be included, indexed to the content of the volume.
3. List, with each product, the name, address and telephone number of:
 - a. Subcontractor and/or installer.
 - b. Maintenance contractor, as appropriate.
 - c. Identify the area of responsibility of each.
 - d. Local source of supply for parts and replacement.
4. Identify each product by product name and other identifying symbols as set forth in the Contract Documents.

B. Product Data:

1. Include only those sheets which are pertinent to the specific product.
2. Annotate each sheet to:
 - a. Clearly identify the specific product or part installed.
 - b. Clearly identify the data applicable to the installation.
 - c. Delete references to inapplicable information.

C. Drawings:

1. Supplement product data with drawings as necessary to clearly illustrate.
 - a. Relations of component parts of equipment and systems.
 - b. Control and flow diagrams.
2. Coordinate drawings with information in Section 01 70 00 Project Close-out with regard to Project Record Drawings to assure correct illustration of completed installation.
3. Project Record Drawings shall not be used as maintenance drawings.

D. Instructions: Written text, as required to supplement product data for the particular installation:

1. Organize in a consistent format under separate headings for different procedures.
2. Complete instructions regarding operation and maintenance of all equipment involved including lubrication, disassembly, and reassembly.
3. Complete nomenclature for all parts of equipment.
4. Complete nomenclature and part number of replaceable parts, name and address of nearest vendor, and other data pertinent to procurement procedures.

E. Copy of each warranty, bond and service contract issued.

1. Provide information sheet for Owner's personnel, giving:
 - a. Proper procedures in the event of failure or emergencies.
 - b. Instances which might affect the validity of warranties or bonds.

3.02 MANUAL FOR MATERIALS AND FINISHES

A. Instructions for care and maintenance:

1. Manufacturer's recommendation for types of cleaning agents and methods.
2. Cautions against cleaning agents and methods which are detrimental to the product.

3. Recommended schedule for cleaning and maintenance.

3.03 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Content, for each unit of equipment and system, as appropriate:

1. Description of unit and component parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data and tests.
 - c. Complete nomenclature and commercial number of all replaceable parts.
2. Operating procedures:
 - a. Start-up, break-in, routine and normal operating instructions.
 - b. Regulation, control, stopping, shut-down and emergency instructions.
 - c. Summer and winter operating instructions.
 - d. Special operating instructions.
3. Maintenance Procedures:
 - a. Routine operations.
 - b. Guide to "trouble-shooting".
 - c. Disassembly, repair and reassembly. Alignment, adjusting and checking.
4. Servicing and lubrication schedule: List of lubricants required.
5. Manufacturer's printed operating and maintenance instructions.
6. Description of sequence of operation by control manufacturer.
7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - a. Predicted life of parts subject to wear.
 - b. Items recommended to be stocked as spare parts.
8. As-installed control diagrams by manufacturer of controls.
9. Each contractor's coordination drawings: As-built color coded piping diagrams.
10. Charts of valve tag numbers, with the location and function of each valve.
11. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
12. Other data as required under pertinent sections of this Specification.

B. Content, for each electric and electronic system, as appropriate:

1. Description of system and component parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data and tests.

- c. Complete nomenclature and commercial number of replaceable parts.
 - 2. Circuit directories of panelboards:
 - a. Electrical service.
 - b. Controls.
 - c. Communications.
 - 3. As-built color coded wiring diagrams.
 - 4. Operating procedures:
 - a. Routine and normal operating instructions.
 - b. Sequences operating instructions. Special operating instructions.
 - 5. Maintenance procedures:
 - a. Routine operations.
 - b. Guide to "trouble-shooting".
 - c. Disassembly, repair and reassembly.
 - d. Adjustment and checking.
 - 6. Manufacturer's printed operating and maintenance instructions.
 - 7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
- C. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner personnel.

3.04 INSTRUCTION OF OWNER PERSONNEL

- A. Prior to final inspection or acceptance, fully instruct Owner designated operating and maintenance personnel in the operation, adjustment and maintenance of all products, equipment and systems, prior to occupancy.
 - 1. Provide services of factory trained instructors from the manufacturer of each major item of equipment or system.
- B. Operating and maintenance manual shall constitute the basis of instruction.
 - 1. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.
 - 2. Where warrants for further instruction or additional instruction is required to instruct the Owner designated personnel, the Contractor shall provide such additional instruction to include service of factory trained instructors. The cost for additional instruction will be reviewed for each individual basis by the Architect.

END OF SECTION

SECTION 01 74 00
WARRANTIES, GUARANTIES AND BONDS

1.00 – GENERAL

1.01 WORK INCLUDED

- A. This Section specifies general requirements for written warranties, guaranties and bonds required by the Contract Documents.
- B. Submittal to, and approval by, the Owner of the warranties, guaranties and bonds are prerequisites to final payment under the Contract.

1.02 RELATED WORK

- A. Related work specified elsewhere: Section 01 70 00 - contract Close-out

1.03 TIME PERIOD:

- A. Deliver manufacturers' warranties, guaranties and bonds required by Contract Documents, with Owner named as beneficiary. For equipment and machinery, or components thereof, bearing a manufacturer's warranty or guaranty that extends for a longer time period than the Contractor's warranty and guaranty, deliver manufacturer's warranties or guaranties in same manner.

1.04 FORM

- A. Written warranties and guaranties, excepting manufacturer's standard printed warranties and guaranties shall be submitted on the Contractor's, Subcontractor's, material suppliers', or manufacturers' own letterhead, addressed to Owner. Warranties and guaranties shall be submitted in duplicate, and in the form shown on the following page, signed by all pertinent parties and by Contractor in every case, with modifications as approved by Owner to suit the conditions pertaining to the warranty or guaranty.

1.05 SUBMITTAL

- A. The Contractor shall collect and assemble written warranties and guaranties from all subs, material suppliers and manufacturers into a bound booklet form, and deliver the bound books to Architect for delivery to the Owner's attorney for final review and approval.
- B. Submit required warranty/guaranty on letterhead of Contractor responsible for each type of Work in accordance with attached sample form.

(See attached Warranty Form)

END OF SECTION

WARRANTY/GUARANTY

Date: _____

FOR _____ WORK

We, the undersigned, do hereby warranty and guaranty that the parts of the Work described above which we have furnished and/or installed for:

PROJECT: SGT. PINNEY MEMORIAL POOL REPLACEMENT

is in accordance with the Contract Documents and that all said Work as installed will fulfill or exceed all the Warranty and Guaranty requirements. We agree to repair or replace Work installed by us, together with any adjacent Work which is displaced or damaged by so doing, that proves to be defective in workmanship, material, or operation within a period of _____ () year(s) from the date of final acceptance by Owner or from the Date of Certificate of Substantial Completion, whichever is the earlier, ordinary wear and tear and unusual neglect or abuse excepted.

In the event of our failure to comply with the above mentioned conditions within a reasonable time period determined by the Owner, after notification in writing, we, the undersigned, all collectively and separately, hereby authorize the Owner to have said defective Work repaired and/or replaced and made good, and agree to pay to the Owner upon demand all moneys that the Owner may expend in making good said defective Work, including all collection cost and reasonable attorney fees.

(Subcontractor, Sub-subcontractor, Manufacturer or Supplier)

By: _____

Title: _____

State License No: _____

Local Representative: For maintenance, repair, or replacement service, contact:

Name: _____

Address: _____

Phone Number: _____

SECTION 01 80 00
GENERAL SAFETY REQUIREMENTS

1.00 – GENERAL

1.01 GENERAL SAFETY PROVISIONS

- A. The Contractor shall take safety and health measures in performing work under this Contract. It shall be the Contractor's sole responsibility to provide for safety of persons and property under this Contract. The Contractor shall meet with the Owner's Representative to develop a mutual understanding relative to administration of the safety plan. The Contractor is subject to applicable federal, state and local laws, regulations, ordinances, codes and orders relating to safety and health in effect on the date of the Contract. Attention is directed to the regulations issued by CAL-OSHA, The Secretary of Labor pursuant to the Contract Work Hours and Safety Standards Act and the Safety and Health Regulations for Construction. The Contractor shall comply with all regulations as applicable and shall comply with safety requirements stated.
- B. During the performance of work under this Contract, the Contractor shall comply with procedures prescribed for control and safety of persons visiting the project site.
- C. Contractor shall advise the Owner of any special safety requirements he has established for this project so that all appropriate Owner personnel can be notified of these restrictions.

1.02 SUBMITTALS

- A. The Contractor shall prepare and submit a detailed Safety Plan (SD-08) at the Pre-Construction meeting. The Safety Plan will be reviewed by the Owner. The Contractor shall meet with the Owner Representative prior to beginning work to discuss in detail the various stages of the work and the Contractor's procedures for insuring the safety and health requirements for the project.

1.03 ACCIDENT REPORTING

- A. The Contractor shall immediately report to the Owner any accident, incident or exposure resulting in fatality, injury or occupational disease or contamination of the property. The Contractor shall investigate all work related incidents or accidents to persons or property to the extent necessary to positively conclude what cause or causes resulted in said accident or incident, and furnish the Owner with a report in such form as the Owner may require of the investigative findings, together with proposed or completed corrective actions.

1.04 FIRST AID FACILITIES

- A. The Contractor shall designate the location of the First Aid Dispensary and shall post emergency first aid and ambulance information at the project site.

1.05 OWNER REPRESENTATIVE VISITING WORK SITE

- A. The Contractor agrees that authorized Owner representatives shall have access to, and the right to examine the site or areas where work is being performed.

1.06 FIRE PREVENTION AND PROTECTION

- A. Open-flame heating devices will not be permitted except by written approval. Such permission will not be granted unless the Contractor has taken reasonable precautions to make such devices safe. Burning trash, brush or wood on the project site will not be permitted. Approval for the use of open fires and open-flame heating devices will in no way relieve the Contractor from the responsibility for any damage incurred because of fires. Flammable liquids shall be stored and handled in accordance with the Flammable and Combustible Liquids Code, NFPA 30.
- B. Open fires will not be permitted in construction areas. Smoking shall not be permitted in areas such as paint storage, fuel storage, and posted no smoking areas.

1.07 USE OF EXPLOSIVES

- A. Explosives shall not be used or brought to the project site without prior written approval. Such approval shall not be construed as relieving the Contractor of responsibility for any injury to persons or property due to blasting operations. Blasting shall be performed by skilled personnel in accordance with State laws and as approved. Minimum safety requirements for blasting shall be in accordance with ANSI A10.7.

1.08 BARRICADES AND TRAFFIC CONTROL

- A. The work shall be conducted so as to minimize obstruction of traffic, and traffic shall be maintained on at least one half of the roadway with at all times. Approval shall be obtained prior to starting any activity that will obstruct traffic. Any reduction of any streets or any alleyways adjacent to the site, parking lots or parking areas shall require a written plan from the Contractor that must be approved by the Owner Representative prior to closure. The plan shall include the posting of Public Notice of the modifications or closure date.

END OF SECTION

SECTION 01 91 13
GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section defines the Contractor's responsibilities with respect to Commissioning. The Contractor shall include this scope in the bid. This includes administrative and procedural requirements as well as a detailed execution of Commissioning. This Section supplements Section 01 41 00 – Testing and Inspection, as well as the Divisions 22 - Plumbing, Division 23 – Mechanical, and Division 26 – Electrical sections which specify testing procedures. This Section also defines the systems and equipment to be commissioned. The Commissioning Agent (CxA) will be part of the Owner's Quality Assurance (QA) Team and participate in the review and execution of the Project Construction Quality Control (CQC) plan, along with the Contractor, Owner's Authorized Representative (OAR), Project Inspector (PI), and Architect of Record (AOR).

1.2 DEFINITIONS

- A. Commissioning (Cx): A systematic process which verifies that the building systems perform according to the Owner's Design Intent/Basis of Design (ODI/BOD). Commissioning includes system documentation, equipment startup, control system calibration, Testing, Adjusting and Balancing (TAB) verification, performance testing, and training.
- B. Commissioning Agent (CxA): A District appointed entity that plans and coordinates all activities which implement Commissioning as outlined by the Owner's Design Intent/Basis of Design (ODI/BOD). The CxA has overall responsibility for planning and coordinating Commissioning. Commissioning activities that take place during construction shall be based on the Contractor's construction schedule.
- C. Commissioning Plan (CxP): A contract document that identifies the project Commissioning goals, Owner's Design Intent/Basis of Design, commissioning milestones, coordination requirements, and project specific Pre-functional Equipment Checklists and Functional Performance Test Checklists. The CxP shall be incorporated by Contractor into the Construction Quality Control Plan.
- D. Pre-functional Equipment Checklist (PEC): A form for each piece of equipment referenced in '1.08 SYSTEMS TO BE COMMISSIONED' that must be completed by the Contractor as a prerequisite to the equipment's Functional Performance Test (FPT). Sample checklists and PEC forms are included in the CxP. The checklists and forms are completed by the Contractor and verified by the CxA.
- E. Functional Performance Test (FPT): A documented test designed by the Commissioning Agent (CxA) that verifies the dynamic functioning and operation of equipment and systems with the goal of verifying that the Owners' Design Intent/Basis of Design (ODI/BOD) is met. Sample testing requirements and forms are included in the CxP. Test procedures are performed by the Contractor and witnessed by the INSPECTOR and CxA.
- F. Acceptance - A formal action, taken by a person with appropriate authorization, to declare that some aspect of the project meets defined requirements – thereby permitting subsequent activities to proceed.

- G. Checklists - Documents that are developed and used during all phases of commissioning to verify that the ODI/BOD is being achieved. This includes checklists for general verification, testing, training, and other specific requirements. Various checklists are prepared by the CxA and the contractor to document completion of testing and/or commissioning of equipment and systems.
- I. Coordination Drawings - Drawings showing the work of all trades to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers' recommended maintenance clearances.
- K. Control system – A component of an environmental, HVAC, electrical, lighting, or energy management system for the reporting, monitoring and/or issuing of commands to and/or from field devices.
- L. Data logging -The monitoring and recording of flows, currents, status, pressures, etc., of equipment using stand-alone data recorders separate from the installed control system or the trending capabilities of those control systems.
- M. Deficiency - A condition that is not in compliance with the contract documents relative to the installation or function of a component, piece of equipment, or system.
- N. Factory Testing - Testing of equipment at the factory or on-site by factory personnel with, or without, an owner's representative present.
- O. Issues Log - A formal and ongoing record of problems or concerns – and their resolution – that have been raised by members of the commissioning team during the course of commissioning.
- P. Seasonal Performance Tests - Tests that are performed when weather conditions are comparable to the design conditions based or the design conditions can be simulated.
- R. Simulated Condition - Condition that is created for the purpose of testing the response of a system (for example: raising/lowering the set point of a thermostat to see the response in a VAV box).
- S. Startup - The initial starting or activating of dynamic equipment.
- T. Systems Manual - A system-focused composite document that includes the operation manual, maintenance manual, manufacturer's technical diagrams and additional information of use to the owner during facility occupancy and operation.
- U. Test Procedure - A written protocol that defines methods, procedures, personnel, and expected outcomes for tests conducted on components, equipment, assemblies, systems, and interfaces among systems. The test procedures are specified in the Commissioning Plan and Technical Specifications sections of the contract documents and the CxP.
- V. Training Plan - A written document that details the expectations, schedule, budget, and deliverables of commissioning activities related to the training of facility operating and maintenance personnel, users, and occupants.
- X. Verification - The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Design Intent/Basis of Design. Verification testing is performed per the prescribed test procedure(s) by the contractor and witnessed by the INSPECTOR and CxA.

- Y, Trending – The analysis of system performance gathered over a period of time by a building management system or other electronic data gathering equipment.

1.3 RELATED REQUIREMENTS

- A. Section 00 7300 – Supplementary Conditions.
- B. Section 01 1216 – Phasing of the Work.
- C. Section 01 2100 – Allowances.
- D. Section 01 2513 – Product Substitution Procedures.
- E. Section 01 3113 – Project Coordination.
- F. Section 01 3119 – Project Meetings.
- G. Section 01 3213 – Construction Schedule.
- H. Section 01 3300 - Submittal Procedures.
- I. Section 01 4516 or 01 4519 – Contractor Construction Quality Control.
- J. Section 01 4523 - Testing and Inspection.
- K. Section 01 4525 - Testing, Adjusting, and Balancing for HVAC.
- L. Section 01 5000 – Construction Facilities and Temporary Controls.
- M. Section 01 7700 – Contract Close-Out.
- N. Section 01 7836 – Warranties.
- O. Section 01 7900 – Maintenance & Operation Staff Demonstration and Training.
- P. Section 23 0800 – HVAC Systems Commissioning.
- Q. Section 23 0813 – Environmental Controls and Energy Management Systems Commissioning.
- R. Section 26 0800 – Electrical Systems Commissioning.

1.4 REFERENCES

- A. Guideline 1.1-2007 -- HVAC&R Technical Requirements for the Commissioning Process.
- B. Associated Air Balance Council Commissioning Guidelines.
- C. CHPS Best Practices Manual, Volume V: Commissioning.
- D. Sample Commissioning Plan Documentation.

1.5 COORDINATION

- A. Items listed below require coordination between the Contractor, OAR, INSPECTOR, and CxA. Details regarding each item are provided through out this Section and/or Sections 01 7900, 23 0800, 23 0813 and 26 0800.
 - 1. Cx Schedule and Meeting Venue.
 - 2. Commissioning Meeting Attendance.
 - 3. Completion of Pre-functional Equipment Checklists (PEC).
 - 4. Functional Performance Testing (FPT).
 - 5. Operations & Maintenance Manual Submittal and Training.
 - 6. Documentation of Pre-functional Equipment Checklists (PEC) & Functional Performance Testing (FPT) Inspections.
- B. For projects using Specification Section 01 4516 or 01 4519, the CxA shall coordinate with the Contractor's designated Quality Control representative, OAR and INSPECTOR.

1.6 SUBMITTALS

- A. Submittal documentation required for the commissioning work will be identified by the CxA and integrated into the normal submittal process and protocol of the construction team. At minimum, the CxA's documentation request will identify the manufacturer and model number, the manufacturer's printed installation and detailed startup procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted. All such documentation will be included by subcontractors in their O&M manual submittals.
- B. The CxA will review and recommend acceptance or any required revision to the OAR for all submittals related to the commissioned equipment for conformance with the contract documents as they relate to commissioning, performance of the equipment, and their adequacy of test procedures. This review is intended primarily to aid in the development of performance procedures and only secondarily to verify compliance with equipment specifications. The CxA will notify the OAR of items missing or areas that are not in conformance with contract documents and which require resubmission.
Submittal of O&M manual documentation does not constitute compliance. The CxA will review all such document submittals and recommend to OAR their acceptance or any required revisions.
- C. Submittal documentation specified in Specifications 23 0800, 23 0813 and 26 0800.

1.7 CONTRACTOR RESPONSIBILITIES

- A. The general responsibilities of Contractor and Subcontractors in commissioning are defined in this section. The specific responsibilities are in the Division 22 and 23 and Division 26 Technical Specifications. All parties shall:
 - 1. Follow the Commissioning Plan.

2. Attend commissioning meetings.

B. Contractor, its design team, subcontractors and vendors shall assign representatives with expertise and authority to act on their behalf and schedule them to participate in and perform required commissioning activities including, but not limited to, providing all tools, or the use of tools, to start, check-out and test equipment and systems, except for specified testing with portable data recorders which shall be supplied and installed by the CxA. Contractor and subcontractors shall:

1. Facilitate coordination of Commissioning.
2. Incorporate Commissioning activities (the CxP) into the Project Schedule.
3. Coordinate and direct Commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
4. Participate in up to three meetings specifically for Commissioning-related items as scheduled by the OAR.
5. Review and accept construction checklists developed by the CxA.
6. Provide information required to perform commissioning tasks, including O&M materials, contractor startup and checkout lists.
7. No later than 60 days prior to startup of the first piece of major equipment, meet with the CxA and OAR to finalize the detailed commissioning procedures and schedule.
8. Before startup, provide detailed startup procedures including current control sequences and interlocks to comply with the detailed functional test plans.
9. Provide one additional copy of all submittals required in Section 01 3300 for all systems being commissioned for review of compliance with commissioning needs by the CxA.
10. Develop and coordinate a startup and initial systems checkout plan with subcontractors and ensure that all subcontractors and vendors execute their commissioning responsibilities according to the contract documents.
11. Review TAB execution plan.
12. Oversee sufficient testing of the control system before TAB is executed.
13. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
14. Coordinate retesting as necessary until satisfactory performance is achieved
15. Complete checklists as work is completed and provide to OAR on a weekly basis.
16. Review equipment warranties to ensure that the owner's responsibilities to keep warranties in force are clearly defined.
17. Oversee and coordinate the training of the owner's personnel.

18. Review and approve the preparation of the O&M manuals including clarifying and updating of original sequences of operation to as-built/as-tested conditions.
19. Coordinate development of a systems manual

1.8 SYSTEMS TO BE COMMISSIONED

- A. Systems to be commissioned for this project include, but are not limited to, those for which Specifications are included in Contract Documents and as listed in:
 1. Section 23 0800, Article 1.06 - Equipment And Systems To Be Commissioned.
 2. Section 23 0813.
 3. Section 26 0800, Paragraph 3.01.B.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Standard testing equipment required to perform startup and initial checkout and required performance testing shall be provided by the contractor for the equipment being tested. This includes, but is not limited to, two-way radios and meters, etc. Testing specified as requiring portable data recorders will be performed with data recorders supplied and installed by the CxA.
- B. Testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified in the specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a current certified calibration to an accuracy of 0.5 degree F and a resolution of plus or minus 0.1 degree F. Pressure sensors shall have an accuracy of plus or minus 2.0 percent of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 MEETINGS

- A. Commissioning Kick-off Meeting: Within 15 days following issuance of Notice-to-Proceed 1 (NTP 1), the OAR will schedule a Construction Quality Control kick-off meeting. The INSPECTOR, Cx team and Contractor Quality Control representative will be in attendance. CxA shall prepare and distribute a list of commissioning topics to be placed on the meeting agenda. Attendance at this meeting and participation in the Commissioning topics is mandatory for the following Contractor personnel:
 1. Contractor's Quality Control Engineer and Commissioning Representative.

2. Contractor's Project Scheduling personnel.
3. Mechanical Subcontractors.
4. Electrical Subcontractors.
5. TAB Subcontractor.
6. Controls Subcontractors.

- B. Other Commissioning Meetings. Other Cx meetings will routinely be scheduled and generally be conducted in conjunction with regularly scheduled site meetings as the Construction progresses. The Commissioning portion of meetings will cover upcoming implementation and coordination of the CxP, deficiency resolution, and planning issues with particular subcontractors.

3.2 STARTUP, CONSTRUCTION CHECKLISTS, AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment/systems to be commissioned:

1. General: Contractor shall use PECs to verify that the equipment and systems are fully connected and operational. PECs for a given system must be successfully completed and accepted prior to startup and formal performance testing of equipment or subsystems of the given system.
2. Startup and Checkout Plan: The CxA will assist the project commissioning team members responsible for startup of any equipment. The primary role of the CxA in this process is to ensure that there is written documentation and that each of the manufacturer-recommended procedures has been completed. The CxA shall provide all the required pre-functional checklists and forms to be completed by Contractor in the CxP. The CxA will ensure that the INSPECTOR and/or District Special Inspectors are informed as to the planned and scheduled startup and checkout procedures.
 - a. Sample Pre-Functional checklists are provided as an attachment to the CxP. These checklists indicate required procedures to be executed prior to equipment startup.
 - b. Contractor shall determine which trade is responsible for executing and documenting each of the line item tasks and transmit the checklists to the responsible subcontractors. Each form may have more than one trade responsible for its execution.
 - c. The contractor/subcontractor responsible for the purchase and/or installation of the equipment shall develop a comprehensive startup plan (with assistance from the CxA) by combining the manufacturer's detailed startup and checkout procedures and the pre-functional checklists.
 - d. The contractor/subcontractor shall submit the full startup plan to the CxA for review and approval.
 - e. INSPECTOR will review and accept, based on CxA recommendation, the procedures and the documentation format for reporting. The CxA will return the procedures and the documentation format to Contractor through the OAR.

- f. Contractor shall transmit the full startup plan to the subcontractors for their review and use.

B. Sensor and Actuator Calibration. All field-installed temperature, relative humidity, CO, CO₂, refrigerant, O₂, and/or pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated. Verify that all locations are appropriate and away from causes of erratic operation. Submit to the CxA through the OAR the calibration methods and results. All test instruments shall have had a current certified calibration record. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated. Contractor to field verify all installed sensors.

1. Sensor Calibration Methods:

- a. All Sensors: Verify that all sensor locations are appropriate and away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2 degrees F of each other for temperature and within a tolerance equal to 2 percent of the reading of each other for pressure.
- b. Sensors Without Transmitters: Standard Application. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, install offset in BAS, calibrate or replace sensor.
- c. Sensors With Transmitters: Standard Application. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, install offset in BAS and calibrate or replace sensor.

2. Tolerances, Standard Applications:

Sensor	Required Tolerance (+/-)
Cooling coil, chilled and condenser water temps	0.4F
AHU wet bulb or dew point	2.0F
Hot water coil and boiler water temp	1.5F
Outside air, space air, duct air temps	0.4F
Watthour, voltage & amperage	1 percent of design
Pressures, air, water and gas	3 percent of design
Flow rates, air, water	10 percent of design
Flow rates, water	4 percent of design
Relative humidity	4 percent of design
Combustion flue temps	5.0F
Oxygen or CO ₂ monitor	0.1 percent pts

CO monitor	0.01 percent pts
Natural gas and oil flow rate	1 percent of design
Barometric pressure	0.1 inch of Hg

3. Valve and Damper Stroke Setup and Check EMS Readout: For all valve and damper actuator positions checked, verify the actual position against the BAS readout. Set pumps or fans to normal operating mode. With the command valve and damper closed, visually verify that the command valve or damper is closed and adjust output zero signal as required. With the command valve or damper open, visually verify that the position is full open and adjust output signal as required. Set command valve or damper to a few intermediate positions. If actual valve or damper position doesn't reasonably correspond, repair or replace actuator.
4. Closure for heating coil valves (NO): Set heating set point 20 degrees F above room temperature. Visually observe valve open. Set heating set point to 20 degrees F below room temperature. Visually observe the valve close. Restore to normal.
5. Closure for cooling coil valves (NC): Set cooling set point 20 degrees F above room temperature. Visually observe the valve close. Set cooling set point to 20°F below room temperature. Visually observe valve open. Restore to normal.

C. Execution of Construction Checklists and Startup:

1. Four weeks prior to the scheduled startup, Contractor shall coordinate startup and checkout with the INSPECTOR and CxA. The execution and approval of the PECs, startup, and checkout shall be directed and performed by Contractor, subcontractor or vendor. Signatures are required of the applicable subcontractors for verification of completion of their work.
2. The INSPECTOR shall observe, as a minimum, the procedures performed for each piece of primary equipment, unless there are multiple units; in which case a sampling strategy may be used. The CxA shall observe all testing.
3. For lower-level components of equipment, (e.g., sensors, controllers), the CxA shall observe a sampling of the startup procedures.
4. Pre-functional checklist documentation, identified in the CxP, is to be used by the subcontractor to document that equipment is ready for startup.
5. The subcontractors and vendors shall execute startup and provide the CxA, through the OAR, with a signed and dated copy of the completed startup and construction checklists.
6. Only individuals of the contractor or sub-contractor (technicians, engineers, manufacturer's representatives/vendors, supervisors, etc.) who have direct knowledge and have witnessed that a line item task on the construction checklist was actually performed shall check off that item.

D. Deficiencies, Non-Conformance, and Approval in Checklists and Startup (Issues Log):

1. The contractor shall ensure that the subcontractors clearly list any outstanding items of the initial startup and construction checklist procedures that were not completed

successfully, on an attached sheet. The form and any outstanding deficiencies shall be provided, through the INSPECTOR, to the CxA within two days of test completion.

2. The CxA will review the report and issue either a non-compliance report or acceptance form, through the INSPECTOR, to Contractor. The installing subcontractors or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, shall notify the INSPECTOR as soon as outstanding items have been corrected, and resubmit an updated startup report with a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CxA will recommend approval of the execution of the checklists and startup of each system.
3. Items left incomplete, which later cause deficiencies or delays during performance testing, may result in assessments to Contractor. Refer to Paragraph 3.05, herein, for details.

3.3 GENERAL REQUIREMENTS FOR TESTING

- A. Complete the following at least two weeks prior to Functional Performance Testing:

1. Arrange for Commissioning observations to be performed by the CxA.
2. Completion and acceptance of the Start-up Plan by the CxA.
3. Correction of deficiencies identified during start-up.
4. Recording of pretest set points.

3.4 FUNCTIONAL PERFORMANCE TESTING (FTP)

- A. Undertake functional testing after the testing requirements listed in Paragraph 3.02 are completed.
- B. Equipment: Refer to Part 2 of this Section for test equipment requirements.
- C. Perform FPT under the observation of the CxA who will verify the results of the functional test procedures documented by Contractor.
- D. Perform all specified tests according to approved testing procedures / plan.
1. Verify and test performance using actual conditions whenever possible.
 2. Simulate conditions when it is not practical to test under actual conditions or when required seasonal testing conditions are not present. The procedure to be used shall be submitted to the OAR for INSPECTOR and CxA review and acceptance at least one week before simulated testing is to occur. After test, return settings to normal operating conditions.
 3. Alter set points when simulating conditions is not practical and when written approval to do so is received from OAR.

4. Override sensor values with a signal generator when actual or simulated conditions and altering set points are not practical. Do not use the sensor to act as the signal generator to simulate conditions or override values.
- E. Functional Performance Testing (FPT) Documentation: This Section specifies the general description of the minimum Divisions 22, 23 and 26 Functional Performance Testing documentation requirements that the Contractor shall provide. The CxA will develop testing procedures in accordance to the requirements of this Section and incorporate into the Cx Plan that Contractor must follow and document. The testing documentation must include the following information:
1. Test number.
 2. Date and time of the test.
 3. Indication of whether the record is for a first test or retest following correction of a problem or issue.
 4. Identification of the system, subsystem, assembly, or equipment.
 5. Conditions under which the test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of the test.
 6. Expected performance of the systems and assemblies at each step of the test.
 7. Narrative description of observed performance of the system, equipment, or assembly.
 8. Notation to indicate whether the observed performance at each step meets the expected results.
 9. Issue number, if any, generated as the result of the test.
 10. Dated signatures of the person performing the test and a witness.
- F. The CxA and INSPECTOR will review and OAR, if applicable, accept functional testing results. Deficiencies found during testing shall be submitted to the OAR and, if required, based on the recommendation of INSPECTOR, by the OAR, corrected by the Contractor and retested. Where there is a dispute over a deficiency, OAR, based on the recommendation of ARCHITECT and INSPECTOR, shall be the final authority.
- G. Problem Solving: The burden of responsibility to solve, correct and retest problems is with the Contractor and the design team with OAR, based on the recommendations of the ARCHITECT, CxA and INSPECTOR, having final responsibility for acceptance of the Work.
- H. Substantial Completion: All testing, retesting, and acceptance of Functional Performance Testing shall be completed prior to issuing the Certificate of Substantial Completion. FPT may be conducted following building occupancy; however, all associated and reasonable additional costs incurred by the CxA shall be assessed against Contractor Retention or Withhold funds.
- I. Deficiencies in the Cx Plan Functional Performance Test Checklist: If there is any Functional Performance Test Checklist missing for any particular piece of equipment, the Contractor shall inform the CxA and ask for an updated Functional Performance Test Checklist.

3.5 RETESTING

- A. Retesting shall be required when a specific Pre-functional Checklist or Start-up test item, reported to have been successfully completed by Contractor or determined during functional testing to be faulty or incomplete, is identified.
- B. Contractor shall be provided one retest opportunity at no additional cost when Contractor can affect corrections within two hours of identification of the need to retest. Costs for retesting beyond one retest, or when Contractor cannot affect corrections within two hours of identification of the need to retest, will be assessed against Contractor funds if OAR determines, based upon the recommendation of the INSPECTOR and CxA, that the Contractor is responsible for the deficiency. These costs shall include all reasonable expenses incurred by the CxA.
- C. For a deficiency identified during functional testing, but not included in the approved Start-up Plan, OAR will direct retesting of the equipment with no costs assessed against Contractor for this initial retesting. Costs for retesting, when Contractor cannot effect corrections within two hours of identification of the need to retest, will be assessed against Contractor funds if OAR determines, based upon the recommendation of the INSPECTOR and CxA, that the Contractor is responsible for the deficiency. These costs shall include all reasonable expenses incurred by the CxA.
- D. Retesting shall not be considered a reason for a claim of delay or for a time extension by the Contractor.

3.6 DEFERRED TESTING

- A. Unforeseen Deferred Tests: Checks or tests not completed due to the incomplete Work, required occupancy conditions, or other conditions may be delayed upon approval of the OAR based upon the recommendation of the INSPECTOR and CxA. These tests may be conducted in the same manner as the seasonal tests.
- B. Seasonal Testing: Complete seasonal testing, when weather or other testing conditions do not emulate the system's design conditions, employing simulated conditions acceptable to OAR based upon the recommendation of the INSPECTOR and CxA. The OAR will coordinate with Contractor, and CxA validate, this activity. Tests shall be executed, documented and deficiencies corrected by the Contractor, with the INSPECTOR and the CxA witnessing. The Contractor shall make adjustments to the Operations and Maintenance Data, as necessary.

3.7 DOCUMENT REVIEW

- A. General: See paragraph 1.06 for submittal requirements.
- B. Operations and Maintenance Manuals: Refer to Section 01 7900 for specific requirements.

3.8 OPERATOR TRAINING

- A. The CxA, under the direction of the OAR, coordinates and verifies training completion as shown in Section 01 7900. Forms and procedures are also described in the CxP.

END OF SECTION

SECTION 02 22 20
EXCAVATION AND BACKFILL FOR STRUCTURES

1.00 GENERAL

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.03 WORK INCLUDED

- A. Excavation, overexcavation, as necessary, and backfill for foundations, footings and general areas for structures.
- B. Preparation, for concrete slabs of building areas.
- C. Removal of debris, vegetation, roots and excess materials.
- D. Trenching for utilities (Reference Specification).
- E. Accept the site as it is at the time of bidding, and perform all work necessary to complete the job.
- F. Check Drawings and/or "Concrete" specifications for base or membrane under slabs.

1.04 RELATED WORK:

- A. Performing excavation and backfill of trenches for utilities.
- B. Granular base for concrete paving.
- C. Field Quality Control: Section 01 40 00; record survey; vertical and horizontal control; soil testing.
- D. Protection of existing utilities.
- E. Sub-slab vapor barrier and protective fill.

1.05 GENERAL REQUIREMENTS:

- A. Field conditions:
 - 1. The building pads have been over-excavated, filled and compacted by others, in accordance with the Soils Report. Contractor shall obtain copies of the compaction reports and verify the conditions as listed below.
 - 2. Verify drawing dimensions with actual field conditions. Inspect related work and adjacent surfaces. Report all conditions that prevent proper execution of this work.
- B. Soil investigation report:
 - I. For character of soil, logs of borings and general recommendations refer to the "Geotechnical Investigation Report", Sgt. John Pinney Memorial Pool Replacement Project, dated November 7, 2023, File No. 23-19224, prepared by soils Engineering, Inc.

2. Copies of report are on file and may be examined at the office of the Architect. Copies will be made available for use at the site during construction.
 3. The report is made available for information only. There is no warranty, either expressed or implied, that conditions indicated by the report prevail over the entire site, or that other materials, proportions of materials, or conditions may not be encountered. The Contractor is cautioned to make such independent investigations as he deems necessary to satisfy himself as to all conditions, including sub-surface conditions, under which he will perform the work.
 4. While the Soil Report is not a part of the Contract Documents, the recommendations contained therein shall be observed in the execution of the work as though repeated as requirements.
- C. Filling, backfilling and compaction will be inspected by and shall be performed to meet the approval of the Soils Engineer.
1. Also conform to requirements of Chapter 33 and Appendix Chapter 33 of the Uniform Building Code.
- D. Test and inspections: Contractor shall pay for all tests and inspections of complete installation. Costs of all tests and inspections at materials sources and costs of retests of rejected work shall be borne by the Contractor. Arranging for and scheduling of tests and inspections are responsibilities of the Contractor.
- E. Layout of the work: The Contractor shall be responsible for the accuracy of all layout work and shall retain and pay for the services of a licensed Surveyor to set the lines and grades for all construction.
- F. Bracing and shoring: When required, design, provide and maintain sheathing, bracing and shoring to safely support the sides of the excavations and to prevent movement which might injure or delay the work, change the required width of the excavation or endanger adjacent pavements, utilities, buildings, or other structures. Design walers and other bracing and install so as to present no obstructions to proper placement of the work. Withdraw and remove sheathing, bracing and shoring as the backfilling is done, in a manner so as to not endanger the completed work.
- G. Remove all water, including rain water, encountered during the course of the trench and sub-structure work, to an approved point of disposal location by the use of pumps, drains, and other approved methods. Keep the excavations free from water until the backfilling is completed.
- H. The Soils Engineer will advise the Contractor on control of moisture, limitation on use of various materials, and methods of compaction, all based on tests made during various stages of excavation and backfill. If these tests indicate specified density is not being obtained, the material shall be recompacted and retested. Costs of retesting shall be borne by the Contractor.
- I. The Contractor shall protect existing utilities.

2.00 PRODUCTS

2.01 MATERIALS

- A. Fill and Backfill materials: May be material from site, if the use of such is recommended in the Soil Report or shall be material from an offsite source approved by the Soils Engineer. Material shall be free of debris, vegetable matter and rocks and cobbles exceeding 6"

dimension. Material shall be non-expansive in nature unless the Soil Report provides for the use and/or treatment of expansive soils.

3.00 EXECUTION

3.01 SUBGRADE IMPROVEMENT FOR EXTERIOR SLABS:

- A. After stripping the area of all vegetation and roots, the top 12" of sub-grade directly below aggregate base shall be scarified and compacted to 95% of maximum density.

3.02 TESTS:

- A. All compaction tests shall conform to ASTM D1557 Method A or C unless otherwise specified in the Soil Report.

3.03 EXCAVATION FOR STRUCTURES:

- A. Excavation to exact dimensions, levels and alignments required, removing all material encountered.
 - I. Where footings are formed, provide ample space for construction, inspection and the stripping of forms.
 - 2. Footings may be cast against neat excavations provided banks will stand without caving or raveling, and excavations are trimmed accurately and smoothly, one inch wider each side than the dimensions on the drawings. If banks cave or slough, footings shall be formed and excavations made at least 1 foot wider each side to permit forming, bracing and inspection.
 - 3. All subgrades for footings shall be approved by the Soils Engineer as to compliance with the drawings and specifications before form work, or other work, is done. The subgrade shall be free from all loose material at time concrete is deposited. Minimum depth of footings shall be 24". Verify with structural drawings.
- B. Excavation limits: Exercise care to not excavate beyond the footing depths or limits shown on the drawings or authorized by the Soils Engineer. Where unauthorized excavation is made below indicated or authorized depth, backfill the overexcavated space with concrete having compressive strength of not less than 1500 psi at 28 days, at the Contractor's expense, or fill as otherwise directed by the Soils Engineer.
- C. Disposition of excavated materials: Remove from the site all material which is not required or approved for backfill.

3.04 BACKFILLING AND COMPACTION:

- A. Structure - General: Backfill excavations as construction operations permit, but not before work to be covered has been inspected and approved, trash and debris removed, and concrete reaches its 28 day strength. Except where walls and foundations have been adequately constructed to withstand eccentric loading, and except where backfill is equally and simultaneously placed on opposing sides of the structure, adequately brace such construction to withstand eccentric loading induced by backfill operations. Perform all backfilling under the supervision of the Soils Engineer. Do not deposit backfill until permission has been given by the Architect. Place backfill in horizontal layers 6" deep, uniformly moistening, tamping and compacting each layer.
- B. Where backfill is placed against waterproofing, take special care to prevent damage to waterproofing membrane.

- C. Compaction shall be as specified above for filling.

3.05 SUBGRADE PREPARATION:

- A. Prepare earth grades to receive concrete flatwork by scarifying the sub-grade, where necessary. Slowly re-moisten the exposed subgrade as directed by the Soils Engineer and, if required, moisture-condition new material, compact and bring to the elevations required. During such operations, cut down or fill all high or low spots, remoistening and recompacting as required. Upon completion, the subgrades shall conform to required elevations and cross sections to receive the concrete flatwork or paving or granular base where specified or indicated.
- B. Grade all planting areas to within 2" of finish grade, remove all rocks and debris.

3.06 TRENCHING FOR UTILITIES:

- A. Excavate sufficiently wide for proper installation of lines. Where depth of trench is greater than five feet, the width of the trench bottom shall be not less than one foot wider nor more than two feet wider than the outside diameter of the pipe. Above the top of the pipe, the trench may be widened. The bottoms of the trenches shall parallel the slope of the pipe inverts with the trench subgrade being the outside of the pipe bottom. Excavate space for pipe bells below trench grade.
- B. Trench bottoms shall be thoroughly compacted, free from loose stones or rock, true to line and grade. If trench bottom is of material which cannot be excavated to true subgrade, over-excavate 4". If bottom is of soft or spongy material, over-excavate 12". Refill over-excavated portions with graded gravel and tamp until firm, unyielding and true to the line and grade.
- C. Provide all sheathing or bracing required to maintain trench walls and to protect workmen.
- D. Keep water out of trenches while lines are being laid, until any concrete mortar or jointing material takes its final set and until backfill is above ground water table.
- E. Do no backfilling until measurements for Record Drawings have been made.
- F. Material around structures and for two feet above pipes shall be free of lumps and stones. Tamp carefully while placing backfill in 6" layers to avoid disturbing pipe. Use sufficient moisture to obtain optimum compaction. When backfill is in place one foot above the top of pipe, the remainder of the backfill may be compacted by mechanical means. Conform to any additional instructions required by mechanical or plumbing specifications.
- G. Compaction by flooding or jetting is expressly prohibited.

3.07 PROTECTION OF FINISH SUBGRADES:

- A. Continued use of prepared subgrades for hauling, which will cut or deform it from required cross section will not be permitted. Repair and recompact any damaged areas at Contractor's expense. Place no material until the subgrade is in a condition satisfactory to the Soils Engineer as meeting these specifications.

3.08 PROTECTION OF EXISTING WORK:

- A. Protect existing paving, walks, buildings, and utilities from damage during installation of new work. Carefully examine the drawings and inspect the site to determine the proximity of such work.

3.09 DUST ABATEMENT

- A. Conform to all codes and regulations and otherwise prevent dust from becoming an annoyance to personnel in the area and elsewhere.

3.10 CLEANUP

- A. Remove from the site all debris resulting from the work, all material not suitable for fill, backfill or finish grading and all excess soil.

END OF SECTION

**SECTION 02 36 00
TERMITE CONTROL**

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SCOPE

- A. Furnish materials and perform labor required to execute this work as indicated on the drawings, as specified, and as necessary to complete the Contract, including, but not limited to, these major items:

- 1. Soil treatment for termite control.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Preparation of soil grades beneath floor and patio concrete slabs.

1.04 GENERAL REQUIREMENTS

- A. Codes: Materials and work shall conform to the governing building code. In case of conflict between these specifications and the Building Code, the more stringent shall govern.

2.00 PRODUCTS

2.01 MATERIALS

- A. Chemicals for soil treatment shall be one of the following:

<u>Chemicals</u>	<u>Concentrations</u>
Aldrin	0.5% applied in water emulsion
Benzene Hexachloride (BHG)	0.8% of gamma isomer applied in water emulsion
Chlordane	1.0% applied in water emulsion
Heptachlor	0.5% applied in water emulsion
Dieldrin	0.5% applied in water emulsion

3.00 EXECUTION

3.01 APPLICATION

- A. Application of chemical soil treatment shall be in strict accordance with the manufacturer's recommendations.
- B. Apply an overall treatment under the entire surface of the floor slab excluding exterior walks and including patio slabs and entrance platforms and around all slab penetrations except water supply. Apply at a rate of 1 1/2 gallons per 10 square feet.

- C. Apply one gallon per 10 linear feet in a strip one foot wide along outside of the foundations.
- D. Treatment shall not be made when the fill is excessively wet or immediately after heavy rains. Unless the treated areas are to be immediately covered, precautions shall be taken to prevent disturbance of the treatment by human or animal contact within the treated soil.

3.02 QUALITY CONTROL

- A. All materials used shall bear the manufacturer's warning to be observed in handling and use of the material.
- B. Submit FHA Form 2052, Termite Soil Treatment Guarantee to Project Manager.

END OF SECTION

**SECTION 02 72 00
PORTLAND CEMENT CONCRETE PAVING**

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SECTION INCLUDES

- A. Stair steps and mow strips.
- B. Colored Concrete Paving.

1.03 RELATED SECTIONS

- A. Section 02 22 20 – Excavation and Backfill for Structures.
- B. Section 03 31 00 – Cast-in-Place Concrete.
- C. Section 07 90 00 – Joint Sealers.
- D. Section 31 23 33 – Trenching and Backfilling.
- E. Section 32 16 00 0 Curbs, Gutters, Sidewalks

1.04 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- C. ASTM A185 – Welded Steel Wire Fabric for Concrete Reinforcement.
- D. ASTM A497 – Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
- E. ASTM A615 – Deformed and Plain Billet-Steel for Concrete Reinforcement.
- F. ASTM C33 – Concrete Aggregates.
- G. ASTM C94 - Ready Mix Concrete.
- H. ASTM C150 – Portland Cement.
- I. ASTM C260 – Air-Entraining Admixtures for Concrete.
- J. ASTM C309 – Liquid Membrane-Forming Compounds for Curing Concrete.
- K. ASTM C494 – Chemical Admixtures for Concrete.
- L. ASTM D1751 – Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.05 SUBMITTALS FOR REVIEW

- A. Section 01 30 00 – Submittals
- B. Aggregate: Submit samples of local aggregates.
- C. Samples: Submit two each sample panels, 48 x 48 inch in size illustrating exposed aggregate finish and each color.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with requirements of Section 03 31 00.
- B. Obtain cementitious materials from same source throughout.

1.07 REGULATORY REQUIREMENTS

- A. In addition to complying with applicable codes and regulations of governmental agencies having jurisdiction, comply with the applicable requirements of Caltrans Standard Specifications for Public Work Construction, and of the CRSI Manual of Standard Practices.
- B. Where the provisions of applicable codes, regulations and standards conflict with the requirements of this specification, comply with the more stringent provisions.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Do not place concrete when base surface temperature is less than 50 degrees F, or surface is wet or frozen.

2.00 PRODUCTS

2.01 FORM MATERIALS

- A. Form Materials: As specified in Section 03 31 00.

2.02 REINFORCEMENT

- A. Reinforcing Steel: Type specified in Section 03 31 00.

2.03 CONCRETE MATERIALS

- A. Concrete Materials: As specified in Section 03 31 00 and Section 32 16 00
- B. Fine and Coarse Mix Aggregates: ASTM C33.
- C. Exposed Aggregate: Gravel washed natural mineral aggregate, peagravel from a single source and color approved by Architect.
- D. Water: Potable, not detrimental to concrete.

2.04 ACCESSORIES

- A. Joint Filler: Premolded asphalt saturated strips 3/8 inch thick. Shape to conform to full depth slabs, curbs, and driveways as required.
- B. Liquid Curing Compound: Non-staining, complying with ASTM C309 at manufacturer's recommend rate of application. Deliver curing compound in unopened labeled containers. Waxfree, fugitive resin type. Thompson's Waterseal, Hunt's TLF, or equal.
- C. Sealer: "Cementone" as manufactured by L.M. Scolfield Company, or approved equal.
- D. Retarder: "Lithotex" manufactured by L.M. Scolfield Company, or approved equal.
- E. Rock Salt: Commercial standard, packaged salt crystals, No. 2 size, free of fines where noted.

2.05 CONCRETE MIX – BY PERFORMANCE CRITERIA

- A. Refer to Section 03 31 00 and Section 32 16 00
- B. Concrete paving shall have a minimum ultimate compressive strength of 2,500 PSI at 28 days.

2.06 SOURCE QUALITY CONTROL AND TESTS

- A. Refer to Section 03 31 00.

2.07 WEED KILLERS

- A. Provide a dry, free flowing, dust free chemical compound containing not less than 30% sodium chlorate or a chlorate-borate compound. Product shall be non-flammable, not creating a fire hazard when applied in accordance with the manufacturer's recommendations, soluble in water, and capable of being spread dry or in solution.
- B. Acceptable Products:
 - 1. "Spike 80W" by Dow Elanco.
 - 2. Equal products of other manufacturers when accepted in advance by the Architect.

2.08 DETECTABLE WARNING SURFACE

- A. Special warnings for disabled persons shall comply with CBC Sections 1133B.8.5. Shall be provided at curb cuts as detailed.
- B. Color shall be yellow and approximate 33538 of SAE AMSSTD-595A.

3.00 EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
- B. Verify gradients and elevations of base are correct.

3.02 SUBBASE

- A. Subgrade shall be smooth, true to line and grade and tested for required compaction prior to start of placing concrete. Dampen subgrade 24 hours before placing. Reroll as required to smooth, hard, even surface of 90 percent compaction. Wet forms to tighten cracks.

3.03 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Notify Architect minimum 48 hours prior to commencement of concreting operations.

3.04 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.05 REINFORCEMENT

- A. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
- B. Place reinforcement as indicated or to obtain the required coverage for concrete protection.
- C. Position, support, and secure reinforcement against displacement by formwork, construction, and concrete placement operations.
- D. For all concrete paving / walkways, ramps, stairs, etc. the minimum reinforcing shall have reinforcing per Section 03 31 00 and as shown on Drawings. Provide (1) #5 continuous nosing bar at all edges of concrete walkways in a scooped footing minimum 8" X 8".
- E. Break reinforcement at expansion joints only.

3.06 CONCRETE

- A. Transit mix the concrete in accordance with provisions of ASTM C94.
 - 1. With each load, provide ticket certifying the materials and quantities as well as compliance with the approved mix design.
 - 2. On the transit mix ticket, state the time water was first added to the mix.
 - 3. At the batch plant, withhold 1-1/2 gallons of water per cubic yard of concrete.

4. Upon arrival at the job site, and as directed by the Testing Laboratory Inspector, add all or part of the withheld water before the concrete is discharged from the mixer.
5. Mix not less than five minutes after the withheld water has been added, and not less than one minute of that time immediately prior to discharge of the batch.
6. Unless otherwise directed, provide 15 minutes total mixing time per batch after first addition of water.
7. Do not use concrete that has stood over 30 minutes after leaving the mixer, or concrete that is not placed within 60 minutes after water is introduced into the mix.
8. Minimum thickness if the concrete slabs or walks shall be four inches thick unless noted otherwise on the drawings.
9. Cement shall be from a single source.

B. Conveying:

1. Place concrete in accordance with the following and pertinent recommendations contained in ACI 304.
2. Deposit concrete continuously in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section.
3. If a section cannot be placed continuously, provide construction joints as specified herein.
4. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic.
5. Deposit concrete as nearly as practicable in its final location so as to avoid segregation due to rehandling and flowing.
6. Do not subject concrete to any procedure, which will cause segregation.
7. Do not use concrete, which becomes non-plastic and unworkable, or does not meet required quality control limits, or has been contaminated by foreign materials.
8. Remove rejected concrete from the site.

C. Deposit and consolidate concrete in a continuous operation within the limits of construction joints until the placing of a panel or section is completed.

1. Bring surfaces to the correct level with a straightedge, and then strike off.
2. Use bullfloats or darbies on the plastic surface, leaving it free from bumps and hollows.
3. Do not sprinkle water in the plastic surface. Do not disturb the surfaces prior to start of finishing operations.

3.07 JOINTS

- A. Expansion and Keyed Joists: Extend entirely through curbs and slabs: Unless otherwise indicated locate at 20 feet on-centers for flatwork and 10 feet on-centers for curbs. Expansion joints may be deleted by City. Verify locations prior to pour.
1. Break reinforcing steel at joints only.
 2. Use at all cold joints.
 3. Install, ONLY AT SPECIFIED LOCATIONS, continuous expansion joint filler full depth at all construction joints and at all vertical surfaces or 1/2" wide x 2" deep tooled joint with tooled edges. Must obtain Architect's approval prior to using tooled joint method.
 4. "Quick" joints may be allowed to control shrinkage at small areas of flatwork only or the approval of the Architect.
 5. Tool edges minimum 1/4 inch radius edges.
 6. All expansion joints shall be caulked. See specification Section 07 90 00.
- B. Control Joints: As shown on drawings, but generally at 10 feet on-centers both ways. Locate between expansion joints where possible. Do not use as substitute for expansion joints.
1. Sawcut one-third depth of slab minimum immediately after slab has attained its initial set or within a 24 hour period.
 2. Plastic "quick" joints with removable cap may be used in lieu of sawcutting. Embed to one-third depth of slab, or may use two inch tooled joint into the depth of the slab.
 3. Location: As shown on drawings.
- C. Tooled Joints:
1. General: Joints shall be true to line and profile. Tooling shall be done while concrete is plastic.
 2. Jointing Tool: Shall be two inches wide at surface, tapered, with top edges rounded to 1/4 inch radius and minimum one inch penetration.
 3. Location: As shown on Drawings, but in any case not more than five feet on centers both ways.

3.08 FLOATING & FINISHING

- A. Floating:
1. Begin floating when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation.

2. During or after the first floating, check the planeness of surface with a ten-foot straight edge applied at not less than two different angles.
3. Cut down high spots and fill low spots, and produce a surface level within ¼ inch in 10 feet as determined by a 10 foot straightedge placed anywhere on the surface in any direction.
4. Refloat the surface immediately to a uniform sandy texture.
5. Where indicated, apply color hardener evenly to the plastic surface by the dry shake method, using a minimum of 60 pounds per 100 square feet. Apply in two shakes. Wood float after each and trowel only after final floating.

B. Finishing:

1. Flatwork without stamped pattern: Portland cement concrete paving shall have a Salt or Medium broom finish on all surfaces with less than 6% slope and slip resistant heavy broom finish on all surfaces with greater than 6% slope. BROOM DIRECTION MAY VARY ON SEPARATE PANELS. VERIFY WITH ARCHITECT. Color as per Paragraph 2.04; location by Architect.
2. Flatwork:
 - a. Curbs and Gutters: Prior to the removal of curb forms, the surface shall be finished true to grade by means of a straight edge float, not less than 10 feet, in length, operated longitudinally over the surface of the concrete. Smooth trowel face of curb immediately after removal of form. Steel trowel face and tops of curb and provide rounded front and back edges. After the face of the curb has been troweled smooth, it shall be given a final brush finish with brush strokes parallel to the line of the curb. Top and face of curbs shall be true and straight, of uniform width, free from humps, sags or other irregularities. Establish a 3" unformed width flow line at the curbs base with a smooth troweled finish, free of humps, sags or other irregularities.
 - b. Tooling: Tool surfaces as indicated in drawings with scoring tool to leave rounded edge.

3.09 CURING

- A. Moist Curing for Natural Concrete: Cover with reinforced waterproof curing paper or polyurethane vapor barrier. Seal all joints and weight down edges. Maintain moist for seven days.
- B. Sealing, for Natural Concrete: Locations as approved by the Architect. Apply a uniform coating within two hours of final troweling.
- C. Curing and Cleaning for Stamped Colored Concrete: Apply Colorwax, in the matching color, uniformly at coverage rate recommended by its manufacturer. Do not apply Colorwax in joints to be grouted.

3.10 ADJUSTING AND CLEANING:

- A. Construction Joints: Clean by sandblasting if necessary to remove excess concrete.

- B. Patching: Patch cracks, rock pockets, and honeycombs as directed by Architect. Apply a uniform coating within two hours of final troweling.

3.11 TOLERANCES

- A. Maximum Variation of Surface Flatness: $\frac{1}{4}$ inch in 10 ft.
- B. Maximum Variation from True Position: $\frac{1}{4}$ inch.

3.12 FIELD QUALITY CONTROL

- A. Refer to Section 03 31 00.

3.13 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian or vehicular traffic over pavement for 7 days minimum after finishing.

END OF SECTION

SECTION 02 76 00
PAVEMENT MARKINGS AND PRECAST CONCRETE BUMPERS

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

- A. Provide pavement marking, crosswalk markings, directional pavement markings as indicated.
- B. Related Sections:
 - 1. Section 07 90 00 – Joint Sealers.
 - 2. Section 32 11 23 – Asphalt Concrete Paving
 - 3. Section 32 16 00 – Curbs, Gutters, Sidewalks
 - 4. Special Provisions – Signing, Striping, And Pavement Markers

1.03 REFERENCES

- A. ADA - Title III of the American with Disabilities Act, for the Disabled
- B. CAR - The California Accessibility Regulations, Part 2, Title 24 of the California Code of Regulations, 1998 California Building Code with State Amendments
- C. Standard Specifications for Public Works Construction (SSPWC), Latest Edition
- D. State of California Department of Transportation Standard Specifications (SSS), Caltrans, Latest Edition

1.04 SUBMITTALS

- A. Make submittals in accordance with Section 01 30 00 - Submittals.
 - 1. Submit a complete list of all materials to be furnished stating supplier and distributor's names.
 - 2. Submit manufacturer's standard color samples for each type of paint specified. Once colors have been selected, submit 3 samples of each color selected for each type of paint, on standard 8-1/2" x 11" spray-out panel.
- B. Shop Drawings: Scaled drawings of layouts for striping for approval prior to their application.
- C. Data: Manufacturer's detailed technical materials and application data, including technical bulletins, guides and manuals for striping and game lines paint.

1.05 REGULATORY REQUIREMENTS

- A. Conform to the more restrictive provisions of Title III of the American with Disabilities Act or the CCR, Title 24, Part 2, California Accessibility Regulations, 1998 California Building Code with State Amendments.
- B. Pavement markings shall conform to AQMD 1113 and current VOC limits.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 – Material Equipment and Product Handling: Environmental conditions affecting products on site.
- B. Do not apply pavement markings to surfaces below 40 degrees F or above 95 degrees F unless recommended by the manufacturer.
- C. Do not apply pavement markings when rain is predicted within 48 hours or less than 5 days after surface has been wet.
- D. Do not apply pavement markings in high or gusty winds.

2.00 PRODUCTS

2.01 MATERIALS

- A. Manufacturers: See Special Provisions – Signing, Striping, And Pavement Markers.
- B. Paint: See Special Provisions – Signing, Striping, And Pavement Markers.

3.00 EXECUTION

3.01 PAVEMENT MARKINGS

- A. See Special Provisions – Signing, Striping, And Pavement Markers.

3.02 SCHEDULE

- A. See Special Provisions – Signing, Striping, And Pavement Markers.

3.03 PRECAST CONCRETE BUMPERS

- A. Drive anchoring pins full depth and recess ½ in. below top surface of precast concrete bumper. Fill with caulking flush to top of bumper.
- B. Precast concrete bumpers: 3,000 psi precast concrete with chamfered edges and openings for anchoring pins. Provide with smooth finish, free from pits and rock pockets.
 - 1. Cement: ASTM C 150, Type I or II.
 - 2. Aggregates: ASTM C 33.
 - 3. Reinforcing steel: ASTM A 615, Grade 40. Two No. 3 bars minimum, full length for bumper, spaced one each side of anchoring pin openings.
 - 4. Anchoring pins: Hot-dip galvanized standard weight steel pipe, solid rod, or reinforcing bar, ¾ in. diameter, 24 in. long.
 - 5. Sealant: As specified in Section 07 90 00.

3.04 PROTECTION

- A. Do not permit pedestrian or vehicular traffic over pavement for two (2) days minimum after finishing.

END OF SECTION

SECTION 02 76 10
CAST IN PLACE DETECTABLE WARNING SURFACES

PART 1 GENERAL

1.01 DESCRIPTION

- A. This Section includes Specifications for furnishing and installing permanently embedded Cast In Place Tactile / Detectable Warning Surface Tiles (CIP) with an in-line truncated dome pattern embedded in all curb ramps at the locations and to the dimensions shown on the Drawings, in accordance with the Contract Documents and as directed by the Engineer.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specifications, apply to this Section.
- B. Americans with Disabilities Act (ADA) Title 49 CFR Transportation, Part 37.9 Standards for Accessible Transportation Facilities, Appendix A, Section 4.29.2 Detectable Warnings on Walking Surfaces. FHA Memo (5-06-02) titled Truncated Domes. Federal Register Volume 71, No. 209, 49 CFR Part 37 (10-30-06), ADA Standards for Transportation Facilities (11-29-06, DOT): Sections 406, 705, and 810. ADA Standards for Accessible Design – 2010 (9/05/11, DOJ), ADAAG: Sections 705 and 810. Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Rights of Way (7/23/11, Access Board), PROWAG: Sections R208, R304, R305, R308, and R309.
- C. American Society for Testing and Materials (ASTM) Test Methods B117, C501, C1028, D543, D570, D638, D695, D790, G151, G155, and E84.
- D. American Association of State Highway and Transportation Officials (AASHTO): Test Method AASHTO-H20.
- E. California Code of Regulations (CCR 2007) Title 24 Part 1 Articles 2, 3 and 4, and Part 2 Section 205 definition of "Detectable Warning", Section 1127B.5 for "Curb Ramps", and Section 1133B.8.5 for "Detectable Warnings at Hazardous Vehicle Areas". California Department of Transportation Detectable Warning Surface Authorized Material List. Division of the State Architect IR 11B-3 (1/26/05) and IR 11B-4 (1/01/11). IR 11B-4 (1/01/11) removed the requirement for a "staggered" pattern and now calls for the "square grid" (in-line) pattern.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's literature describing products, installation procedures and maintenance instructions.

- B. Samples for Verification Purposes: Submit two (2) Tactile Warning Surface samples minimum 8" x 8" of the kind proposed for use. Samples shall be properly labeled and shall contain the following information: Name of Project, Submitted by, Date of Submittal, Manufacturer's Name, and Catalog Number.
- C. Shop Drawings: Submit Standard Manufacturer Shop Drawings showing all pertinent characteristics of the Composite Shell Cast In Place Tactile Warning Surface Tile (CIP), including profile, sound on cane contact amplification feature and installation methods.
- D. Material Test Reports: Submit current test reports from qualified, accredited independent testing laboratory in accordance with ASTM guidelines and indicating that materials proposed for use are in compliance with specification requirements and meet the properties indicated. All test reports submitted shall be representative of the Composite Shell Cast In Place Tactile Warning Surface Tile (CIP) delivered to the Project.
- E. Maintenance Instructions: Submit copies of manufacturer's specified maintenance practices for each type of Tactile Warning Surface Tile and accessory.

1.04 QUALITY ASSURANCE

- A. Provide Cast In Place Tactile Warning Surface Tiles (CIP) and accessories as produced by a single manufacturer with a minimum of five years experience in manufacturing Cast In Place Composite Shell Tactile Warning Surface Tiles.
- B. Installer's Qualifications: Engage an experienced installer certified in writing by the Tactile Warning Surface manufacturer, who has successfully completed Tactile Warning Surface installations similar in material, design, and extent to that indicated for the Contract.
- C. Cast In Place Tactile Warning Surface Tiles (CIP) must be compliant with ADAAG, PROWAG, and California Title 24 requirements. Division of the State Architect IR 11B-3 (1/26/05) and IR 11B-4 (1/01/11). IR 11B-4 (1/01/11) removed the requirement for a "staggered" pattern and now calls for the "square grid" (in-line) pattern.
- D. Cast In Place Tactile Warning Surface Tiles (CIP) shall meet or exceed the following test criteria using the most current test methods:
 - 1. Compressive Strength: 28,900 psi minimum, when tested in accordance with ASTM D695.
 - 2. Flexural Strength: 29,300 psi minimum, when tested in accordance with ASTM D790.
 - 3. Water Absorption: Not to exceed 0.10%, when tested in accordance with ASTM-D570.
 - 4. Slip Resistance: 1.05 minimum wet and 1.18 dry static coefficient of friction when tested in accordance with ASTM C1028.
 - 5. Flame Spread: 25 maximum, when tested in accordance with ASTM E84.

6. Salt and Spray Performance of Tactile Warning Surface: No deterioration or other defects after 200 hours of exposure, when tested in accordance with ASTM-B117.
7. Chemical Stain Resistance: No reaction to 1% hydrochloric acid, motor oil, calcium chloride, gum, soap solution, bleach, and antifreeze, when tested in accordance with ASTM D543.
8. Abrasion Resistance: 500 minimum, when tested in accordance with ASTM C501.
9. Accelerated Weathering of Tactile Warning Surface when tested by ASTM-G155 or ASTM G151 shall exhibit the following result: $\Delta E < 5.0$ at 2,000 hours minimum exposure.
10. Tensile Strength: 11,600 psi minimum, when tested in accordance with ASTM D638.
11. AASHTO-H20 Load Bearing Test: No Damage at 16,000# loading.
12. Freeze/Thaw/Heat: No deterioration when tested in accordance with ASTM C 1026.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Cast In Place Tactile Warning Surface Tiles (CIP) shall be suitably packaged or crated to prevent damage in shipment or handling. Finished surfaces shall be protected by sturdy wrappings.
- B. Storage Facility
 1. Store CIP Tiles in an area that is within an acceptable temperature range (40-90 degrees).
 2. Maintain Storage Facility in a clean dry condition to prevent contamination or damage to CIP Tiles.

1.06 GUARANTEE

- A. CIP Tiles shall be guaranteed in writing for a period of five (5) years from date of Contract's final completion. The guarantee includes manufacturing defects, breakage, and deformation.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Composition: CIP Tiles shall be manufactured using a matte finish exterior grade homogeneous (uniform color throughout thickness of product) glass and carbon reinforced polyester based Sheet Molding Compound (SMC) composite material. Truncated domes must contain fiberglass reinforcement within the truncated dome for superior structural integrity and impact resistance. A matte finish will be required on the Tactile Warning Surface for superior slip resistance performance superior to that offered by a gloss finish. Use of Tactile Warning Surface Products employing coatings or featuring layers of material with differing composition, performance, or color properties is expressly prohibited under this Section.

- B. Color: Color shall be homogeneous throughout CIP Tile.
1. Federal Yellow (Y) per Federal Standard 595B Table IV, Color No. 33538.
 2. Brick Red (R) per Federal Standard 595B Table IV, Color No. 20109.
 3. Clay Red (CR) per Federal Standard 595B Table IV, Color No. 22144.
 4. Safety Red (SR) per Federal Standard 595B, Table IV, Color No. 31350.
 5. Black (B) per Federal Standard 595B Table IV, Color No. 37038.
 6. Dark Gray (G) per Federal Standard 595B Table IV, Color No. 36118.
 7. Safety Blue (B) per Federal Standard 595B Table IV, Color No. 15187.
 8. White (W) per Federal Standard 595B Table IV, Color No 37925.
 9. Seattle Yellow (SY) per Federal Standard 595B Table IV, Color No. 23594.
 10. Houston Beige (Pantone #7529C).
- C. Domes: Square grid pattern of raised truncated domes of 0.2" nominal height, base diameter of 0.9" and top diameter of 0.45". The Federal Code of Regulations permits a truncated dome spacing range of 1.6"-2.4." For superior wheelchair, walker and shopping cart mobility, the preferred truncated dome spacing shall have a center-to-center (horizontally and vertically) spacing of 2.35", measured between the most adjacent domes on square grid.
- D. Configuration: CIP Tile sizes shall be as indicated on the Contract Drawings. For superior load bearing capacity, CIP Tile shall feature internal embedment ribs at 3" on center maximum. The field area shall consist of a non-slip textured surface with a minimum static coefficient of friction of 0.80, wet and dry. At a minimum, CIP Tile thickness shall measure 0.20" (nominal).
1. The field area shall consist of a non-slip textured surface with a minimum static coefficient of friction of 0.80, wet and dry.
- E. Truncated Dome Surface of Composite CIP Tile shall be protected with factory installed plastic sheeting for cleanliness during the installation process. Basic Installation Guidelines shall be printed on the plastic sheeting in both English and Spanish for customer convenience.
- F. Dimensions: Cast In Place Tactile Warning Surface Tiles shall be held within the following dimensions and tolerances:

Specifiers Note: Edit section below by selecting desired length and width. Delete non-relevant dimensions.

2. Length and Width:
 - 1.67" Dome Spacing: [24"x36"] [24"x48"] [24"x60"] [36"x48"] [36"x60"]
 - 2.35" Dome Spacing: [24"x36"] [24"x48"] [24"x60"] [36"x48"] [36"x60"]

- G. Cleaning materials used on site shall have code acceptable low VOC solvent content and low flammability.
- H. The Specifications of the concrete, sealants and related materials shall be in accordance with the Contract Documents and the guidelines set by their respective manufacturers.

2.02 MANUFACTURERS

- A. Available manufacturers, subject to compliance with these Specifications include, but are not limited to, the following:
 - 1. ADA Solutions Inc. of Chelmsford, MA (Phone: 800-372-0519, Fax: 978-262-9125, Web Site: www.adatile.com , E: info@adatile.com), or approved equal.
 - 2. Requests for Approved Equal Status must be submitted and approved by the Architect.

2.03 EQUIPMENT

- A. Contractor shall provide all tools, equipment and services required for satisfactory installation per manufacturer's instruction as Incidental Work. Equipment, which may be required include typical mason's tools, a 4-foot long level with electronic slope readout, 25-pound weights, vibrator and rubber mallet with 2" x 4" x 10" wood tamping plate, and a device for cutting the Tactile Warning Surface Product.

PART 3 EXECUTION

3.01 PREPARATION

- A. During all concrete pouring and CIP Tile Installation procedures, ensure adequate safety guidelines are in place and that they are in accordance with the applicable industry and government standards.
- B. The physical characteristics of the concrete shall be consistent with the Contract Specifications while maintaining a slump range of 4 - 7 to permit solid placement of the CIP Tile. An overly wet mix will cause the CIP Tile to float. Under these conditions suitable weights such as 2 concrete blocks or sandbags (25 pounds) shall be placed on each CIP Tile.
- C. The concrete shall be poured and finished, true and smooth to the required dimensions and slope prior to CIP Tile placement.

3.02 INSTALLATION

- A. Contractor will not be allowed to install Tactile Warning Surface Tiles until all submittals have been reviewed and approved by the Engineer.
- B. CIP Tile shall be installed per manufacturer's instructions.

- C. To the maximum extent possible, the CIP Tiles shall be oriented such that the rows of in-line truncated domes are parallel with the direction of the ramp. When multiple CIP Tiles regardless of size are used, the truncated domes shall be aligned between the tactile warning surface Tiles and throughout the entire tactile warning surface installation.
- D. In accordance with the Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Rights of Way (7/23/11, Access Board): Sections 304 + 305), Tactile Warning Surface Tile shall be located relative to the curb line as shown within Sections 304+305 of the Guidelines.
- E. CIP Tiles shall be tamped or vibrated into the fresh concrete to ensure that there are no voids or air pockets, and the field level of the CIP Tile is flush to the adjacent concrete surface or as the Drawings indicate to permit proper water drainage and eliminate tripping hazards between adjacent finishes.
- F. Cutting and Setting of CIP Tiles shall be cut into size and configuration indicated on the Drawings using a 60 tooth carbide blade on a table saw or equivalent cutting device. Minimize any cantilever effect (to the maximum extent practicable) when cutting between successive embedment ribs as concrete will tend to flow up and over the CIP Tiles. The top of the body of the CIP Tiles shall be fully seated and flush with the adjacent concrete substrate. For specific instructions for cutting and setting refer to Tactile Warning Surface manufacturer's written instructions.

3.03 CLEANING AND PROTECTING

- A. Protect CIP Tiles against damage during construction period to comply with CIP Tiles manufacturer's Specifications.
- B. During and after the CIP Tiles installation and the concrete curing stage, it is imperative that there are no walking, leaning or external forces placed on the CIP Tiles to rock the CIP Tile, causing a void between the underside of the CIP Tile and the concrete.
- C. Remove Protective Plastic Sheeting from CIP Tile within 24 hours of installation of the CIP Tile. Particularly under hot weather conditions (80 degrees or higher), plastic sheeting will adhere strongly (resulting in difficult removal of same) to Tactile Warning Surface Tile when not removed quickly.
- D. If requested by the Project Manager, clean CIP Tiles not more than four (4) days prior to date scheduled for inspection intended to establish date of substantial completion in each area of project. Clean CIP Tile by method specified by Tactile Warning Surface Products manufacturer.

END OF SECTION

**SECTION 03 31 00
CAST-IN-PLACE CONCRETE**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.
- D. Welding certificates.
- E. Material certificates.
- F. Material test reports.
- G. Floor surface flatness and levelness measurements.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
- E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- F. Pre installation Conference: Conduct conference at Project site

- G. Tests for Concrete Materials at Batch Plant: Utilizing batch plant test records, perform the following tests in accordance with provisions of the building code:
1. Cement: Sample and test cement, or provide mill test reports, as accepted, certifying that the cement conforms to the requirements of this specification.
 2. Aggregate:
 - a. Sample and test concrete aggregate for grading and soundness before concrete mix designs are established.
 - b. Test aggregate for shrinkage characteristics in accordance with ASTM C 157.
 - c. Conduct petrographic examinations of aggregate proposed for use in accordance with ASTM C 295.
 3. Air Content: ASTM C 173, volumetric method or ASTM C 231, pressure method. One test for each set of compressive strength test specimens.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- D. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from galvanized-steel wire into flat sheets.
- E. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, plain steel.
- F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type II, gray.
- B. Normal-Weight Aggregates: ASTM C 33, graded.
 - 1. 1. Maximum Coarse-Aggregate Size: No larger than three-fourths of the clear space between reinforcing bars or between reinforcing bars and forms, nor larger than one-fifth of the narrowest dimension between sides of forms, nor larger than one-third of the depth of slab. 1-inch maximum aggregate may be used in other than mass concrete. 1 ½-inch maximum aggregate may be used in mass concrete where reinforcement clearance will permit.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

2.4 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

2.5 WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

2.6 VAPOR BARRIER

- A. Sheet Vapor Barrier: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape. Stego Wrap Vapor Barrier (15-mil) by Stego Industries LLC or approved equal.
- B. Sheet Vapor Barrier: Polyethylene sheet, ASTM D 4397, not less than 15 mils (0.25 mm) thick. Permeance of less than 0.01 perms per ASTM F 1249 or ASTM E 96.
- C. Sheet Vapor Barrier Location: Concrete slab to be placed directly on the vapor barrier.
- D. Sheet Vapor Barrier Installation:

2.7 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.8 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.9 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301. Comply with ACI 318 Sec 3.6
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not more than 15 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 2. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
- D. Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 3000 psi (24.1 MPa) at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.50.

3. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
5. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd. (0.90 kg/cu. m)
6. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
7. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.10 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Do not chamfer exterior corners and edges of permanently exposed concrete.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR BARRIERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor barrier to comply with ASTM E 1643. Follow manufacturer instructions for placement (including laps, sealing around

penetrations and foundation walls), protection and repair. Provide reinforcement supports that do not puncture the vapor barrier. Place vapor barrier sheeting with the longest dimension parallel with the direction of the concrete pour.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 1. Do not cut or puncture vapor barrier. Repair damage and reseal vapor barrier before placing concrete.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect. Comply with ACI 318 Sec 6.4.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. When not shown on drawings locate not more than twenty five feet on center. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Sawcutting to occur within 18 hours of finishing.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
- E. Waterstops: Install in construction joints and at other joints according to manufacturer's written instructions.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 2. Comply with ACI 318 Sec 5.10

- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

Apply to concrete surfaces exposed to public view and/or to receive a rubbed finish.

- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 - 1. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. 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 to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic, porcelain or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch (3.2 mm).
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. After floating, draw broom across the surface at right angle to flow of traffic producing a uniform non-skid surface. For light broom finish, draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture. For medium broom finish, use a fiber broom, leaving depressions approximately 1/16" deep. For heavy broom finish, use a coarse broom leaving depressions approximately 1/8" deep. Use liquid curing membrane.
 2. At sloped surfaces, provide medium broom finish for slopes 6% or less and heavy broom finish for slopes greater than 6%.
 3. Concrete paving and other paving finishes along accessible route of travel to be slip-resistant and medium broom finish.

3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Comply with ACI 318 Sec 5.11. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall

within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

- a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

Curing and Sealing Compound: Apply uniformly to floors and slabs in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period. Acceptable manufacturers include "#1100 Clear" as manufactured by W.R. Meadows, Inc. ; "Curetox" as manufactured by Toch Brothers, Inc., or "Kure-N-Seal", manufactured by Sonneborn Building Products.

3.10 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. Corrective work: Grinding (if needed) shall be done dry with a vacuum attachment. Ensure any patching materials that are used are compatible with the flooring adhesive to be used.

3.11 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. Comply with Sec. 01-45-29.

END OF SECTION

SECTION 04 21 15

ADHERED LIGHTWEIGHT MASONRY

VENEER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Adhered lightweight masonry veneer system.
- B. Related Sections: Sections that contain requirements relating to this Section include:
 - 1. Section 04 22 00 Concrete Masonry Unit (CMU)
 - 2. Section 04 22 23 Architectural Concrete Masonry
 - 3. Section 06 10 00 "Rough Carpentry" for wood stud wall framing and plywood sheathing for exterior walls supporting thin masonry veneer.
 - 4. Section 09 24 00 "Portland Cement Plaster and Lath" for cement plaster substrate for lightweight masonry veneer system.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI A108 Series: Specifications for Installation of Ceramic Tile.
 - a. A108.01: General Requirements: Subsurfaces and Preparations by Other Trades.
 - b. A108.02: General Requirements: Materials, Environmental, and Workmanship.
 - c. A108.1B: Ceramic Tile Installed on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar.
 - d. A108.10: Installation of Grout in Tilework.
 - 2. ANSI A118.4: Specifications for Latex-Portland Cement Mortar.
 - 3. ANSI A118.6: Specifications for Standard Cement Grouts for Tile Installation.
- B. ASTM International (American Society for Testing and Materials):
 - 1. ASTM C 67: Test Methods for Sampling and Testing Masonry and Structural Clay Tile.
 - 2. ASTM C 482: Test Method for Bond Strength of Ceramic Tile to Portland Cement.
 - 3. ASTM C 920: Specification for Elastomeric Joint Sealants.

4. ASTM C 1088: Specification for Thin Veneer Masonry Units Made From Clay or Shale.
 5. ASTM C 270 Type S specification for mortar unit masonry
- C. California Building Code (CBC) – California Code of Regulations, Title 24, Part 2.
- D. Tile Council of North America (TCNA).
1. Handbook for Ceramic Tile Installation.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations, sizes, profiles, coursing patterns of thin-masonry veneer and locations of special shapes. Show details and locations of expansion, contraction, control, and isolation joints in substrates and finished thin-masonry veneer surfaces.
- C. Samples for Initial Selection: For the following, for selection by Architect:
1. Thin-masonry masonry veneer units: Manufacturer's full range of thin-masonry colors and textures.
 - a. Minimum Number of Colors for Selection: 20.
 2. Grout: Manufacturer's full range of grout colors.
 - a. Minimum Number of Colors for Selection: 36.
 3. Sealant: Manufacturer's color charts consisting of strips of cured sealants showing full range of colors available.
 - a. Minimum Number of Colors for Selection: 70.
- D. Samples for Verification: For each type and color of the following:
1. Thin-masonry masonry veneer units, in the form of straps of five or more masonrys.
 2. Special thin-masonry shapes.
 3. Grout. Make Samples using same sand and grout ingredients to be used on Project.
 4. Joint sealants, in joints formed between two thin-masonry units, matching typical mortar joint width.
- E. Product Certificates: For each type of product, signed by product manufacturer.
- F. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Thin-Masonry Veneer: Obtain exposed masonry thin-masonry veneer units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- B. Source Limitations for Grout Materials: Obtain grout ingredients of a uniform quality, including color for exposed thin-masonry veneer, from a single manufacturer for each cementitious component and from single source or producer for each aggregate.
- C. Regulatory Requirements: Comply with applicable provisions of the California Building Code (Title 24, Part 2), Chapter 14 for adhered veneer.

- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockups for each type of exposed thin masonry veneer construction in sizes approximately 48 inches long by 48 inches high. Include the following conditions:
 - a. Sealant-filled joint at least 16 inches long in each exterior wall mockup.
 - b. Lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
 - c. Upper corner of door opening.
 - d. Outside corner condition.
 - e. Inside corner condition.
 - f. Exposed edge condition.
 2. Clean exposed faces of mockups with masonry cleaner as indicated.
 3. Protect accepted mockups from the elements with weather-resistant membrane.
 4. Approval of mockups is for color, texture, and blending of veneer units; relationship of mortar and sealant colors to veneer unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
 5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store thin-masonry veneer units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store liquid latexes and emulsion adhesives in unopened containers and protected from freezing.

1.7 PROJECT CONDITIONS

- A. Stain Prevention: Prevent grout, mortar, and soil from staining the face of thin-masonry veneer. Immediately remove grout, mortar, and soil that come in contact with such veneer units.
 1. Protect base of walls from rain-splashed mud and from mortar and grout splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar and grout droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar and grout droppings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide adhered lightweight masonry veneer installation in which adhesion between adhered veneer units and backing substrate achieves a shear strength of at least 50 psi based on gross unit surface area when tested in accordance with ASTM C 482.

2.2 MASONRY VENEER UNITS

- A. Lightweight Masonry Veneer: ASTM C 1670, Exterior Grade.
 - 1. Product: Subject to compliance with requirements, provide one of the following:
 - a. Orco Block & Hardscape; Lightweight 301 Precision Finish.
 - i) Color: To be approved by Architect.
 - b. Equal product in accordance with Division 1 requirements for product substitutions.
 - 2. Efflorescence: Provide masonry that has been tested according to ASTM C1400 and is rated "not effloresced."
 - 3. Size (Actual Dimensions): 7-5/8 inches high by 15-5/8 inches long.
 - 4. Maximum Weight: 15 lbs per square foot.
 - 5. Keyways: Minimum of two continuous mortar keyways at backside.
 - 6. Special Shapes: Provide manufacturer's shapes designed to simulate appearance of full-size masonry units as follows:
 - a. Corner unit for outside corner conditions.
 - b. Trim unit for exposed edge conditions.
 - c. Cap for top conditions.

2.3 SETTING AND GROUTING MATERIALS

- A. Type S Mortar (Thick Bed Bonding): ASTM C270, consisting of the following:
 - 1. Prepackaged dry-mortar mix combined with liquid-latex additive.
 - a. For wall applications, provide nonsagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Orco Block & Hardscape; VBM Mortar.
 - b. Equal product in accordance with Division 1 requirements for product substitutions.

2.4 Color: As selected by Architect from manufacturer's full range.

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT; field-tintable.
 - 1. Products: Subject to compliance with requirements, provide one of the

following:

- a. Pecora Corporation; 890 FTS.
 - b. Equal product in conformance with Division 1 requirements for product substitutions.
2. Colors: Provide colors of exposed sealants to match colors of adjacent thin-masonry grout joints.

2.5 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturer's written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where thin-masonry veneer will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed veneer.
 1. Verify that substrates for setting thin-masonry units are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile (e.g. thin-masonry) installation standards for installations indicated.
 2. 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 before installing thin masonry units.
 3. Verify that joints and cracks in thin masonry substrates are coordinated with thin-masonry grout locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with thin-masonry setting materials

3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to installation methods indicated.
- B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated below:

1. Exterior Walls: TCA W241.
- C. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate location of openings, movement-type joints, returns, and offsets. Maintain masonry module size at corners, wall openings, and other terminations, unless indicated otherwise.
- D. Bond Pattern: Unless otherwise indicated, lay exposed masonry veneer units in bond pattern to match existing pattern. Use manufacturer's corner unit at outside corners, sides of wall openings, and at exposed ends of walls. Use trim unit at exposed top edges of walls and bottom edges of wall openings (e.g. sills).
- E. Back-butter each veneer unit with bonding mortar as required to achieve 95 percent coverage. Use method to fully adhere veneer unit to substrate with maximum coverage with corners and edges fully supported.
- F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and thin masonry. Do not sawcut joints after setting thin masonry.
 1. Locate joints in masonry veneer surfaces directly above joints in cement plaster substrate below.
 2. Prepare joints and apply sealants to comply with requirements of Section 07 92 00 "Joint Sealants."
- G. Grout masonry veneer to comply with requirements of ANSI A108.10.
 1. Maintain joint thickness to match existing joints
 2. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint width, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections, and prepare test reports.
 1. Notify Owner's testing agency at least 2 working days prior to date when observation and testing services are needed.
- B. Bond Strength: Shear testing of bond strength between adhered masonry veneer units and backing substrate shall be performed according to ASTM C 482.
 1. Testing Frequency: At least one shear test at each building for each 5,000 square feet of building floor area or fraction thereof, but in no case less than two tests at each building.
- C. Test results shall be reported in writing to Architect and Contractor within 48 hours of testing. Reports of bond-strength tests shall contain Project identification name and number, date of thin-masonry veneer installation, and name of testing and inspecting agency.
- D. Additional Tests: Testing and inspecting agency shall, at Contractor's expense, make additional tests of adhered masonry veneer when test results indicate that bond strengths, or other requirements have not been met.
- E. Correct deficiencies in the Work that test reports and inspections indicate do not comply with specified requirements.

- F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 CLEANING AND PROTECTING

- A. On completion of placement and grouting, clean all masonry veneer surfaces so they are free of foreign matter.
 - 1. Remove latex portland cement grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from masonry according to masonry and grout manufacturer's written instructions. Use only cleaners recommended by masonry and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of masonry 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.

END OF SECTION

SECTION 04 22 00
CONCRETE MASONRY UNIT (CMU)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnish materials and perform labor required to execute this work as indicated on the drawings, as specified and as necessary to complete the Contract, including, but not limited to, these major items:
 - a. Concrete masonry units.
 - b. Precast concrete caps.
 - c. Vertical and horizontal reinforcing and dowels projecting into subsequently placed concrete.
 - d. Setting of flashing and other work to be embedded in masonry.

B. Work installed but furnished in other Sections:

1. Sleeves, inserts and similar items furnished by other trades for installation in masonry.

C. Related sections:

1. Section 03 31 00 - Cast-In-Place Concrete: Concrete, including dowels installed in concrete, placed prior to installation of masonry work, for anchorage of masonry.
2. Section 04 21 15 – Adhered Lightweight Masonry Veneer
3. Section 04 22 23 – Architectural Concrete Masonry
4. Section 05 50 00 - Metal Fabrications: Furnishing items to be embedded in masonry.
5. Section 07 17 75 - Water Repellent Coating.
6. Section 07 62 00 - Flashing and Sheet Metal.
7. Section 07 90 00 - Joint Sealants.
8. Section 09 96 23 – Anti-Graffiti Coating - Clear

1.2 DEFINITIONS AND REFERENCES

- A. ASTM A615 - Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
- B. ASTM C33 - Concrete Aggregates.
- C. ASTM C90 - Test Method Pullout Strength for Hardened Concrete.
- D. ASTM C114 -Test Methods for Chemical Analysis of Hydraulic Cement.
- E. ASTM C144 - Aggregate for Masonry Mortar.

- F. ASTM C150 - Portland Cement.
- G. ASTM C207 - Hydrated Lime for Masonry Purposes.
- H. ASTM C404 – Aggregates for Masonry Grout.

1.3 SUBMITTALS

- A. Procedures: In accordance with requirements of Section 01 30 00.
- B. Product data: Manufacturer's information for all specified items.
- C. Samples: Samples of all blocks used in the work.
- D. Sample panel: Erect a 3' high x 4' long sample panel of concrete block masonry. After review and acceptance by Architect, ensure that all masonry work matches accepted panel.
- E. Certificates: Prior to delivery, submit certificates attesting compliance of CMU with applicable specifications for grades, types or classes.

1.4 QUALITY ASSURANCE

- A. Regulatory requirements:
 - 1. Materials and work: Conform to California Building Code latest edition, Chapter 21, Title 24, Part 2, California Code of Regulations latest edition. In case of conflict between these specifications and Building Codes, the more stringent shall govern.
 - 2. Provide for testing and quality control per CBC Sections 2105A.1 and 2105A.2.1.
 - 3. NOTE! All structural masonry requires continuous inspection by an inspector approved by enforcement agency.
- B. Verify that masonry units have been cured for 28 days before delivery to project site.

1.5 PRODUCT HANDLING

- A. Procedures: In accordance with Section 01 60 00.
- B. Deliver reinforcement to site bundled, tagged and marked; handle to prevent damage to material. Use metal tags indicating size, length and other markings shown on placement drawings. Maintain tags after bundles are broken.
- C. Protection: Safeguard all materials against injury in transit, delivery, storage, sorting, installation, cleaning, and until final acceptance of completed work.
- D. Store cement and lime in rain proof sheds with elevated floors.
- E. Store sand on tightly floored space, protected against mixing with ground or other materials.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCT

- A. Manufacturer: Orco Block Co., Inc.

- B. Specified manufacturer establishes a standard of quality, function and design for this project. Other acceptable manufacturers having equivalent products may be used only with Architect's approval.

1. Alternate manufacturers: Angelus Block Company, or equal.

2.2 MATERIALS

- A. Concrete block units: ASTM C90, Grade N-1, hollow, medium weight, load bearing units. Aggregates - ASTM C33. Sizes and types as shown on drawings. Provide open end units, special sizes and special shapes shown on drawings.
1. Masonry units: Cured for not less than 28 days when placed in structure and have a maximum linear shrinkage of 0.06% from saturated to over-dry condition, when tested according to methods published in Quality Control Standards of Concrete Masonry Association.
2. Colors: To be selected by Architect from manufacturer's full range of colors and textures.
- B. Portland cement: ASTM C150, Type II; standard brand, containing not more than 0.6% total alkali, where calculated as sodium oxide in accordance with ASTM C114. Use only one brand.
1. Plastic cement is not acceptable.
- C. Sand: ASTM C144. For grout, not less than 3% shall pass the No. 100 sieve.
- D. Pea gravel: ASTM C404. Clean, hard, containing not more than 5% by weight of flat, thin, elongated, friable, or laminated pieces; uniformly graded with not over 5% passing a No. 8 sieve to 100% passing a 3/8" sieve.
- E. Lime putty: Make from hydrated lime conforming to ASTM C207, Type S, pulverized to such fineness that 100% will pass a 50 mesh sieve. Mix lime in water, run through screen into box, and age 48 hours.
- F. Reinforcing steel: ASTM A615, Grade 60 except rebar sizes. No. 3 and No. 4 may be grade 40.
- G. Water: Clean; from a source intended for domestic consumption.
- H. Admixtures: Red Label for mortar, and Grout Aid Type II for grout, both by Sika Corporation. Use is at Contractor's option.
- I. Concrete cap: Size as shown on drawings. Color to match adjacent CMU.

2.3 MORTAR AND GROUT

- A. Mixes: Design by a testing laboratory, select and pay for by Contractor.
1. Plastic cement is not acceptable.
- B. Compressive strengths at 28 days shall be as shown on the structural drawings. If not shown, use the following as a minimum:
1. Typical walls.
- | | |
|-------------------------|----------|
| a. Block Units | 2600 psi |
| b. Mortar (Type M or S) | 2400 psi |

c. Grout 2700 psi

- C. Mixing: Mix water, and cement for two minutes, then add lime and admixture, continue mixing in a mechanically operated batch mixer; a continuous mortar mixer will not be permitted. Mix to maintain a slump of from 2 1/2" to 3".
- D. Discard mortar and grout not used within 30 minutes after leaving mixer. Retempering of mixture shall not be allowed.

2.4 QUALITY CONTROL OF MASONRY CONSTRUCTION

- A. The compressive strength of concrete masonry shall be determined by the **PRISM TEST METHOD** prior to the start of construction and during construction per CBC, section 2105A.2.2.2.
- B. Mortar and grout sample shall be taken for test to establish whether the masonry components meet the specified component strengths per CBC, section 2105A.5.
- C. Masonry core test shall be performed to determine the quality of the masonry constructed per CBC, section 2105A.4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine adjacent construction and supports. Verify that surfaces are within allowable tolerances, plumb, level, clean, and will provide solid anchoring surfaces.
- B. Correct conditions detrimental to proper or timely completion of this work before proceeding with installation.

3.2 SCAFFOLD AND PROTECTION

- A. Provide and maintain scaffolding, staging and forms of protection necessary for execution of work, as required, substantially constructed, moved and dismantled as necessary to properly follow sequence of operations.

3.3 SHORES AND CENTERING

- A. Provide shores and centering for work, constructed true to required shape, size and form, well braced and made rigid, and capable of supporting and sustaining loads to which subjected. Leave shores and centering in place until the masonry is sufficiently set to safely carry its own weight and added loads of construction.

3.4 PLACING REINFORCEMENT

- A. Reinforcement steel, except dowels in other material. Accurately set and place strictly as shown or noted. In spaces containing reinforcement, except small rods or mesh one-quarter inch or less in diameter, the clear distances between masonry and the reinforcement shall be at least 1/4".
 - 1. Vertical bars: Continuous from bottom of cell to top of wall, centered in cells, except where otherwise shown on drawings. Where necessary, hold vertical steel firmly in place by frames or other suitable devices as reviewed and accepted.
 - 2. Horizontal bars: Wire temporarily above exact position and tag to correct locations shown on drawings. Use calibrated vertical markers to indicate correct location. Provide horizontal bars where shown on drawings, held in contact to vertical bars or dowels.

3.5 PREPARATION

- A. Previously placed concrete or masonry: Clean of encrustation, laitance, oil, and coatings which would reduce bond, including sandblasting as required. Clean thoroughly and roughen contact surfaces of all foundations and floors that are to receive masonry work, before start of laying masonry units. Protect roughened surface during construction to assure a good bond between grout fill and concrete surface. Wash surfaces thoroughly with water under pressure; leave surfaces damp where masonry units connect with earlier placed work.
- B. Masonry units: Thoroughly clean of dust, grease, oil or other matter which would reduce bond.
- C. Wetting: Protect concrete masonry unit against wetting before installation.
- D. Reinforcement: Clean of mill scale; loose rust, oil and coatings which would reduce bond.
- E. Obtain approval of methods of placement and fastening of reinforcement prior to start of work.

3.6 BONDING

- A. Masonry bonding to concrete: Clean top surface of concrete. Remove laitance and expose aggregates before placing masonry units.
- B. Lay up wall in straight uniform courses with regular running bond or as shown on drawings.

3.7 GROUTING - LOW LIFT

- A. Low-lift grout if used shall conform to CBC, Section 2104A.6.1.1.2 and Section 2104A6.1.2.2.
- B. Prior to grouting, clean grout space so that all spaces to be filled with grout do not contain mortar projections greater than 1/2", mortar drippings or other foreign material.
- C. Maximum lift: 4 feet.
- D. Grouting of the wall: Complete in one day, with no interruptions greater than one hour.
- E. Fill all cells and spaces with grout.
- F. Consolidate grout by mechanical vibration or other means which are approved by Division of State Architect, during placing, before loss of plasticity, in a manner to fill grout space without contacting reinforcing. Mechanical vibration requires use of high frequency vibration equipment producing 10,000 cycles per second, minimum, and sized as required.

3.8 GROUTING - HIGH LIFT

- A. High-lift grout shall conform to CBC, Section 2104A.6.1.2.1 and Section 2104A6.1.2.3.
- B. Construction requirements of high-lift grouted wall shall be per CBC, Section 2104A.6.2.
- C. Additional requirements for high-lift grouted wall construction shall be per DSA IR 21-2.

3.9 BLOCK LAYING (GENERAL)

- A. Notes: General Notes on structural drawings are part of this Section.
- B. Preserve unobstructed vertical continuity of cells to be filled. Fully bed webs and cross-walls forming such cells in mortar to prevent leakage of grout. Strike joints around such cells smooth.

- C. Fractional parts of masonry units are prohibited where whole units can be used. Chinking of interstices with fragments will not be allowed. Provide special units as necessary to form opening and lintels.
- D. Install lintel units at lintels, corner units at corners.
- E. No miters are permitted. No exposed cells are permitted.
- F. No part of any masonry wall may be carried more than 3 feet higher than adjoining portions.
- G. Where it is absolutely necessary, for construction purposes, to stop off longitudinal runs of masonry, stop off only racking back one-half unit length in each course. Toothing will not be permitted.
- H. Execute masonry work according to best standards of practice for trade. Erect masonry plumb, square, straight and true to indicated lines, position and dimensions and in level courses.
- I. Make provision for special units as required to form bond beams, openings and offsets and maintain a proper bond throughout entire length of wall.
- J. Masonry units: Sound, dry, clean and free from cracks when placed in the structure.
- K. Do not wet masonry units except in very dry weather, moisten contact surfaces of units immediately before laying.
- L. Cut units accurately to fit openings for other work. Cut and patch holes neatly and accurately.
- M. If it is necessary to move a unit after it has been once set in place, remove unit from wall, clean and set in fresh mortar.
- N. Where necessary to cut concrete masonry units in order to conform to adjacent construction or to indicate joint pattern, saw masonry units with diamond or other abrasive saw to produce a straight, sharp edge without spalling or other defects. Cut units as required to maintain uniform joint widths throughout.
- O. When possibility of rain occurs, cover tops of all walls exposed to weather, and all concrete masonry units with sheets of polyethylene, or other reviewed and accepted effective forms of protection, to prevent absorption of water. Store masonry units above ground if there is a possibility of surface flooding exists.

3.10 JOINTS

- A. Exterior joints: Point mortar joints flush, using a pointing trowel, and then tool to a slight concave profile, making solid, smooth, watertight joints.
- B. Interior joints: Strike flush and sack as work progresses.
- C. Unless otherwise shown, make joints 3/8" thick with full mortar coverage on face shells and on webs surrounding cells to be filled.
- D. Set lintels, capping units and bearing plates in a full bed of mortar.

3.11 BOLTS, ANCHORS AND REGLETS

- A. Set bolts, anchors, reglets, and inserts necessary for attachment of subsequent work, and items furnished under other sections. Provide a minimum of 1" grout around all anchor bolts.

3.12 POINTING AND CLEANING

- A. Leave exposed surfaces clean and free of surplus mortar or foreign material. Exercise care to keep grout and mortar droppings off finished surfaces.
 - 1. Defective joints: Point holes or defective mortar joints, in exposed masonry, and where necessary, cut out defective joints and repoint.
 - 2. Staining and excess mortar: Protect exposed masonry against staining. Where grout or mortar does contact faces of masonry, remove it immediately. Where accidental spillage occurs, wash and clean surfaces immediately.

3.13 FIELD QUALITY CONTROL

- A. Contact testing laboratory to test mortar and grout to extent required by governing code. Core testing per CBC 2007, Section 2105A.4 and Section 2105A.5.
- B. Whenever there is any evidence that materials to be used in masonry construction do not conform to the Contract Documents, test materials for compliance before being used in project.
- C. District will pay for tests if they prove compliance with Contract Documents; otherwise costs of tests shall be paid by Contractor.
- D. Continuous inspection: As required by structural drawings.

END OF SECTION

SECTION 04 22 23
ARCHITECTURAL CONCRETE MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Architectural concrete masonry exterior wall veneer facing.
- B. Architectural concrete masonry exterior single wythe walls.

1.2 RELATED SECTIONS

- A. Section 04 22 00 – Concrete Masonry Unit (CMU)
- B. Section 04 21 15 – Adhered Lightweight Masonry Veneer
- C. Section 05 50 00 - Metal Fabrications
- D. Section 07 62 00 - Sheet Metal Flashing and Trim
- E. Section 07 17 75 – Water Repellent
- F. Section 07 90 00 - Joint Sealants
- G. Section 09 96 23 – Anti-Graffiti Coating - Clear

1.3 REFERENCES

- A. ASTM C 33 - Standard Specification for Concrete Aggregates.
- B. ASTM C 90 - Standard Specification for Loadbearing Concrete Masonry Units.
- C. ASTM C 140 - Standard Specification for sampling and testing Concrete Masonry Units.
- D. ASTM C 150 - Standard Specification for Portland Cement.
- E. ASTM C 595 – Standard Specification for Standard Hydraulic Cements
- F. ASTM C 331 - Standard Specification for Lightweight Aggregates for Concrete Masonry Units.
- G. ASTM C 1019 - Standard Test Method for Sampling and Testing Grout.
- H. ASTM C 1093 - Standard Practice for Accreditation of Testing Agencies for Masonry.
- I. ASTM C 1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
- J. ASTM C 1506 - Standard Test Method for Water Retention of Hydraulic Cement-Based Mortars and Plasters.
- K. ASTM D 2287 - Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
- L. ASTM E 514 - Standard Test Method for Water Penetration and Leakage Through Masonry.

- M. TMS 402 / 602-16 - Building Code Requirements and Specifications for Masonry Structures.
- N. NCMA TEK Bulletin 3-3A - Reinforced Concrete Masonry Construction.
- O. NCMA TEK Bulletin 8-2A - Removal of Stains from Concrete Masonry Walls.
- P. NCMA TEK Bulletin 10-2B - Control Joints for Concrete Masonry Walls.
- Q. NCMA TEK Bulletin 14-4A - Strength Design of Concrete Masonry.
- R. NCMA TEK Bulletin 19-4A - Flashing Strategies for Concrete Masonry Walls.
- S. NCMA TEK Bulletin 19-5A - Flashing Details for Concrete Masonry Walls.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

- A. Concrete Unit Masonry Construction: Comply with the following:
 - 1. TMS 602-16 - Building Code Requirements and Specifications for Masonry Structures.
 - 2. National Concrete Masonry Association (NCMA) TEK Bulletins.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods including written plan for cold and hot weather construction and masonry cleaning procedures.
- C. Selection Samples: Submit three full size units of each type/color of exposed architectural concrete masonry unit for review of color and texture to verify compliance with products specified. Provide the maximum color and texture variation range expected in the finished work. Production orders may be released after submittals are approved.
- D. Manufacturer's Certificates and Test Reports: Certify products meet or exceed specified requirements. Test reports should be within 12 months of bid date.
- E. Mix Designs: For each type of grout. Include description of type and proportions of ingredients.
 - 1. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum ten years documented experience and a current member in good standing of the National Concrete Masonry Association.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience with projects of similar scope and complexity.
- C. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of masonry work.
- D. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- E. Source Limitations: Provide each type of masonry unit from a single manufacturing source

to ensure uniform texture and color for continuous and visually related items.

- F. Mock-Up: Prior to starting masonry work build sample wall panel(s) for Architect's inspection and acceptance. Build panel(s) on a firm foundation, in location acceptable to the Architect. Panel(s) shall be L-shaped, with long side a minimum of 5 foot 4 inches long by 4 foot 0 inches high and with one corner return at least 2 foot 0 inches long. Construct sample panel(s) full thickness, installing wall reinforcement, anchors, ties and other required accessories. Provide special features as directed for control joints, weeps, etc. Panel(s) shall show color range and texture of masonry units, bond, mortar joints and workmanship to be expected for the project.
 - 1. Build sample panels for:
 - a. Each type of exposed unit masonry construction.
 - b. Typical exterior wall.
 - c. Typical interior wall.
 - d. Typical exterior and interior walls.
 - 2. Clean one-half of each sample panel using approved masonry cleaning materials and methods to represent final cleaning. Remaining one-half to remain without final cleaning for comparison purposes.
 - 3. Retain sample panels during construction as a standard for judging completed masonry work. Do not alter, move, or destroy sample panels until work is completed or removal is authorized.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver architectural concrete masonry units to the job site on wood pallets with manufacturer's recommended unit protective covers.
- B. Inspect architectural concrete masonry units upon delivery to ensure color match with required materials and accepted samples.
- C. Stack masonry units in a dry place off the ground on pallets or a prepared plank platform. Method of stacking is acceptable. Protect with non-staining waterproof tarpaulin coverings arranged to allow air circulation around and above masonry units.
- D. Exercise care in the storage, handling and installation of masonry units. Do not build soiled or damaged masonry units into the work.

1.8 SEQUENCING

- A. Ensure that locating templates and other information required from others for built-in installation of products of this section are furnished in time to prevent interruption of construction progress.

1.9 PROJECT CONDITIONS

- A. Follow hot weather and cold weather requirements in the masonry code and specifications, TMS 402 and TMS 602.
- B. Cold Weather Procedures:
 - 1. Preparation:
 - a. If ice or snow has formed on the masonry bed, remove it by carefully applying heat not to exceed 120 degrees F until the surface is dry to the touch.
 - b. Remove any block units or mortar that is frozen or damaged.
 - 2. Work in Progress:
 - a. Air temperature 40 degrees F to 32 degrees F:
 - 1) Heat sand or mixing water to produce mortar temperatures that match air

- temperature.
- b. Air temperature 32 degrees F to 25 degrees F:
 - 1) Heat sand and mixing water to produce mortar temperatures between 40 degrees F and 120 degrees F.
 - 2) Maintain temperature of mortar on boards above freezing.
 - 3) Installation in colder air temperatures will require heat sources on the wall and the use of windbreaks or tents to create a controlled environment suitable for proper bonding and curing.
- 3. Completed Work and Work Not in Progress:
 - a. Mean daily air temperature of 40 degrees F to 32 degrees F: Protect masonry from rain and snow for 24 hours by covering with a weather-resistive membrane.
 - b. Mean daily air temperature of 32 degrees F to 25 degrees F: Cover masonry with a weather-resistive membrane for 24 hours.
 - c. Mean daily air temperature of 25 degrees F to 20 degrees F: Cover masonry with insulating blankets for 24 hours.
- C. Hot Weather Procedures:
 - 1. When ambient temperature exceeds 90 degrees F and wind exceeds 8 miles per hour:
 - a. Maintain temperature of mortar and grout between 70 degrees F and 120 degrees F.
 - b. Limit the spread of the mortar bed to 4 feet and place units within 1 minute of spreading mortar.
 - c. Control moisture evaporation in partially or newly completed walls by fog spraying with potable water, covering with opaque plastic or canvas or both.
 - 2. Protection of Work in Progress:
 - a. Covering:
 - 1) Cover tops of walls with a strong waterproof membrane at the end of each day or work shutdown. Extend the waterproof membrane cover a minimum of 24 inches down the side of each wall.
 - 2) Hold cover securely in place.
 - b. Load Application:
 - 1) Do not apply uniform floor or roof loading for at least 12 hours after completing columns and walls.
 - 2) Do not apply concentrated loads for at least 3 days after completing columns and walls.
 - c. Staining:
 - 1) Prevent grout and mortar from staining the face of masonry.
 - 2) Remove grout and mortar that comes in contact with masonry units immediately.
 - 3) Protect sills, ledges and projections from mortar droppings.
 - 4) Protect base of wall from rain-splashed mud and mortar splatter.
 - 5) Turn scaffold boards on edge when work is not in progress to lessen splattering.
- D. Coordination: Coordinate Work to ensure top of wall is covered and remains covered until properly block openings are protected with coping or finishing system indicated on the Drawings

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer:
 - ORCO Block & Hardscape Stanton, CA, www.orco.com
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 63

00 - Product Requirements.

2.2 MATERIALS

- A. Aggregate:
 - 1. ASTM C 33 normal weight aggregate.
 - 2. ASTM C 331 lightweight aggregate.
- B. Cement: ASTM C 150 or ASTM C 595, Type required. Color, White/Grey as required for use with the color specified.
- C. Water Repellent Admixture: Integral polymeric water repellent admixture for concrete masonry units used in masonry exposed to the exterior. Acceptable products:
 - 1. Master Builders: MasterPel Integral Water Repellent
 - a. Water resistance: ASTM E 514
- D. Color Pigments: Lightfast, alkali-resistant, weather-resistant natural or synthetic iron oxides manufactured specifically for use in concrete masonry units.

2.3 ARCHITECTURAL CONCRETE MASONRY UNITS

- A. Hollow Load Bearing Units:
 - 1. Masonry units shall meet ASTM C 90:
 - 2. Provide unit type and size(s) indicated on the drawings. 10x8x16 Hi-RH Pre-Insulated w/Vertical Score, 10x8x16 Hi-RH Pre-insulated 301, 8x8x16 MW OEBC, 10x8x16 MW w/Vertical Score, 10x8x16 MW 301. All in a Precision Finish.
 - 3. Unit Color and Texture: As indicated on drawings.
 - 4. Unit Weight: Medium weight / Light Weight / Normal Weight.
 - 5. Unit Compressive Strength: Minimum net area compressive strength of 2,500 psi unless otherwise indicated.
- B. Pre-installed two-piece, interlocking, concrete masonry unit Insulation.
 - 1. KORFIL Hi-R-H manufactured by Concrete Block Insulation Systems, Inc.
 - 2. Physical Properties of EPS:
 - a. Typical Density (lbs/cu.ft.) Min.: 1.05-1.50
 - b. Thermal Resistance (R) per inch: 5.00
 - c. Water Vapor Permeance: 1.10
 - d. Water Absorption% volume: <1.00
 - e. Flame Spread Rating: <5.00
 - 3. Additional Properties of EPS Inserts:
 - a. Rot and Vermin resistance: Produced from expanded polystyrene – full resistant to rot; does not attract vermin, termites or rodents.
 - b. Components: Insulation shall contain no fluorocarbons and no formaldehyde.
 - c. Shape: Two-piece, interlocking insert shall overlap at both head & bed joints with edges of adjacent inserts of the same type.
- C. Special shapes:
 - 1. Provide closures, jamb units, headers, lintels, bond beams and other special shapes as indicated.
 - 2. Provide standard manufactured sizes or cut full size units for fractional course height and lengths.

2.4 MASONRY ACCESSORIES

- A. Mortar shall be ORCO Blended Products Type S or MAC pre-blended mortar, unless otherwise indicated. Preblended mortars shall meet the property specification of ASTM C

- 270.
1. Mortar color and type: OBP Type S MAC Color to Match Block
 2. Comply with manufacturer's instructions for mixing and mortar preparation.
- B. Provide water repellent admixture for exterior wall mortar.
1. Water Repellent Mortar Admixture: Shall be MasterPel dry mortar admixture. Admixture shall be incorporated into pre-blended ORCO Blended Products Type S or Type M mortar.
 2. Comply with manufacturer's instructions for mixing and mortar preparation.
- C. Masonry Anchorage and Reinforcement: Comply with applicable portions of TMS 602 Article 2.4, and/or Section 04 05 19.29 - Stone Anchors.
- D. Fabricated Steel Lintels: Comply with Section 05 50 00 - Metal Fabrications.
- E. Sheet Metal Flashing and Trim: Comply with Section 07 62 00 - Sheet Metal Flashing and Trim.
- F. Flexible Flashing: Comply with Section 07 65 26 - Self-Adhering Sheet Flashing.
- G. Foamed-in-place insulation materials and installation: Comply with Section 07 21 29 - Spray Foam Insulation.
- H. Control Joints:
1. Vinyl: ASTM D 2287.
- I. Weeps: Weeps are to be used in conjunction with flashing materials for proper functioning of the masonry wall drainage system. Specified weep material is:
1. Weep holes, weep tubes, plastic vents or cells in veneer wall systems such as from Hohmann & Barnard, or equivalent.
- J. Masonry Cleaning Materials: Standard-strength proprietary masonry cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new concrete masonry without discoloring or damaging masonry surfaces. Provide cleaning product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units.
- K. Masonry Sealing Materials: Provide cleaning material manufacturer's compatible masonry sealer coating for all single wythe concrete masonry exterior walls.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, structure and installation conditions. Do not proceed with architectural concrete masonry work until unsatisfactory conditions have been corrected.
- B. Verify items provided by other Sections of work are properly sized and located.
- C. Verify that items to be built in are in proper location, and ready for roughing into masonry work.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean substrate surfaces thoroughly prior to installation.
- B. Establish lines, levels and coursing. Verify anchors and flashings are correctly located and installed.
- C. Furnish temporary bracing as required during installation of masonry work. Maintain in place until building structure provides permanent support.
- D. Do not wet concrete masonry units except as per TMS 402/602
- E. Prepare surfaces using the methods recommended by the manufacturer for achieving the

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Layout walls in advance for accurate spacing of surface bond patterns, with uniform joint widths and to properly locate openings, movement type joints, returns and offsets. Whenever possible, avoid the use of less than half-size units at corners, jambs and other locations. Notify Design Professional when split masonry coursing at heads and sills of openings and cut concrete masonry coursing less than 4 inches in height not permitted.
- C. Lay up walls plumb and true to comply with specified tolerances. Provide square corners, except as otherwise indicated, with courses level, accurately spaced and coordinated with other work. Use double lines at multiple wythe walls.
- D. Pattern bond: Lay exposed concrete unit masonry in running bond with vertical joint in each course centered on units in courses above and below. Bond and interlock each course of each wythe at corners. Do not use units with less than 4 inches of horizontal face dimensions at corners or jambs. Install special shape units where indicated.
- E. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings, load bearing walls, all courses of piers, columns and pilasters and where adjacent to cells or cavities to be reinforced or filled with concrete or grout. Maintain 3/8 inch nominal joint widths, except as necessary at first course bed joints, and except for minor variations required to maintain bond alignment
- F. Lay solid concrete masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints
- G. Compress and cut joints flush for masonry walls that are below grade, concealed or covered by other materials.
- H. Tool joints in all exposed masonry work to a concave joint when thumb print hard, unless plans indicate otherwise.
- I. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.
- J. Step back unfinished work adjoining new work. Rack back 1/2 unit length in each course; do not tooth. Clean exposed surfaces of set masonry and remove loose masonry units and mortar before laying fresh masonry.
- K. Provide interlocking masonry bond in each course at corners and intersecting walls, unless otherwise indicated on plans such as for stack bond.
- L. Load-bearing walls: If carried up separately, provide rigid steel anchors spaced not more

than 2 feet on center vertically. Embed ends in mortar filled cores. Build full height of story to underside of structure. Grout juncture with structure solid with grout.

- M. Non load-bearing walls: Build full height of story to underside of structure, except as otherwise shown. Terminate full height non load-bearing walls one joint thickness below the structure to allow for deflection of the structural element without loading the wall. Provide an open joint for application of joint sealant.
- N. [If Applicable:] Pre-installed two-piece, interlocking Concrete Masonry Unit Insulating Inserts:
1. General: Inserts shall be pre-installed by CMU manufacturer prior to delivery to jobsite.
 2. Unless otherwise indicated on Construction Documents, inserts shall be left in place when grouting.
- O. As the work progresses, build in items specified under this and other Sections of the specifications. Fill in solidly with masonry around built-in items.
1. Bed hollow metal frame anchors in mortar. Align anchors with joint coursing. Draw anchors tight and fill space between hollow metal frames and masonry solid with fine mortar grout.
 2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath or other approved material, in the joint below and rod grout into core.
 3. Provide solid masonry bearing for all lintels, beams, joists, plates and load-bearing members.
 - a. Provide solid masonry units or hollow units filled solid.
 - b. Minimum one block course under steel angle lintels and steel joists not bearing on bond beams.
 - c. Minimum two block courses under steel beams and steel beam lintels. Where beams and lintels are parallel with wall, extend solid bearing to walls, extend solid bearing 16 inches each side of centerline of beam.
 4. Take particular care to embed all conduits and pipes within concrete masonry without fracturing exposed shells and to fit units around switch, receptacle and other boxes set in walls. Where electric conduit, outlets, switch boxes and similar items occur, grind and cut units before building in services.
 5. Install anchors and reglets for flashing and related work built into masonry work.
 6. Install reinforcing steel and grout where indicated. Comply with Drawing details for reinforcing [steel size and spacing.
- P. Anchor masonry to structural members where masonry abuts or faces such members to comply with the following:
1. Provide an open space not less than 1/2 inch width between masonry and structural member. Keep open space free of mortar or other rigid materials.
 2. Anchor masonry to structural members with metal ties embedded in masonry joints and attached to the structure. Provide anchors with adjustable tie sections. Space anchors not more than 24 inches on center vertically and 36 inches on center horizontally.
 3. Anchor veneers to concrete structural members with dovetail anchors.
- Q. Control Joints: Provide control joints for exterior masonry construction.
1. Provide sash blocks with premolded shear key. Rake out mortar, if any, and form continuous vertical joints in masonry construction to receive joint sealant at the locations listed below.
 2. Locate control joints as indicated on the Drawings.
- R. Bond Beams: Install bond beams where indicated. Comply with Drawings for reinforcing steel size and spacing. Fill bond beam masonry units solid with concrete fill or coarse mortar grout. Use smooth dowels to allow for horizontal movement at control joints unless

otherwise indicated on the Drawings.

- S. Lintels:
 - 1. Install loose steel lintels furnished under Section 05 50 00 - Metal Fabrications Metal Fabrications where shown. Set lintels in full bed of mortar.
 - 2. Provide minimum bearing at each jamb of 4 inches for openings for less than 6 feet and 8 inches for wider openings
- T. Flashing and weeps: Install flashing as specified in Section 07 62 00 - Sheet Metal Flashing and Trim or Section -
 - 1. Install concealed through wall masonry flashing at all cavity and veneer wall sills, masonry openings in exterior walls with masonry above head, over all horizontal steel members built into masonry and elsewhere as indicated. Comply with SMACNA "Architectural Sheet Metal Manual" Chapter 4 Flashing recommendations and with NCMA TEK Bulletins 19-4A and 19-5A details to ensure water resistant masonry construction.
 - 2. Install weeps in head joints of final course of exterior masonry wythe above flashing. Space weeps maximum of 24 inches on center horizontally with exterior ends and located to avoid door openings. Install weeps at head joints with outside face of weep material held 1/8 inch from the finish face of masonry unit.
 - 3. Install cavity fill on top of base flashing. Install a bed of mortar, conforming to the curve of the flashing, placed under the metal flashing.
 - 4. Install vents in head joints of final top course exterior masonry veneer wythe. Install at head joints with outside face of vent material held 1/8 inch from the finish face of masonry unit. Space vents 24 inches on center horizontally.
 - 5. Install compressible joint material at lintels and horizontal steel members. Build in joint fillers and seal with joint sealant specified in Section 07 90 00 - Joint Protection.

3.4 REINFORCED CONCRETE MASONRY

- A. Fill scheduled wall and column masonry work. Fill all cores solid with concrete fill/coarse masonry grout as specified in Section 04 05 16.26 - Engineered Masonry Grouting.
 - 1. Grouting: Comply with TMS 602 grout placement requirements. Consolidate grout at time of placement.
 - a. Low-Lift Grouting: Place concrete fill/coarse masonry grout in maximum 5-foot vertical lifts.
 - b. High-Lift Grouting (If Approved): Place concrete fill/coarse masonry grout in maximum 12 foot vertical lifts (Recommend the use of super plasticizer with hi-lift grout).
 - 2. Recess top of grout fill minimum 1-1/2 inches below top of course to form a key with following lift.
 - 3. Where vertical reinforcing is required, install reinforcing before filling operation. Wet sticking of reinforcing is not permitted. Comply with Drawing details for reinforcing steel size and spacing.
- B. Install bond beams where indicated. Install reinforcing before filling operation. Fill units solid with grout. Comply with drawing details for reinforcing steel size and spacing.

3.5 REPAIR AND POINTING

- A. Clean and point exposed architectural concrete masonry at end of each working day. Remove and re- place masonry units that are loose, chipped, broken, stained, or otherwise damaged. Provide new units to match adjoining units and install in fresh mortar pointed to eliminate evidence of replacement.
- B. During the tooling of joints, enlarge any voids or holes, except weeps and completely fill with mortar. Point up all joints at corners, openings and adjacent work to provide a neat, uniform

appearance. Remove line pins and fill all line pin holes.

- C. Wipe off excess mortar as the work progresses. Dry brush with bristle brushes exposed masonry at the end of each day's work. Remove mortar spatters and joint ridges.

3.6 QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Testing Prior to Construction: One set of tests.
- C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- E. Mortar Test (Property Specification): According to ASTM C 270.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.7 CLEANING

- A. Cut out defective mortar joints and holes in exposed masonry and re-point with mortar of matching color and texture. Commence cleaning of the masonry walls as soon as the mortar is thoroughly set and cured. After mortar has cured for a period of 7 days (and no later than 14 days after completion of installation), the cleaning process can begin.
- B. Demonstrate the cleaning procedure on the sample panel at the job site prior to commencing cleaning on the building. When the sample panel is cleaned to the approval of the Architect, and the walls are complete, clean the building with the approved cleaning method.
- C. Protect adjacent and surrounding surfaces not intended to be cleaned from exposure to the cleaning chemical to prevent damage.
- D. Prevent cleaning chemical from coming into contact with people, motor vehicles, landscaping and other building materials that could be harmed by such contact. Follow Masonry cleaner Manufacturers' recommendations for personal protection.
- E. Clean the exposed masonry surfaces of stains, efflorescence, mortar, grout dropping and debris using methods that do not damage the masonry. Do not use high pressure cleaning or aggressive scrubbing after cleaner application.
- F. The results of the cleaning process shall be inspected by the project Architect or authorized owner representative for acceptance after the walls have dried. For cleaning results to be accepted, the walls must comply with the standard set for the cleaning results on the sample panel, and the walls shall be free from mortar or efflorescence stains, and the color and texture of the finished walls shall not show damage, discoloration or staining from the cleaning process. If such damage or stains are present, then the walls must be cleaned and color corrected, as needed, to remove any such stains, discoloration or damage prior to the application of Coatings
- G. After cleaning allow units to dry and when specified apply a sealer as provided in Section 3.8.

3.8 COATING:

- A. After the results of the cleaning process have been fully accepted by the Architect, apply a colorless, non-staining, non-yellowing, breathable, penetrating water and anti-graffiti repellent coating. Repellent shall be applied to the exterior exposed surface of the concrete masonry walls. Water-repellents must be capable of performing over hairline cracks and small voids less than 1/16". "Film Forming" Acrylic sealers will not be allowed. The water-repellent must not alter the color or texture of the wall after the material has fully cured. Water-repellent must be low VOC water or solvent based. Follow manufacturer's application recommendations.

3.9 PROTECTION

- A. Protect installed products until completion of project.
 - 1. Protect top of wall until covered or capped to a waterproof condition by subsequent construction.
 - 2. Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Remove immediately any grout, mortar, and soil that comes in contact with such masonry
 - 3. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
 - 4. Protect sills, ledges, and projection from mortar splatter and dropping.
 - 5. Protect surfaces of windows and door frames; as well as similar products with painted and integral finishes from mortar splatter and dropping
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

**SECTION 05 12 00
STRUCTURAL STEEL**

1.00 GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY:

- A. Extent of structural steel work is shown on drawings, including schedules, notes and details to show size and location of members, typical connections, and type of steel required.
- B. Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown on drawings.
- C. Miscellaneous Metal Fabrications are specified elsewhere in Division 5.
- D. Refer to Division 3 for anchor bolt installation in concrete; Division 4 for masonry.
- E. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
 - 1. Promptly remove and replace materials or fabricated components which do not comply.
- F. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.
 - 1. Promptly notify Architect whenever members and connections for any portion of structure are not clearly indicated.

1.03 SUBMITTALS:

- A. Product Data: Submit producer's or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).
 - 1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.
 - 2. Structural steel primer paint.
 - 3. Shrinkage-resistant grout.
- B. Shop Drawings: Submit shop drawings prepared under supervision of a registered professional engineer, including complete details and schedules for fabrication and assembly of structural steel members, procedures and diagrams.

- C. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS A2.1 and A2.4 symbols, and show size, length, and type of each weld.
 - 1. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of others sections.
- D. Test Reports: Submit copies of reports of tests conducted on shop and field bolted and welded connections. Include data on type(s) of tests conducted and test results.

1.04 QUALITY ASSURANCE:

- A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:
 - 1. AISC "Code of Standard Practice for Steel Buildings and Bridges".
 - 2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including "Commentary" and Supplements thereto as issued.
 - 3. AISC "Specifications for Architecturally Exposed Structural Steel".
 - 4. AISC "Specifications for Structural Joints using ASTM A325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
 - 5. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel".
 - 6. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".
- B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".
 - 1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
 - a. If recertification of welders is required, retesting will be Contractor's responsibility.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Deliver materials to site at such intervals to insure uninterrupted progress of work.
- B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not to delay work.
- C. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
- D. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

2.00 PRODUCTS

2.01 MATERIALS:

- A. Metal Surfaces, General: For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.
- B. Structural Steel Shapes, Plates and Bars:
 - 1. Wide flanges, ASTM A992.
 - 2. Plates, ASTM A36.
 - 3. Channels and angles, ASTM A36.
- C. Cold-Formed Steel Tubing: ASTM A 500, Grade B.
- D. Steel Pipe: ASTM A 53, Type E or S, Grade B; or ASTM A 501.
 - 1. Finish: Black, except where indicated to be galvanized.
- E. Anchor Bolts: ASTM F1554, Grade 36 and 105 headed bolts and threaded rods per drawings.
- F. Expansion bolt fasteners: Hilti Anchors per drawings.
- G. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular low-carbon steel bolts and nuts.
 - 1. Provide hexagonal heads and nuts for all connections.
- H. Electrodes for Welding: E-70 electrodes complying with AWS Code.
- I. Structural Steel Primer Paint: SSPC - Paint 13, or fabricator's standard rust-inhibiting primer.
- J. Non-metallic Shrinkage-Resistant Grout: Pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CE-CRD-C621.

2.02 FABRICATION:

- A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.
- B. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

- C. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.
- D. Connections: Provide welded or bolted connections, as indicated.
- E. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.
- F. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.
- G. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, where indicated.
- H. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.
- I. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.03 SHOP PAINTING:

- A. General: Shop paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel which is partially exposed on exposed portions and initial 2" of embedded areas only.
 - 1. Do not paint surfaces which are to be welded or high-strength bolted with friction-type connections.
 - 2. Do not paint surfaces which are scheduled to receive sprayed-on fire proofing.
 - 3. Apply two (2) coats of paint to surfaces which are in accessible after assembly or erection. Change color of second coat to distinguish it from first.
- B. Surface Preparation: After inspection and before shipping, clean steel work to be painted. Remove loose rust, loose mill scale, and spatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:
 - 1. SP-1 "Solvent Cleaning".
 - 2. SP-2 "Hand Tool Cleaning".
 - 3. SP-3 "Power Tool Cleaning".
 - 4. SP-5 "White Metal Blast Cleaning".
- C. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 1.5 mils. Use painting methods, which result in full coverage of joints, corners, edges and exposed surfaces.

2.04 EXPOSED STRUCTURAL STEEL COATING:

- A. All exposed structural steel members shall receive Kynar coating,. See specifications section 09 94 00.
- B. Structural steel framing members shall not require any fire-rated coating.

3.00 EXECUTION

3.01 ERECTION:

- A. Surveys: Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Architect. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been agreed upon with Architect.
- B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.
- C. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete work.
- D. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
- E. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
- F. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to grouting.
- G. Grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
 - 1. For proprietary grout materials, comply with manufacturer's instructions.
- H. Field Assembly: Set structural frames accurately to line and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces, which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
- I. Level and plumb individual members of structure with in specified AISC tolerances.
- J. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

- K. Splice members only where indicated on structural drawings.
- L. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.
- M. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
- N. Do not enlarge unfair holes in members by burning or by use of drift pins. Ream holes that must be enlarged to admit bolts.
- O. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in structural framing.
- P. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
- Q. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

3.02 QUALITY CONTROL:

- A. Owner will engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.
- B. Testing agency shall conduct and interpret tests and state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.
- C. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.
- D. Testing agency may inspect structural steel at plant before shipment; however, Architect reserves right, at any time before final acceptance, to reject material not complying with specified requirements.
- E. Correct deficiencies in structural steel work which inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as may be necessary to reconfirm any non-compliance of original work, and as may be necessary to show compliance of corrected work.
- F. Shop and Field Bolted Connections: Inspect or test in accordance with AISC specifications.
- G. Shop and Field Welding: Inspect and test during fabrication of structural steel assemblies, as follows:
 - 1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
 - 2. Perform visual inspection of all welds.

3. Perform tests of welds as follows:
 - a. Ultrasonic Inspection: ASTM E 164.

END OF SECTION

SECTION 05 30 00
METAL DECKING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Floor and roof metal decking.
2. Shear connector studs for composite decking construction.
3. Edge strips, closure strips and decking accessories.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 41 00 - Testing and Inspection.
3. Section 03 31 00 – Cast-In-Place Concrete.
4. Section 05 12 00 - Structural Steel Framing.
5. Section 07 62 00 - Sheet Metal Flashing and Trim.

1.02 REFERENCES

A. ASTM International (ASTM):

1. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
2. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
4. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
5. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.

B. American Welding Society (AWS):

1. AWS D1.1 - Structural Welding Code Sheet – Steel.
2. AWS D1.3 – Structural Welding Code Sheet – Sheet Steel.

C. American Iron and Steel Construction (AISI):

1. AISI – Specifications for the Design of Cold-Formed Steel Structural Members.

- D. Underwriters Laboratory (UL):
 - 1. UL – Fire Resistance Directory.

1.03 PERFORMANCE REQUIREMENTS

- A. Compute properties of deck sections on basis of effective design width as limited by provisions of the AISI specifications. Provide no less than deck section properties specified, including section modulus and moment of inertia per foot of width.
- B. Regulatory Requirements:
 - 1. Decking installed as part of a fire rated assembly shall meet the requirements of the applicable UL Fire Resistance Directory design number.
 - 2. Work of this section shall be in accordance with CBC.

1.04 SUBMITTALS

- A. Shop Drawings: Drawings, sections and details indicate type of decking, location, finish, gage of metal, arrangement of sheets, necessary fabrication to incorporate decking into the Work, and relationship to openings and flashing.
- B. Product Data: For each type of decking specified, including structural properties, dimensions, profiles and finishes.
- C. Welder Certificates: Signed by CONTRACTOR certifying that welders comply with the requirements specified under Article "Quality Assurance".

1.05 QUALITY ASSURANCE

- A. General: Metal decking steel shall conform to requirements of strengths and properties of standards specified.
- B. Qualifications of Welders: Properly certified for the type of Work involved in compliance with CBC requirements.
- C. Continuous inspection of welding will be performed by a special inspector. Refer to Section 01 41 00 - Testing and Inspection. The Project Inspector will be responsible for monitoring the work of the special inspector to ensure that the inspection program is satisfactorily completed.
- D. Identification of metal decking steel shall conform to the standards specified in this section and the Drawings.
 - 1. Fabricator shall furnish sufficient evidence to the ARCHITECT attesting compliance with specified requirements.
 - 2. Conform to CBC requirements. Unclassified or unidentified decking is not permitted. Furnish deck manufacturer's certified mill analyses and test reports for each heat covering decking having a minimum F_y of 33 Ksi. In addition, for decking having F_y greater than 33 Ksi, testing laboratory shall perform one tension and elongation test and one bend or flattening test for each gage.
- E. Unidentifiable Steel: Steel which is not readily identifiable as to grade from markings and test records is not permitted to be provided as part of the Work of this section.

- F. Manufacturers shall be members of Steel Deck Institute (SDI).

1.06 DELIVERY, STORAGE AND HANDLING

- A. Protect steel deck from corrosion, deformation and other damage during delivery, storage and handling.
- B. Deck bundles shall be stored off the ground, with one end elevated to provide drainage. Bundles shall be protected against condensation with a ventilated waterproof covering.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. ASC Steel Deck.
- B. Verco Manufacturing Co.
- C. Epic Metals Corporation.
- D. Equal.

2.02 MATERIALS

- A. Metal Decking:
 - 1. Roll-formed sheets conforming to ASTM A653, with G90 zinc coating.
 - 2. Section properties conforming to applicable provisions of latest edition of AISI - Specification for the Design of Cold-Formed Steel Structural Members.
- B. Flexible Closure Strips for Deck: Vulcanized, closed-cell, expanded chloroprene elastomer, complying with ASTM D1056, Grade SCE #41.
 - 1. Brittleness Temperature: Minus 40 degrees F, ASTM D746.
 - 2. Flammability Resistance: Self-extinguishing,
- C. Decking Accessories: Metal cover plates, sheet metal edging, metal closure strips, valley and ridge strips, seat angles, sump pans, flashings: 22 gage minimum, with ASTM A653, G90 zinc coating.
- D. Shear Connectors: Headed stud type, ASTM A108 Grade 1015, cold-finished carbon steel complying with AISC specifications.
- E. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035B and approved by the OWNER's Office of Environmental Health and Safety (OEHS).

2.03 FABRICATION

- A. Corrugated sheets or sections shall be designed to support required live load between supporting members.

- B. Provide decking in lengths to span over three or more supports.
- C. Except as detailed otherwise, provide decking with interlocking side laps, 2 ½-inch minimum end bearing, and 1 ½-inch minimum side bearing.
- D. Welding: Provide materials and methods in accordance with recommendations of steel decking manufacturer and reviewed submittals. Hold decking tight to the supporting elements with screws or other means for proper welding or crimping of the decking edges. Conform to AWS D1.3, and to the patterns and weld types indicated, with welds free from sharp edges and protrusions. Field coat welds and abraded surfaces at completion with an anodic type galvanizing repair paint. Omit the field paint coating where welds or abrasions are covered by concrete fill or sprayed fireproofing.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify supporting structure and existing conditions prior to starting work.
- B. Remove oil, dirt, paint, and rust from steel surfaces to which metal decking will be welded.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 OPENINGS

- A. Cut and reinforce units to provide openings which are located and dimensioned on the structural and mechanical Drawings.
- B. Provide openings, or other Work not indicated on the Drawings.

3.03 INSTALLATION

- A. Install metal decking in accordance with decking manufacturers' recommendations, requirements of Drawings, Shop Drawings, and Specifications.
- B. Install metal decking on supporting steel framework and adjust to final position before permanently fastening in place.
 - 1. Install each unit to proper bearing on supports.
 - 2. Install units in straight alignment for entire length of run of cells with close registration of cells of one unit with those of abutting unit.
- C. Fasten decking to steel framework at ends of units and at intermediate supports. Welding shall be as indicated on Drawings.
- D. Fasten side laps between supports as indicated on Drawings.
- E. Perform field cutting parallel with cells in area between cells, leaving sufficient horizontal material to permit welding to support steel.
- F. Weld shear connectors to supports thru decking units as required by Drawings. Weld only on clean, dry surfaces. Do not weld shear connectors thru two layers of decking units.

3.04 METAL FLASHINGS AND CLOSURES

- A. Furnish, install, and weld in position, sheet metal closure flashing, closure angles, closure plates, profile plates, and shear plates.
- B. Close open ends of cell runs at columns, openings, walls, similar interruptions and termination.

3.05 FIELD QUALITY CONTROL

- A. Install steel decking under continuous inspection according to CBC Section 1704A.
- B. Welding inspection for steel deck diaphragms shall conform to CBC Section 2204A.1.

3.06 CLEAN UP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.07 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

**SECTION 05 50 00
METAL FABRICATIONS**

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

1.02 SUMMARY

- A. This section includes the following metal fabrications:
 - 1. Rough hardware.
 - 2. Ladders.
 - 3. Ladder and safety cages.
 - 4. Ship's ladders.
 - 5. Stair Nosing.
 - 6. Loose bearing and leveling plates.
 - 7. Loose steel lintels.
 - 8. Miscellaneous framing and supports for the following:
 - a. Overhead doors.
 - b. Suspended toilet partitions.
 - c. Suspended folding partitions.
 - d. Suspended operable partitions.
 - e. Applications where framing and supports are not specified in other sections.
 - 9. Miscellaneous steel trim.
 - 10. Shelf and relieving angles.
 - 11. Metal bar gratings.
 - 12. Expanded metal gratings.
 - 13. Floor plate and supports.
 - 14. Tread plate and supports.
 - 15. Steel pipe railings.
 - 16. Cast treads and thresholds.

- 17. Metal stairs.
- 18. Pipe bollards.
- 19. Catwalks and Stage Rigging

B. Related Sections: The following sections contain requirements that relate to this section:

- 1. Division 5 Section "Structural Steel".
- 2. Division 5 Section "Handrails and Railings".

1.03 DEFINITIONS

A. Definitions in ASTM E 985 for railing-related terms apply to this section.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for products used in miscellaneous metal fabrications, including paint products and grout.
- C. Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.
- D. Samples representative of materials and finished products as may be requested by Architect.
- E. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" article.
- F. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project name, addresses, names of Architects and Owners, and other information specified.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm experienced in successfully producing metal fabrications similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.
- B. Installer Qualifications: Arrange for installation of metal fabrications specified in this section by same firm that fabricated them.
- C. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel," D1.3 "Structural Welding Code - Sheet Steel", and D1.2 "Structural Welding Code -Aluminum."
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.06 PROJECT CONDITIONS

- A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.

1.07 SEQUENCING AND SCHEDULING

- A. Sequence and coordinate installation of wall handrails as follows:
 - 1. Mount handrails only on completed walls. Do not support handrails temporarily by any means not satisfying structural performance requirements.
 - 2. Mount handrails only on gypsum board assemblies reinforced to receive anchors, and where the location of concealed anchor plates has been clearly marked for benefit of Installer.

2.00 PRODUCTS

2.01 FERRUS METALS

- A. Metal Surfaces, General: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.
- B. Steel Plates, Shapes, and Bars: ASTM A 36.
- C. Rolled Steel Floor Plates: ASTM A 786.
- D. Steel Bars for Gratings: ASTM A 569 or ASTM A 36.
- E. Wire Rod for Grating Cross Bars: ASTM A 510.
- F. Steel Tubing: Cold-formed steel tubing, ASTM A 500, Grade B.
- G. Uncoated Structural Steel Sheet: Product type (manufacturing method), quality, and grade, as follows:
 - 1. Cold-Rolled Structural Steel Sheet: ASTM A 611, Grade A, unless otherwise indicated.
- H. Uncoated Steel Sheet: Commercial quality, product type (method of manufacture) as follows:
 - 1. Cold-Rolled Steel Sheet: ASTM A 366.
- I. Galvanized Steel Sheet: Quality as follows:
 - 1. Structural Quality: ASTM A 446; Grade A, unless another grade required for design loading, and G90 coating designation unless otherwise indicated.
- J. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:
- K. Gray Iron Castings: ASTM A 48, Class 30.

- L. Malleable Iron Castings: ASTM A 47, grade 32510.
- M. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.
- N. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A 153.
- O. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for the metal alloy to be welded, and as indicated on drawings.
- P. Metal Mesh / Screen: McNichols 1" and 2" square, 24 gauge wire cloth or approved equal. Vinyl coating is optional.
- Q. 2" x 4" x 12.5 gauge welded wire mesh screen at Catwalks.

2.02 NONSHRINK NONMETALLIC GROUT

- A. Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout complying with CE CRD-C 621. Provide grout specifically recommended by manufacturer for type of application used.
- B. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include but are not limited to the following:
 - 1. "Masterflow 713"; Master Builders.
 - 2. "Five Star Grout"; U.S. Grout Corp.

2.03 FASTENERS

- A. General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A.
- C. Lag Bolts: Square head type, FS FF-B-561.
- D. Machine Screws: Cadmium plated steel, FS FF-S-92.
- E. Wood Screws: Flat head carbon steel, FS FF-S-111.
- F. Plain Washers: Round, carbon steel, FS FF-W-92.
- G. Drilled-In Expansion Anchors: Expansion anchors complying with FS FF-S-325, Group VIII (anchors, expansion, [non-drilling]), Type I (internally threaded tubular expansion anchor); and machine bolts complying with FS FF-B-575, Grade 5.
- H. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class, and style as required.
- I. Lock Washers: Helical spring type carbon steel, FS FF-W-84.
- J. Beam Clamps and Rigging Clamps

2.04 PAINT

- A. Shop Primer for Ferrous Metal: Manufacturer's or fabricator's standard, fast-curing, lead-free, universal modified alkyd primer selected for good resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure complying with performance requirements of FS TT-P-645.
- B. Galvanizing Repair Paint: High zinc dust content paint for re-galvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint-20.
- C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 except containing no asbestos fibers.
- D. Exposed steel shall have Kynar coating. See specifications section 09 90 00.

2.05 FABRICATION, GENERAL

- A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to properly complete the work. Work to dimensions indicated using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.
- B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- C. Shear and punch metals cleanly and accurately. Remove burrs.
- D. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Remove sharp or rough areas on exposed traffic surfaces.
- F. Weld corners and seams continuously to comply with AWS recommendations and 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 that no roughness shows after finishing and contour of welded surface matches those adjacent.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- H. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

- I. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. 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.
- J. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.
- K. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.06 ROUGH HARDWARE

- A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 sections.
- B. Fabricate items to sizes, shapes, and dimensions required. Furnish malleable-iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

2.07 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports for applications indicated or which are not a part of structural steel framework, as required to complete work.
- B. Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.

2.08 MISCELLANEOUS STEEL TRIM

- A. Provide shapes and sizes indicated for profiles shown. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings, and anchorages as required for coordination of assembly and installation with other work.

2.09 FLOOR PLATE AND TREAD PLATE

- A. Checkered steel plate-safety plate: U.S. steel's multigrip S- 400 or Inryco's 4-way medium pattern.

2.10 STEEL PIPE RAILINGS AND HANDRAILS

- A. General: Fabricate pipe railings and handrails to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacing, and anchorage. Handrails shall be 1.25" to 1.50" diameter steel pipe hot dip galvanized and Kynar painted per specification section 09 94 00. Handrails shall be mounted 1.50" clear from side walls. CBC Sections 1133B.4.2.5 and 1133B.5.5.1. All welded joints and surfaces shall be ground smooth, no sharp or abrasive corners, edges, or surfaces. Wall surfaces adjacent to handrail shall be smooth. CBC Sections 1133B.4.2.6 and 1133B.5.5.1
- B. Interconnect railing and handrail members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.

1. At tee and cross intersections, notch ends of intersecting members to fit contour of pipe to which end is joined and weld all around.
- C. Form changes in direction of railing members by bending to preserve the contour of the member.
 - D. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
 - E. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.
 - F. Close exposed ends of pipe by welding 3/16 inch thick steel plate.
 - G. Toe Boards: Where indicated, provide toe boards at railings around openings and at the edge of open-sided floors and platforms.
 - H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of railings and handrails to other work. Furnish inserts other anchorage devices for connecting railings and handrails to concrete or masonry work.
 1. For railing posts set in concrete fabricate sleeves from steel pipe with an inside diameter not less than 1/2 inch greater than the outside diameter of post, with steel plate closure welded to bottom of sleeve.
 - I. Fillers: Provide steel sheet or plate fillers of thickness and size indicated or required to support structural loads of handrails where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses. Size fillers to produce adequate bearing to prevent bracket rotation and overstressing of substrate.

2.11 CAST TREADS AND THRESHOLDS

- A. Fabricate units of material, sizes, and configurations indicated. If not indicated, provide cast-iron units with integral abrasive finish. Furnish in lengths as required to accurately fit each opening or conditions.
 1. Cast units with an integral abrasive grit consisting of aluminum oxide, silicone carbide, or a combination of both.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

American Abrasive Metals Co.
 American Mason Safety Tread Co.
 American Safety Tread Co., Inc.
 Armstrong Products, Inc.
 Safe-T-Metal Co., Inc.
 Wooster Products Inc.
- C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with the manufacturer.
- D. Apply black asphaltic coating to concealed bottoms, sides, and edges of cast-iron units set into concrete.

- E. Provide a plain surface texture, except where fluted or cross-hatched surfaces are indicated. Provide 2" contrasting color (70% recommended) warning stripe of material at least as slip resistant as the other treads of the stairs, 1" max. from edge of nosing and top landing. At interior stairs, provide warning stripe at top and bottom tread nosing only. At exterior stairs, provide warning stripe at top landing and all tread nosings. CBC Section 1133B.4.4

2.12 STEEL FRAMED STAIRS

- A. General: Construct stairs to conform to sizes and arrangements indicated. Join pieces together by welding, unless otherwise indicated. Provide complete stair assemblies, including metal framing, hangers, columns, railings, newels, balusters, struts, clips, brackets, bearing plates, and other components necessary for the support of stairs and platforms, and as required to anchor and contain the stairs on the supporting structure.
 - 1. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM "Metal Stair Manual" for class of stair designated, except where more stringent requirements are indicated:
 - a. Commercial class, unless otherwise indicated.
 - b. Architectural class where indicated.
 - 2. Fabricate treads and platforms of exterior stairs to accommodate slopes to drain in finished traffic surfaces.
- B. Stair Framing: Fabricate stringers of structural steel channels, or plates, or a combination thereof, as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to strings, newels, and framing members to strings and headers; fabricate and join so that bolts, if used, do not appear on finish surfaces. Provide temporary support for stairs as required during construction.
- C. Metal Pan Risers, Sub-treads, and Sub-platforms: Shape metal pans for risers and sub-treads to conform to configuration shown. Provide thicknesses of structural steel sheet for metal pans indicated, but not less than that required, to support total design loading.
 - 1. Form metal pans of uncoated cold-rolled steel sheet, unless otherwise indicated.
 - 2. Attach risers and sub-treads to stringers by means of brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting or bolting.
 - 3. Provide sub-platforms of configuration and construction indicated sub-platform by welding.
- D. Steel Floor Plate Treads and Platforms: Checkered steel plate - safety plate.
 - 1. Form treads of raised pattern steel floor plate with integral nosing and back edge stiffener. Weld steel supporting brackets to stringers and treads to brackets.
 - 2. Fabricate platforms of raised pattern steel floor plate of thickness indicated. Provide nosing matching that on treads at all landings. Secure with welds.

3. Provide 2" contrasting color (70% recommended) warning stripe of material at least as slip resistant as the other treads of the stairs, 1" max. from edge of nosing and top landing. At interior stairs, provide warning stripe at top and bottom tread nosing only. At exterior stairs, provide warning stripe at top landing and all tread nosings. CBC Section 1133B.4.4.

2.13 STEEL AND IRON FINISHES

- A. Galvanizing: For those items indicated for galvanizing and all exposed items at exterior locations, apply zinc-coating by the hot-dip process compliance with the following requirements:
 1. ASTM A 153 for galvanizing iron and steel hardware.
 2. ASTM A 123 for galvanizing both fabricated and un-fabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch thick and heavier.
- B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 1. Exteriors (SSPC Zone 1B): SSPC-SP6 "Commercial Blast Cleaning."
 2. Interiors (SSPC Zone 1A): SSPC-SP3 "Power Tool Cleaning:"
- C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finish or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC-PA1 "Paint Application Specification No. 1" for shop painting.

3.00 EXECUTION

3.01 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- B. Center nosing on tread widths with noses flush with riser faces and tread surfaces.
- C. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

3.02 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.
- D. 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 the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- E. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and 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 that no roughness shows after finishing and contour of welded surface matches those adjacent.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint or zinc chromate primer.

3.03 SETTING LOOSE PLATES

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

3.04 INSTALLATION OF SUPPORTS FOR TOILET PARTITIONS

- A. Anchor supports securely to, and rigidly brace from, overhead building structure.

3.05 INSTALLATION OF METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of NAAMM grating standard referenced under Part 2 that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

- B. Secure removable units to supporting members with type and size of clips and fasteners indicated, or if not indicated as recommended by grating manufacturer for type of installation conditions shown.
- C. Secure non-removable units to supporting members by welding where both materials are the same; otherwise, fasten by bolting as indicated above.
- D. Attach toe plates to gratings by welding, at locations indicated.

3.06 INSTALLATION OF STEEL PIPE RAILINGS AND HANDRAILS

- A. Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
 - 1. Anchor posts in concrete by means of pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with non-shrink, non-metallic grout, mixed and placed to comply with anchoring material manufacturer's directions.
 - a. Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8 inch build-up, sloped away from post. For installations exposed on exterior, or to flow of water, seal anchoring material to comply with grout manufacturer's directions.
 - 2. Anchor posts to steel by welding as shown.
 - 3. Anchor rail ends into concrete and masonry with steel round flanges welded to rail ends and anchored into wall construction with lead expansion shields and bolts.
 - 4. Anchor rail ends to steel by welding as shown.
- B. Secure handrails to wall with wall brackets and end fittings. Provide bracket with not less than 1-1/2 inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated. Secure wall brackets and wall return fittings to building construction as follows:
 - 1. Use type of bracket with pre-drilled hole for exposed bolt anchorage.
 - 2. For concrete and solid masonry anchorage, use drilled-in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.
 - 3. For wood stud partitions, use lag bolts set into wood backing between studs. Coordinate with stud installations for accurate location of backing members.
 - 4. For steel framed gypsum board assemblies, fasten brackets directly to steel framing or concealed anchors using self-tapping screws of size and type required to support structural loads.

3.07 INSTALLATION OF CAST TREADS AND THRESHOLDS

- A. Install cast treads and thresholds with anchorage system indicated to comply with manufacturer's recommendations.

- B. Seal thresholds exposed to exterior with elastomeric sealant complying with Division 7 Section "Joint Sealers" to provide a watertight installation.

3.08 ADJUSTING AND CLEANING

- A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touch-up of field painted surfaces.
 - 1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION

**SECTION 05 55 00
MISCELLANEOUS METALS**

PART 1 - GENERAL

- A. Requirements of Division 1 apply to this Section.

1.1 WORK INCLUDED

- A. Shapes, sleeves, anchors, connectors, plates, backing plates, supports, and fastenings required but which are not specified in other Sections.
- B. Pipe guards.
- C. Wrought Iron Fence and Gates.
- D. Other metal fabrications indicated.

1.2 RELATED WORK SPECIFIED ELSEWHERE AS REQUIRED

- A. Setting of items to be embedded in concrete.

1.3 GENERAL REQUIREMENTS:

- A. Field conditions: Verify drawing dimensions with actual field conditions. Inspect related work and adjacent surfaces. Report all conditions which prevent proper execution of this work.
- B. Shop Drawings: Submit in accordance with Section 01340 showing incomplete detail all information required for fabrication, finishing and installation of this work.
- C. Codes: Materials and work shall conform to the governing Building Code. In case of conflict between these specifications and the Building Code, the more stringent shall govern.
- D. General: Examine all drawings and specifications and include all miscellaneous metal that is not required to be furnished by another trade. Provide all connections, anchors, bolts, and other fastenings as required. Do all cutting, punching, drilling and tapping required for proper assembly of the work.
- E. Delivery: Insure that items to be set in concrete are delivered at the proper time.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Steel shapes: Conform to ASTM A36.
- B. Structural pipe columns: Conform to ASTM A53, Grade B.

- C. Pipe for railings: Conform to ASTM A53 or A120.
- D. Cast iron: Conform to ASTM A48, soft gray iron.
- E. Malleable iron castings: Conform to ASTM A47.
- F. Welding rods: Conform to requirements of AWS for intended use.
- G. Galvanizing: Conform to ASTM A123.
- H. Bolts, nuts, screws: Conform to ASTM A307, Grade A.
- I. Steel plate: Conform to ASTM A283, Grade A.
- J. Steel tubing: Conform to ASTM A501 or A500.
- K. Bars, flats, rounds: Conform to ASTM A36, standard grade mild steel.
- L. Primer: Conforming to FS-TT-P-86, Type I.
- M. Touch-up for galvanized surfaces: All State #321 Galvanizing Powder (30% tin, 30% zinc, 40% lead and flux), "Galvalloy", "Galvover", or approved equal.
- N. Miscellaneous material: As indicated or specified.

2.2 SHOP PRIME COAT:

- A. Ferrous metal: Properly clean and prepare for painting in compliance with the paint manufacturer's instructions and apply one shop coat of material of the type specified. Thoroughly and completely cover all exposed surfaces as well as surfaces concealed after assembly. Apply paint by brush or spray gun, as best adapted to the paint material and surface conditions. Allow paint to become dry and hard before handling.
 - 1. Apply primer to 2 mil minimum dry coat thickness and touch up after installation and leave in proper condition to receive finish coats.

2.3 GALVANIZING:

- A. Galvanize all items to be exposed on the exterior and those interior items so specified. Use the hot dip process, conforming to ASTM A123.
- B. Average weight of zinc coating per square foot of actual surface: Not less than 2.0 ounces, with no individual specimen showing less than 1.8 ounces. (One oz. of zinc corresponds to a coating thickness of 0.0017".)

2.4 FABRICATION:

- A. Using skilled mechanics, form and fabricate items of work as indicated and as required to meet installation conditions. Make provisions to connect with or receive the work of other trades.
- B. Unless otherwise indicated, weld or bolt connections between members. Where possible, conceal connections in the finished work. Where exposed screw fastenings are required,

use Phillips ovalhead screws to match parent material. Fit or miter exposed joints to hairline tolerance or use welded joints. On finished surfaces, grind all welds smooth and flush with base metal.

- C. Bend pipe or tubing without collapsing or deforming the walls, and so as to provide a smooth uniform curved section and maintain uniform sectional shape.
- D. Where items are to be embedded in concrete, provide welded-on anchors or lugs as indicated or required.

PART 3 - EXECUTION

3.1 ITEMS EMBEDDED IN CONCRETE OR MASONRY:

- A. Provide bolts, eyebolts, dowels, anchors, plates, inserts, and other miscellaneous items that are to be installed in forms before concrete pouring, or for building into masonry, as indicated. Examine and check the drawings for the number, type and location of such items.

3.2 INSTALLATION:

- A. Install all items plumb, level and square, securely and rigidly attached to supporting construction and as detailed.

3.3 DESCRIPTION OF ITEMS:

- A. Those items which are of standard or stock design or which are sufficiently detailed or described on the drawings to permit their fabrication and installation, are not covered herein even though they may be included in the Scope.
- B. Backing plates in connection with studs and furring necessary for engaging and fastening of stair rail brackets, lavatories and fixtures, etc., shall be provided in locations indicated, or as necessary. Securely fasten backing plates to studs supporting members in required position. Dap into wood studs. Weld between steel studs. Finish with rust inhibitive prime coat.
- C. Pipe handrails (if shown): Fabricate from 1 1/4" standard steel pipe to shapes and dimensions indicated. Make joints flush with concealed seamless fittings. Accurately cut, miter, weld and grind smooth to flush surfaces. Make bends to preserve the contour of the pipe. All railings shall meet all disabled access requirements. Install as follows:
 - 1. To masonry walls: Provide cast brackets providing 1 1/2" min. or indicated clearance between railing and wall. Secure to wall with screws into expansion shields.
 - 2. To stud walls: Provide cast brackets providing 1 1/2" min. or indicated clearance between railing and wall. Provide proper backing at studs at proper locations before application of gypsum board. Provide collar, flush metal filler, and secure to backing.
- D. Pipe guards and bollards: standard steel pipe as shown. Galvanized after fabricated.

- E. Wrought Iron Fence and Gates: Fabricate from wrought steel square tubes as shown and to match existing. Provide all necessary operating hardware for the gates. Reinstall salvaged fence and gates as required. Fence and gates to be hot dip galvanized. Provide factory applied architectural coating over hot-dip galvanized steel "Colorgalv" by Duncan Galvanizing. Primer coat shall be factory applied prime coating. Apply primer within 12 hours after galvanizing at the same facility where the galvanizing is done. Finish coat shall be factory-applied high performance architectural finish. Apply finish coating at the galvanizer's plant, in a controlled environment as recommended by the finish coating manufacturer. Color to match existing steel fencing to remain at campus. Submit two 3 inch by 6 inch samples of factory applied coatings and colors proposed for use for approval prior to coating application. Provide 20 year warranty against rust.
- F. Other miscellaneous metal work as indicated.

END OF SECTION

**SECTION 06 10 00
ROUGH CARPENTRY**

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Supply and install Rough Carpentry work as indicated.

1.02 RELATED SECTIONS

- A. Section 01 40 00: Quality Control.
- B. Section 01 41 00: Testing and Inspection Requirements
- C. Section 03 31 00: Cast-In-Place Concrete.
- D. Section 06 20 00: Finish Carpentry.
- E. Section 09 25 00: Gypsum Board.

1.03 SUBMITTALS

- A. Submittals: Submit in accordance with Section 01 30 00.

1.04 QUALITY ASSURANCE

- A. All work shall be performed in accordance with the local codes and the most current DSA requirements. Where there is a question between the specifications, Architect/Contractor shall conform to the most constrictive requirement.
- B. Douglas fir, larch or hemlock structural and framing lumber shall be graded in accordance with the "Standard Grading Rules" of the West Coast Lumber Inspection Bureau (WCLIB) or the "Western Lumber Grading Rules" of the Western Wood Products Association (WWPA) latest editions.
- C. Redwood structural and framing lumber shall be graded in accordance with "Standard Specifications for Grades of California Redwood Lumber" of the Redwood Inspection Service, latest edition.
- D. Each piece of lumber shall bear official grade mark of the association under whose rules it was graded, or official grade mark of another recognized grading agency using grading rules herein specified.
- E. All 2x structural and framing members shall be air-dried to a moisture content not to exceed 19% before use.
- F. Work of this Section shall comply with provisions of current edition of UBC and Title 24, see Section 01 45 29: Testing and Inspection.

- G. Plywood shall conform to requirements of "Product Standard PS 1 issued by the U.S. Department of Commerce, and shall be grade marked by a recognized grading agency (APA and PTL).
- H. Each piece of preservative treated lumber shall be identified by the Quality Mark of an approved inspection agency in accordance with Title 24, see Section 01 45 29: Testing and Inspection.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Lumber: Structural and framing lumber shall be of the following species and grades unless noted otherwise on the drawings:

	<u>USE</u>	<u>SPECIES</u>	<u>GRADE</u>
1.	Subfloor, wall sheathing, roof sheathing and ceiling stripping.	Douglas Fir	"Construction" Board, Structural #1 only WCLIB; WWPA
2.	Beams, girders and truss members (5" and thicker, rectangular, width more than 2" greater than thickness) where exposed as finish members.	Douglas Fir WWPA	Select Structural
3.	Joists, rafters, lintels, posts, mullions and members (2" to 4" thick, 2" to 4" wide)	Douglas Fir	"Structural No. 1 Structural Light Framing, WCLIB;
4.	Other lumber (2" to 4" thick, 2" to 4" wide) not specified in subparagraph 5 above.	Douglas Fir	"Structural No. 1" and Framing WCLIB; WWPA
5.	Framing lumber (2" to 4" thick, 5" and wider).	Douglas Fir	"No. 1" and better Joists and Planks, WCLIB; WWPA.
6.	Mudsills and plates in contact with soil. treated	Douglas Fir	Same as subparagraphs 5 and 6.
7.	Sills or plates resting on concrete or masonry surfaces 6" or less above soil or finish grade.	Douglas Fir treated	Same as subparagraphs 5 and 6.
8.	Sills, foundations plates & sleepers which rest on concrete, masonry foundations, or are laid on concrete on concrete slab in direct contact with soil.	Douglas Fir treated	Same as subparagraphs 4 and 5.

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|----|--|------------------------|--------------------------------------|
| 9. | Miscellaneous nailing strips and blocks embedded in concrete or masonry. | Douglas Fir
treated | Same as
subparagraphs
4 and 5. |
|----|--|------------------------|--------------------------------------|
- B. Plywood: Plywood used for structural purposes, shall be APA grade Structural I plywood. Other plywood used for non-structural purposes shall be exterior type, or Exposure 1.
- C. Preservative Treated Wood:
1. Wood and plywood specified as treated wood shall be pressure treated wood in accordance with CBC 2303.1.8."
 2. Seasoning: Treated lumber shall be air seasoned after treatment, for a minimum of 2 weeks before use.
 3. Creosote shall not be used for treating wood in contact with painted or plastered surfaces.
 4. When treated wood member has been notched, dapped, drilled or in any way cut into, such newly cut surfaces shall be painted with a heavy coat of same preservative material used in treatment of wood member.
- D. Fire Retardant Protection: Wood and plywood specified as "Fire Retardant Protected Wood" shall be treated by approved methods and materials, and shall be dried, following treatment, to a maximum moisture content as follows: Solid sawn lumber 2" in thickness or less to 19%; and plywood to 15%.
- E. Plywood subflooring shall be "Underlayment", Group 1, Exposure 1; of thickness indicated.
- F. Mineral Fiber Panels: Shall be asbestos free, thickness as indicated.
- G. Reused Materials: Sound lumber and timber which has been used for formwork may not be reused for stress carrying or non-stress carrying members. May not be used in any construction other than formwork.

PART 3 – EXECUTION

3.01 FASTENINGS

- A. Nails and Spikes:
1. Use only common wire nails or spikes.
 2. Whenever necessary to prevent splitting, holes shall be prebored for nails and spikes.
 3. Nails in plywood shall not be overdriven.
 4. Machine Applied Nailing: Use of machine nailing is subject to a satisfactory jobsite demonstration for each project and approval by the Project Architect or Structural Engineer and the Division of the State Architect Field Representative. Approval is subject to continued satisfactory performance. Machine nailing will not be approved in 5/16" plywood. If nailheads penetrate outerply more than would be

normal for a hand hammer or if minimum allowable edge distances are not maintained, performance will be deemed unsatisfactory and material may be scrapped.

B. Lag Screws:

1. When placing lag screws in a wood member, prebore lead hole as recommended in CBC Title 24 Sec 23.
2. Lag screws which bear on wood shall be fitted with standard steel plate washers under head. Lag screws shall be screwed and not driven into place.
3. Lag screws applied in moisture rich environments or "wet" timber shall be galvanized to prevent degradation of both the lag screw and the material.

C. Bolts:

1. Lumber and timber to be fastened together with bolts shall be clamped together and holes for bolts bored true to line.
2. Bolts shall be fitted with steel plates or standard cut washers under heads and nuts. Bolts shall be tightened when installed and again just before completion of work.
3. Bolts applied in moisture rich environments or "wet" timber shall be galvanized to prevent degradation of both the bolt and the material.

D. Wood Screws: When placing wood screws, lead holes shall be prebored as recommended in CBC Title 24. Wood screws shall be appropriately selected for the application and treated as necessary to prevent corrosion

E. Framing Anchors: Framing anchors, joist hangers, ties and other mechanical fastenings shall be galvanized or have a rust-inhibitive coating. Nails and fastenings shall be of type recommended by manufacturer.

3.02 ERECTION

A. Stud Walls, Partitions and Furring:

1. Wood stud walls, partitions and vertical furring shall be constructed of members of size and spacing indicated. Provide single plate at bottom and double plate at top unless otherwise indicated. Interior, nonbearing non-shear partitions may be capped with a single top plate, installed to provide overlapping at corners and at intersections with other wall and partitions or by metal ties as detailed.
2. Walls and partitions shall have horizontal staggered blocking not less than 2" nominal thickness and same width as studs, fitted snugly, and nailed into studs. Blocking shall be at mid-height of partition or not more than 7'-0" on center vertically. Install wood backing on top of top plate wherever necessary for nailing of lath or gypsum board.
3. Walls, partitions and furred spaces shall have 2" nominal thickness wood firestops, same width as space to be firestopped, at ceiling line, mid-height of partition and at floor line. Firestops at floor line are not required when floor is

concrete. If width of opening is such that more than one piece of lumber is necessary, provide 2 thicknesses of 1" nominal material laid with staggered joints.

4. Firestops shall be placed in all stud walls and partitions, including furred spaces, so that maximum dimension of any concealed space is not over 10'-0".
5. Corners, and where wood stud walls and wood vertical furring meet, shall be formed of triple studs. Openings in stud walls and partitions shall have headers as indicated and a minimum of 2 studs at jambs, one stud of which may be cut to support header in bearing.
6. Where wood masonry or concrete walls intersect, end stud shall be fastened at top, bottom and midheight with one 1/2" diameter bolt through stud and embedded in masonry or concrete a minimum of 4". Bolts shall have washers under nuts.
7. Sills under bearing, exterior or shear walls shall be bolted to concrete with 5/8" rd. by 12" long bolts spaced not more than 4'-0" on center. There shall be a bolt within 9" of each end of each piece of sill. Sills shall be placed and leveled with shims and washers placed and nuts tightened to level bearing after which space between sill and concrete shall be dry packed with cement grout. Non-bearing interior plates may be fastened to concrete with low velocity powder driven fasteners provided Structural Engineer's approval is obtained in writing, prior to use.

B. Beams, Girders and Joists:

1. Ends of wood beams, girders and joists which are 2'-0" or less above finished outside grade and which abut, but do not enter concrete or masonry walls, as well as wood blocking used in connection with ends of those members shall be treated with wood preservative.
2. Where wood beams, girders and joists enter masonry or concrete walls 2'-0" or less above outside wall, metal wall boxes or equivalent moisture barriers shall be provided between wood and masonry or concrete.

C. Furring: Where metal furring is not indicated or specified, provide wood furring at all points indicated and required for concealing conduit, piping, structural framing or other unfinished materials. Wood furring shall be 2x studs of required width. Vertical members contacting concrete or masonry shall be attached as specified for anchoring interior wood stud partitions.

D. Nailing Strips and Plates:

1. Provide wood nailing strips, plates and blocking indicated or required. Nailing strips in connection with metal work shall be bolted to metal. Wood nailing blocks for securing grounds shall be built into concrete, or masonry.
2. Nailing schedule shall comply to Title 24, see Section 01 45 29: Testing and Laboratory Services.

E. Wood Backing: Provide wood backing as indicated and as required to receive plumbing, electrical fixtures and equipment, cabinets, door stop plates and other fixed equipment.

END OF SECTION

SECTION 06 17 33

WOOD I JOISTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Prefabricated plywood web joists.

B. Related Sections:

1. Division 01 - General Requirements.
2. Section 01 41 00 - Testing and Inspection.
3. Section 06 10 00 - Rough Carpentry.
4. Section 06 17 36 - Metal Web Wood Joists.

1.02 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating joist locations, sizes, camber, spacing, species, stress grades and attachment details.
- B. Evaluation Reports: Submit research or evaluation reports stating compliance to CBC.

1.03 QUALITY ASSURANCE

- A. Comply with following as a minimum requirement: Prefabricated plywood web joists shall comply with requirements of ICC Evaluation Service, Inc. report No. PFC-5803, current editions.
- B. Fabrication and installation of wood chord metal joists shall comply with requirements of CBC Chapter 23.
- C. Provide special inspections per CBC Chapter 17A.
- D. Each member shall be stamped with an identifying mark. Manufacturer shall provide a verified report identifying members by mark and including pertinent data such as certification of flange material and species, type of glue, and other information as may be required.
- E. Plywood web joist fabrication shall be inspected as part of manufacturer's approved quality assurance program. Inspection shall be performed in accordance with Section 01 41 00 - Testing and Inspection.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Store plywood web joists above grade on platforms, skids, or other required supports.
- B. Protect joists from moisture with polyethylene film or waterproof paper.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. TrusJoist, A Weyerhaeuser Business.
- B. Standard Structures, Inc.
- C. Louisiana-Pacific Corporation.
- D. Georgia-Pacific Corporation.
- E. Equal.

2.02 MATERIALS

- A. Wood Chord: Solid-sawn lumber, laminated veneer lumber (LVL), laminated strand lumber (LSL) or machine-stress-rated (MSR) structural lumber. Allowable unit stresses for chord members shall be as set forth in applicable California Building Code and as noted in the ICC reports. Lumber grade identification shall be as indicated on Drawings.
- B. Web shall be plywood or oriented strand board.
- C. Accessories: Supply miscellaneous accessories including bracing, blocking, stiffeners, bearing clips, and any other required accessories required by joist manufacturer to complete joist installation.
- D. Adhesives: Adhesives must meet requirements for exterior type complying with ASTM D2559.

2.03 FABRICATION

- A. Fabricate joists in accordance with referenced standards.
- B. TJI Joists: Plywood web type members, structural grade plywood Micro-Lam or machine stress rated lumber chord flanges assembled with waterproof glues; plywood webs of APA Structural 1 Grade installed with face grain running in vertical direction of members and butt jointed for a continuous web member; web pressure formed and tightly fitted into a groove routed on centerline of wide face of flange members to form a pressure glue joint at that junction.
 - 1. Flanges: Joists shall be factory fabricated with micro-lam billets utilizing waterproof glues and having machine stress rating of $F_b=2,100$ psi, $E=1,800,000$ psi. Moisture content at time of fabrication shall be between 7 and 19 percent of a surface dry basis. Joints shall be pre-qualified, finger joints.
 - 2. Webs: Plywood complying with PS 1, C-C Structural 1, grade marked by an ICC-approved agency or oriented strand board OSB complying with APA E446. Moisture content at time of fabrication shall be between 7 and 16 percent. Difference in average moisture content between panels glued to each other in any member shall not exceed 5 percent. Plywood containing core gaps at ends shall not be furnished. Install plywood web with face veneers oriented vertically, and butt jointed with adhesive to form a continuous member. Top and bottom edges of webs shall be specially prepared and pressure fitted into a machined groove in center of wide face of flange members so as to form a tight glued junction. Provide web bearing stiffeners as indicated.

3. Adhesives: Exterior type, phenol, resorcinol or phenol-resorcinol. Adhesive shall be mixed and handled in accordance with manufacturer's instructions.

PART 3 - EXECUTION

3.01 GENERAL

- A. Joists shall be of sizes and spacing indicated. Top and bottom chord and web members shall be of sizes and stress-grade lumber indicated or specified.

3.02 INSTALLATION

- A. Joints shall be installed in accordance with Drawings and Shop Drawings.
- B. Temporary construction loads, which cause stresses beyond design limits, shall not be applied to joists.
- C. Installation bracing, in addition to specified bridging, bracing shall be provided as required to keep joists straight and plumb until sheathing material has been installed.

3.03 CLEANUP

- A. Remove debris, rubbish, and waste material and legally dispose of off Project site.

3.04 PROTECTION

- A. Protect Work of this section until Substantial Completion.

END OF SECTION

**SECTION 06 20 00
FINISH CARPENTRY**

1.0 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

- A. Furnish materials and perform labor required to execute this work as indicated on the drawings, as specified and as necessary to complete the Contract, including, but not limited to, these major items:
 - 1. Installation of finish hardware.
 - 2. All other finish carpentry and millwork indicated or required to complete the work.

1.03 RELATED SECTIONS

- A. Section 06 41 00 – Custom Casework.
- B. Section 08 71 00 – Door Hardware.
- C. Section 09 22 16 – Non-Structural Metal Framing.
- D. Section 09 90 00 – Painting.

1.04 GENERAL REQUIREMENTS

- A. Shop Drawings: Submit drawings showing in complete detail all information required for fabrication, finishing, and installation of this work.
- B. Samples: Submit samples of wood that will receive transparent finish, laminated plastic, accessories and hardware.
- C. Reference Specifications: Unless otherwise indicated or specified, all materials, fabrication, and workmanship shall conform to the applicable requirements of the Woodwork Institute of California, "Manual of Millwork", latest edition, (WI) custom grade work, which is hereby made a part of this Section.

1.05 GRADING

- A. Softwood Lumber: Grade and grade-mark in accordance with Rules No. 16 of the West Coast Lumber Inspection Bureau, or WWPAA grading Rules for Western Lumber, latest edition. Grade-mark shall bear the symbol of an approved grading agency.
- B. Other Lumber and Plywood: Conform to the current grading rules of the associations which have jurisdiction over the various lumber species.
- C. Grade-mark and mill identification of the association having jurisdiction shall appear on each piece of softwood lumber when delivered to the site.
- D. Perform grading of hardwood and plywood, except as otherwise specified, in accordance with rules as noted. Identify each delivery of such material to the site with a certificate of grading issued by the association or member manufacturer. In the absence of specific association bureaus for a species, govern grading as follows:
 - 1. Hardwood Lumber: National Hardwood Lumber Association.
 - 2. Plywood: United States Product Standard PS 1-07.
 - 3.

1.06 DRYING AND STORAGE

- A. Kiln drying or equivalent air drying is required for all lumber used for finish. Test of lumber upon delivery to the site shall show a moisture content of not to exceed 12 percent by weight.
- B. Store lumber and millwork on wood sills, within enclosed portions of the building, locations, approved by the Architect, and only where not subjected to moisture.

2.00 PRODUCTS

2.01 MATERIALS

- A. Trim: All exposed finish wood trim not otherwise identified: VGDF, clear and free of defects. Where opaque finish is indicated, finger joints are acceptable.
- B. Plywood: PS 1-07, flat or mixed grain, face grades as specified for particular use.
- C. Hardwood solid stock and plywood for transparent finish: As specified for particular use.
- D. Waterproof Glue: Polyvinyl acetate emulsion with 55 percent solids, Wilhold by Acorn Adhesives, Weldwood by U.S. Plywood, or approved equal.
- E. Exposed Nails: Finish or casing nails.
- F. Anchors:
 - 1. Concrete-Buildex Tapcon 1/4 inch x 1-1/2 inches minimum embedment.
 - 2. Metal: Buildex Teks 10-14 x 1-1/2 inches.

3.00 EXECUTION

3.01 FINISH CARPENTRY INSTALLATION

- A. Perform work under constant supervision of competent foreman, who shall carefully lay out work as required to carry out intent of the drawings, and to properly accommodate the work of other trades. Accurately sawcut and fit lumber into the respective locations, true to line, grade, and level, as indicated or required, and permanently secure in proper position with spikes, nailings, lag screws, bolts, or other fastenings and fittings as detailed, herein specified, or as directed, substantial and rigid in all parts and connections.
- B. Finish Woodwork: As a minimum requirement, comply with standards for custom grade work of the WI. Smoothly dress and belt sand finish woodwork at the mill; hand-sand prior to erection. Finish free from open joints, hammer and machine marks, structural defects, and surface blemishes. Wherever practicable, conceal means of fastening various parts and members together. Where surface nailing is unavoidable, neatly set nails for putty stopping. Perform all work by skilled mechanics, true to detail, with all arises in finished work slightly rounded by sanding. Use longest practicable lengths. Miter all joints-but joints are prohibited.
- C. Fitting of moving units shall provide uniform minimum clearance suitable for permanent operation and make proper allowance for paint. Tightly scribe, cut and fit wood trim and millwork against abutting surfaces. Blind nail wood finish where possible. Set all nails for putty.

3.02 INSTALLATION OF DOORS AND HARDWARE

- A. Surface-Mounted Hardware: Drill pilot holes for all screws. Accurately and neatly make holes from templates or from the finished Hardware Schedule. Fire doors require self-tapping, full thread, sheet metal screws.
- B. Fit hardware to fully conform to standard procedures and to manufacturer's directions. Position of hardware, see Section 08 71 00.

Top butt	5 inches below top of door
Bottom butt	10 inches above finish door
Center butt	Midway between top and bottom butt
- C. Preparation for Painting: Removed all finish items (except butts), including finish hardware previously installed on metal doors, which is not otherwise protected. Reinstall after painting is complete.
- D. Key File: Lay out a key file for the systematic filing of all keys within the room where the hardware is stored. Promptly tag and file all keys as the lock sets are installed. On completion of the work, including final corrections and adjustments of finish hardware, deliver all keys and master keys complete to the Owner.

END OF SECTION

**SECTION 06 41 00
CUSTOM CASEWORK**

1.00 GENERAL

1.01 SECTION INCLUDES

- A. Special fabricated cabinet units.
- B. Countertops.
- C. Cabinet hardware.

1.02 REFERENCES

- A. ANSI A135.4 – Basic Hardboard.
- B. ANSI A208.1 – Mat Formed Wood Particleboard.
- C. AWI (Architectural Woodwork Institute) – Quality Standards.
- D. BHMA A156.9 – Cabinet Hardware.
- E. FS MMM-A-130 – Adhesive, Contact.
- F. HPM (Hardwood Plywood Manufacturer's Association) HP – American Standard for Hardwood and Decorative Plywood.
- G. NEMA (National Electric Manufacturers Association) LD3 – High Pressure Decorative Laminates.
- H. NHLA (National Hardwood Lumber Association).
- I. PS 1 –Construction and Industrial Plywood.
- J. PS 20 – American Softwood Lumber Standard.
- K. WI (Woodwork Institute of California) – Manual of Millwork.

1.03 SUBMITTALS FOR REVIEW

- A. Shop drawings shall indicate list of material and hardware, sized, sections, elevations, and details of construction and assembly as required by Section 1 "Millwork Shop Drawings of the May, 1955 edition Woodwork Institute of California, Manual of Millwork.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with WI Custom quality and obtain certification unless noted otherwise in the Contract Documents.

2.00 PRODUCTS

2.01 TYPE AND MANUFACTURE

- A. Cabinets shall be manufactured in accordance with WI Manual of Millwork, Section 15 Custom Grade typical modified as indicated in the drawings and specifications and herein specified. All units shall be factory finished. Provide Style A Frameless, Type I construction unless otherwise noted.

2.02 MATERIALS, FINISH AND CONSTRUCTION

- A. Exposed Portions:
 - 1. Material for exposed portions shall be faced with decorative high pressure laminated plastic.
 - a. Plastic laminate shall be Standard Grade, Matte finish, thermoplastic laminate surfacing, .050-inch thick, meeting the requirements of NEMA LD 3-85. Backing sheets shall be .020-inch thick conforming to the requirements of NEMA LD, latest edition. Use post forming grade where required by the drawing details, minimum thickness .042 inch +/- .004 inch.
 - b. Color and pattern as selected by Architect. Accepted manufacturers include Laminate, Formica, and Wilson Art Architect reserves the right to select more than one color and pattern from more than one manufacturer for use on any one cabinet. Architect may select colors from any of the listed manufacturers.
- B. Semi-Exposed Portions:
 - 1. Material for semi-exposed portions, except interior faces of hinged doors, shall be high pressure laminate cabinet liner meeting the requirements of NEMA LD-3-85.
 - 2. The interior faces of hinged doors shall be faced with 0.032-inch minimum thickness high pressure laminate plastic conforming to NEMA LD-3.
- C. Concealed Portions:
 - 1. Material for concealed portions may be sound, dry solid stock, plywood or particleboard, except where otherwise specified herein.
 - 2. Prime unfinished surfaces with primer coat or sealer.
- D. Visible Edges: All visible edges, exposed or semi-exposed, of ends, tops, bottoms, shelves (4 sides/edges), webs, stretchers, divisions, doors and drawer fronts shall be edged with melamine decorative paper tape matching adjacent color.
- E. Laminate Core Material shall be particleboard meeting the requirements of ANSI A 208.1-87, Table 1, Grade 1-M-3.
- F. Adhesive shall be Type II, water resistant.

2.03 TOPS AND BOTTOMS

- A. Tops and bottoms shall be particleboard or plywood with 0.050" high pressure laminated plastic on exposed portions or cabinet liner on semi-exposed portions, net thickness shall be 0.735 inch.
- B. Plywood bottoms of upper cabinets with spans 4'0 inches or over in length between vertical members of the cabinet body shall be a minimum of 1 inch in thickness.

2.04 ENDS AND DIVISIONS

- A. Cabinet ends and divisions shall be particleboard or plywood as detailed in the Drawings with 0.050" thick high pressure laminated plastic on exposed faces or high pressure laminate cabinet liner on semi-exposed portions, net thickness shall be .0735 inch. Visible edges shall be .050" high pressure laminated plastic.
- B. Cabinet ends shall be lockjointed, securely glued, and blind nailed or screwed to the tops, web frames, and bottoms at not to exceed 4" on center. Doweled construction is acceptable.

2.05 WEB FRAMES AND STRETCHERS

- A. Web frames and stretchers shall be a minimum of 0.735 inch in thickness and 2-1/2 inches in width, and shall be solid stock or plywood. A solid piece of plywood or particleboard a minimum of 0.735 inch in thickness, the full length and depth of the cabinet opening, may be used in lieu of a web frame or stretchers.
- B. Web frames shall be furnished under countertops; or a continuous stretcher front and rear may be furnished in lieu of the frame, and shall be attached by means of a dado, tenon or metal angle bracket. A continuous stretcher at the front shall be furnished at the approximate mid-height of all drawer cabinets over 2 feet-6 inches in drawer opening height and shall be attached by means of a dado, tenon or metal angle bracket.

2.06 BACKS

- A. Semi-exposed backs shall be 1/4-inch thick plywood or tempered and sealed hardboard with high pressure laminate cabinet liner. Exposed backs shall be 1/2-inch thick plywood with 0.050 inch high pressure laminated plastic.
- B. Color shall match adjacent semi-exposed or exposed portions as applicable.
- C. Backs shall be securely nailed, doweled or dadoed to the case body, divisions, or fixed shelves.

2.07 SHELVES

- A. Shelves shall be plywood or particleboard with 0.050 inch thick high pressure laminate cabinet plastic when shelves are exposed and high pressure laminate cabinet liner when shelves are semi-exposed. Minimum net thickness shall be 0.735 inch. Exposed edges shall be bound in .0550 inch thick high pressure laminated plastic.
- B. Adjustable shelves with unsupported spans in excess of 3 feet-6 inches between vertical members of the case body for plywood, and in excess of 3 feet-0 inches for particle board, shall be minimum of 1-inch thickness; and, shall be mounted on surface or recessed metal shelf standards with clips adjustable at 1/2-inch center.

2.08 CABINET BASES AND SLEEPERS

- A. Cabinet bases may be constructed with either separate or integral bases. All bases and sleepers shall be 0.735 inch solid stock or as indicated in drawings if more stringent. Sleepers shall be provided at a maximum of 3 feet-0 inches on center.

2.09 ANCHOR STRIPS

- A. Anchor strips or solid stock or plywood shall be a minimum of 1/2 inch in thickness and a minimum of 2-1/2 inches in width, and shall be provided at the wallside of the cabinet back on both top and bottom of wall hung cabinets and at top only of base cabinets unless otherwise shown on the Drawings.

2.10 COUNTERTOPS

- A. LG Hausys, Hi-Macs engineered stone countertops.
 - 1. 90-93 percent hard aggregates (quartz granite or mirror) boded with 7-10% resins and environmentally safe, color fast pigments.
 - 2. 3/4-inch Thickness.
 - 3. 2-1/4 inches Bullnose edge.
 - 4. 4 inches High square butt backsplash with 1/4 inch beveled top edge.

5. Polished finish.
6. Color as selected by Architect.
7. Seams in countertop treated in same manner as for granite.

2.11 HARDWARE

- A. All hardware shall be jig fitted at the factory by trained craftsman only. Provide U.S. 26D Dull Chrome finish.
 1. Hinges – Blum Clip 125# 74M5558 – 3 on doors over 42 inches high; 2 on doors under 42 inches high.
 2. Pulls – Shall be U shaped or looped wire pulls (3-3/4 inches long by 1-1/4 inches high by 3/4 inch deep).
 3. Catches – Shall be Amerock #T-9798-AW three-plate magnetic catch manufactured by Amerock Corporation, or accepted equal.
 4. Elbow Catches – Amerock #3675 on companion doors where locks are specified.
 5. Door Locks – National C8102.6 – masterkeyed to other casework.
 6. Drawer Locks – National C8108 – masterkeyed to other casework.
 7. Drawer Guides – Shall be Blum 430E series or accepted equal.
 8. Shelf Standards – Shall be Knap & Vogt #255 mounted with four Knap & Vogt #237 clips for each shelf, or accepted equal.
 9. Grommets – Hafele #429.99; provide at all locations where electrical, computer, telephone, etc. Receptacle are below countertop. Color as selected by Architect.

2.12 FABRICATION - GENERAL

- A. All units shall be completely fabricated and finished in the factory, except as otherwise specified or indicated for modified units. All doors and all hardware shall be jig fitted and ready for site installation.

3.00 EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION FOR INSTALLATION

- A. Make necessary measurements in the field to assure proper fit of shop fabricated items.

3.03 INSTALLATION

- A. Install the work of this Section in accordance with the accepted Shop Drawings and Section 26, WI "Manual of Millwork: using factory trained craftsman.
 1. Scribe units to wall, floor, and other surfaces as appropriate, with not more than 1/32 inch clear between the cabinet or fixture and the abutting permanent surface, and with no change of clearance in excess of 0.01 inch in any 4 inches.
 2. Set each unit square, level, plumb, and aligned within a tolerance of one on 1000 vertically and horizontally, and within 1/4 inch of the designated location for freestanding work.

- B. Upon completion of installation, thoroughly clean each item by use of only such cleaning materials as are recommended by the manufacturer of the item being cleaned.
- C. Touch up scratches and abrasions to be completely invisible to the unaided eye from a distance of five feet.

END OF SECTION

**SECTION 06 61 16
SOLID SURFACING FABRICATIONS**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Provide solid surfacing fabrications including but not limited to following:
1. reception areas.
- B. Related Sections: Following description of work is included for reference only and shall not be presumed complete:
1. Section 06 10 00 – Rough Carpentry
 2. Section 06 20 00 – Finish Carpentry
 3. Section 06 41 00 – Custom Casework
 4. Section 07 90 00 - Joint Sealants

1.02 REFERENCES

- A. Abbreviations and Acronyms:
1. LEED®: Leadership in Energy and Environmental Design; www.cagbc.org.
 2. MDF: Medium Density Fiberboard.
 3. SCAQMD: South Coast Air Quality Management District; www.aqmd.gov.
 4. VOC: Volatile Organic Compound.
- B. Definitions:
1. Solid Surface: Non-porous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment.
- C. Reference Standards:
1. ANSI/NPA A208.2-09 - Medium Density Fiberboard (MDF) For Interior Applications
 2. ASTM C920-14a - Standard Specification for Elastomeric Joint Sealants
 3. ASTM D638-10 - Standard Test Method for Tensile Properties of Plastics
 4. ASTM D785-08 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials
 5. ASTM D790-10 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 6. ASTM D5420-10 - Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
 7. ASTM E84-14 - Standard Test Method for Surface Burning Characteristics of Building Materials
 8. ASTM E228-11 - Standard Test Method for Linear Thermal Expansion of Solid Materials with a Push-Rod Dilatometer
 9. ASTM G21-13 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
 10. ASTM G22-76(96) - Standard Practice for Determining Resistance of Plastics to Bacteria

- | | | |
|-----|--|--|
| 11. | ASTM G155-13 | - Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials |
| 12. | CSA B45.5-11/
IAPMO Z124-2011 | - Plastic Plumbing Fixtures |
| 13. | NFPA 255-06 | - Standard Method of Test of Surface Burning Characteristics of Building Materials |
| 14. | NSF/ANSI 51-07 | - Food Equipment Materials |
| 15. | SCAQMD Rule 1168 | - Adhesive and Sealant Applications (amended January 2005) |
| 16. | UL 723 | - Standard for Test for Surface Burning Characteristics of Building Materials |
| 17. | UL Environment/
Materials,
GREENGUARD
UL 2818 | - Standard for Chemical Emissions for Building

- Finishes and Furnishings, Section 7.1 |
| 18. | UL Environment/
Materials,
GREENGUARD
UL 2818 | - Gold Standard for Chemical Emissions for Building

- Finishes and Furnishings, Section 7.1 and 7.2 |
| 19. | UL 2824 | - GREENGUARD Certification Program, Method for Measuring Microbial Resistance from Various Sources Using Static Environmental Chambers |

ADMINISTRATIVE REQUIREMENTS

- D. Preinstallation Meetings: Arrange preinstallation meeting 1 week prior to commencing work with all parties associated with trade as designated in Contract Documents or as requested by Architect. Presided over by Contractor, include Architect who may attend, Subcontractor performing work of this trade, Owner's representative, testing company's representative and consultants of applicable discipline. Review Contract Documents for work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.

1.03 SUBMITTALS

- A. Product Data: Indicate Product description including solid surface sheets, sinks, bowls and illustrating full range of standard colors, fabrication information and compliance with specified performance requirements. Submit Product data with resistance to list of chemicals.
- B. Shop Drawings: Submit Shop Drawings for work of this Section in accordance with Section 01 30 00. Indicate plans, sections, dimensions, component sizes, edge details, thermosetting requirements, fabrication details, attachment provisions, sizes of furring, blocking, including concealed blocking and coordination requirements with adjacent work. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, waste receptacles and other items installed in solid surface.
- C. Coordination Drawings: Submit coordination drawings indicating plumbing and miscellaneous steel work indicating locations of wall rated or non-rated, blocking requirements, locations and recessed wall items and similar items.
- D. Samples: Submit samples in accordance with Section 01 30 00. Submit minimum 6" x 6" samples. Cut sample and seam together for representation of inconspicuous seam. Indicate full range of color and pattern variation. Approved samples will be retained as standards for work.

SPEC NOTE: NSF/ANSI 51, FOOD ZONE, SPLASH ZONE AND NON-FOOD ZONE, APPLICATION WHERE FOOD MAY BE DROPPED ONTO SERVING SURFACES. DELETE FOLLOWING IF NO FOOD CONTACT IS REQUIRED FOR PROJECT. DELETE FOLLOWING ON FLAMMABILITY IF

THERE IS NO REQUIREMENT FOR FIRE PERFORMANCE.

- E. Test and Evaluation Reports: Submit flammability test reports [and food preparation zone certifications/listing confirming compliance with NSF/ANSI 51. Refer to www.nsf.org for the latest compliance to NSF/ANSI 51 for Food Zone — all food types.]

1.04 CLOSEOUT SUBMITTALS

- A. Operational and Maintenance Data:
 - 1. Submit manufacturer's care and maintenance data, including repair and cleaning instructions. Include in Project closeout documents.
 - 2. Provide a commercial care and maintenance kit and video. Review maintenance procedures and warranty details with Owner upon completion.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installers: Provide work of this Section executed by competent installers with minimum 5 years experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.

- B. Mock-Ups:

- 1. Prior to final approval of Shop Drawings, erect 1 full size mock-up of each component at Project site demonstrating quality of materials and execution for Architect review.
 - 2. Should mock-up not be approved, rework or remake until approval is secured. Remove rejected units from Project site.
 - 3. Approved mock-up will be used as standard for acceptance of subsequent work.
 - 4. Approved mock-ups may remain as part of finished work.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Delivery and Acceptance Requirements: Deliver no components to Project site until areas are ready for installation.
- B. Storage and Handling Requirements:
 - 1. Store components indoors prior to installation.
 - 2. Handle materials to prevent damage to finished surfaces.

1.07 WARRANTY

- A. Manufacturer Warranty: Provide manufacturer's standard warranty for material only for period of 10 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Architect and at no expense to Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer List: Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:

1. Corian® by DuPont; www.corian.com
2. Samsung Chemical USA; www.staron.com
3. Wilsonart Contract; www.wilsonartcontract.com

- B. Substitution Limitations: This Specification is based on Corian® Products. Comparable Products from manufacturers listed herein will be accepted provided they meet requirements of this Specification.

2.02 MATERIALS

- A. Performance/Design Criteria:

	Property	Requirement (min or max)	Test Procedure
1.	Solid Surface Based Products:		
a.	Tensile Strength	6000 psi min	ASTM D638
b.	Tensile Modulus	1.5 x 10 ⁶ psi min	ASTM D638
c.	Tensile Elongation	0.4% min.	ASTM D638
d.	Flexural Strength	10000 psi min	ASTM D790
e.	Flexural Modulus	1.2 x 10 ⁶ psi min	ASTM D790
f.	Hardness	>85-Rockwell "M" scale min.	ASTM D785
g.	Thermal Expansion	2.2 x 10 ⁻⁵ in./in./°F	ASTM E228
h.	Fungi and Bacteria	Does not support microbial growth	ASTM G21 & G22
i.	Microbial Resistance	Highly resistant to mold growth	UL 2824
j.	Ball Impact	No fracture - 1/2 lb. Ball: 6 mm slab - 36" drop 12 mm slab - 144" drop	NEMA LD 3, Method 3.8
k.	Weatherability	ΔE*94<5 in 1,000 hrs	ASTM G155
l.	Flammability		ASTM E84, NFPA255 & UL 723
All Colors			
		6 mm	12 mm
m.	Flame Spread	<25	<25
n.	Smoke Developed	<25	<25
o.	Class	A	A
		NFPA 101®, Life Safety Code	

SPEC NOTE: Industry standard is to use 1/2" thick Products. 1/4" thick Product is used vertically only. Contact manufacturer's rep. for 3/4" thick Product and Product data and panel size limitations.

- B. Solid Surface Material:

- C. Non-porous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment; not coated, laminated or of composite construction; meeting following criteria:

- D. Flammability: Class 1 and A when tested to UL 723.

SPEC NOTE: CHECK WHETHER CUT OUTS ARE NEAR A HEAT SOURCE; IF NOT DELETE FOLLOWING 2 PARAGRAPHS.

- E. Heat Reflecting Tape: Manufacturer's standard aluminum foil tape, with required thickness, for use with cutouts near heat sources.
- F. Insulating Nomex® Fabric: Manufacturer's standard for use with conductive tape in insulating solid surface material from adjacent heat source.

2.03 COMPONENTS

SPEC NOTE: REFER TO TECHNICAL BULLETIN K-25291 – STRUCTURAL SUPPORT.

- A. Counter Perimeter Frame: Ensure 3/4" thick, moisture resistant [cores for counter tops in wet areas having sinks or lavatories are 3/4" thick exterior grade plywood with waterproof adhesive, Fir or Poplar plywood, veneer core only.] [MDF core conforming to ANSI/NPA A208.2 balanced design, manufactured from recycled materials, meeting ANSI Standards for emissions, of minimum density of 48 lb/cu ft and surface character to match sample approved by Architect. Ensure fire retardant Product contains fire-retardant chemicals injected with raw materials during manufacturing and achieves a maximum flame-spread rating of 25 with a maximum smoke development of 200 when tested to ASTM E84.]
- B. Fabrication:
1. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved Shop Drawings and solid polymer manufacturer requirements. Form joints between components using manufacturer's standard joint adhesive without conspicuous joints. Provide factory cutouts for plumbing fittings and bath accessories as indicated on Drawings.
 2. Where indicated, thermoform corners and edges or other objects to shapes and sizes indicated on Drawings, prior to seaming and joining. Cut components larger than finished dimensions and sand edges to remove nicks and scratches. Heat entire component uniformly prior to forming.
 3. Ensure no blistering, whitening and cracking of components during forming.
 4. Fabricate backsplashes from solid surfacing material with optional radius cove where counter and backsplashes meet as indicated on Drawings. Backsplashes for most colors may be fabricated by traditional means discussed in K-25294 *Backsplashes*. Colors with metallic/mica particle or veined colors creating directional aesthetics (K-26833 *Directional Aesthetics*) may require the techniques in Technical Bulletin K-28235 *Thermoformed Backsplash*.
 5. Fabricate joints between components using manufacturer's standard joint adhesive. Ensure joints are inconspicuous in appearance and without voids. Attach 50 mm (2") wide reinforcing strip of solid polymer material under each joint. Reinforcing strip of solid polymer material is not required when using DuPont™ Joint Adhesive 2.0.
 6. Provide holes and cutouts for plumbing and bath accessories as indicated on Drawings.
 7. Rout and finish component edges to a smooth, uniform finish. Rout cutouts, then sand edges smooth. Repair or reject defective or inaccurate work.

SPEC NOTE: SELECT DESIRED FINISH OR WHERE MORE THAN 1 FINISH IS REQUIRED, ENSURE LOCATIONS OF DIFFERENT FINISHES ARE IDENTIFIED ON DRAWINGS.

8. Finish: Ensure surfaces have uniform finish:

SPEC NOTE: FOLLOWING IS STANDARD FINISH AND IS LOWEST MAINTENANCE FINISH.
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- a. Matte, with a 60° gloss rating of 5 - 20.
- 9. Fabrication Tolerances:
 - a. Variation in Component Size: +/-1/8".
 - b. Location of Openings: +/-1/8" from indicated location.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
 - 1. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 2. Verify actual site dimensions and location of adjacent materials prior to commencing work.
 - 3. Examine cabinets upon which counter tops are to be installed. Verify cabinets are level to within 1/8" in 10' - 0".
 - 4. Notify Architect in writing of any conditions which would be detrimental to installation.
- B. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.02 INSTALLATION

- A. Install components plumb, level, rigid, scribed to adjacent finishes in accordance with reviewed Shop Drawings and Product installation details.
- B. Fabricate field joints using manufacturer's recommended adhesive, with joints being inconspicuous in finished work. Exposed joints/seams are not permitted. Keep components and hands clean when making joints. Reinforce field joints as specified herein. Cut and finish component edges with clean, sharp returns.
- C. Route radii and contours to template. Anchor securely to base component or other supports. Align adjacent components and form seams to comply with manufacturer's written recommendations using adhesive in color to match work. Carefully dress joints smooth, remove surface scratches and clean entire surface.
- D. Install countertops with no more than 1/8" sag, bow or other variation from a straight line.
- E. Adhere undermount/submount/bevel mount sinks/bowls to countertops using manufacturer's recommended adhesive and mounting hardware.
- F. Adhere topmount sinks/bowls to countertops using manufacturer recommended adhesives and color-coordinated silicone sealant. [Secure seam mount bowls and sinks to counter tops using color matched joint adhesive.]
- G. Seal between wall and components with joint sealant as specified herein and in Section 07 90 00, as applicable.

- H. Provide backsplashes and endsplashes as indicated on Drawings. Adhere to countertops using a standard color-coordinated silicone sealant. Adhere applied sidesplashes to countertops using a standard color-matched silicone sealant. Provide coved backsplashes and sidesplashes at walls and adjacent millwork. Fabricate radius cove at intersection of counters with backsplashes to dimensions shown on reviewed Shop Drawings. Adhere to countertops using manufacturer's standard color-coordinated joint adhesive.
- I. Keep components and hands clean during installation. Remove adhesives, sealants and other stains. Ensure components are clean on date of Substantial Completion of the Work.
- J. Coordinate connections of plumbing fixtures with [Division 22] [Mechanical]. Make plumbing connections to sinks in accordance with [Division 22] [Mechanical].

3.03 REPAIR

- A. Repair minor imperfections and cracked seams and replace areas of severely damaged surfaces in accordance with manufacturer's "Technical Bulletins".

3.04 SITE QUALITY CONTROL

- A. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Architect at no cost to Owner.

3.05 CLEANING

- A. Remove excess adhesive and sealant from visible surfaces.
- B. Clean surfaces in accordance with manufacturer's "Care and Maintenance Instructions".

3.06 PROTECTION

- A. Provide protective coverings to prevent physical damage or staining following installation for duration of Project.
- B. Protect surfaces from damage until date of Substantial Completion of the Work.

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END OF SECTION

SECTION 06 83 16
FIBERGLASS REINFORCED PANELS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fiberglass reinforced plastic panels and accessories.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 09 25 00 - Gypsum Board.

1.02 PROJECT REQUIREMENTS

- A. Fiberglass reinforced plastic panels and accessories for kitchen and food preparation areas as indicated on the Drawings.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate location and dimension of joints and fastener attachments
- B. Samples: Submit 8 inch by 10 inch sample of each type, color, and accessories to be installed.
- C. Certificate of Compliance: Submit certificate from manufacturer the installed wall surfacing meets Specification requirements.

1.04 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 - 1. Class A Interior Finish Material as defined by the National Fire Protection Association Life Safety Code 101.
 - 2. Underwriters Laboratories, Inc. listed, in accordance with ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. USDA/FSIS Requirements.
 - 4. FMRC (Factory Material Research Center) approved.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in manufacturer's cartons properly labeled and identified.
- B. Store materials flat in a clean, dry storage area where temperature shall be maintained above 50 degrees F. Do not store rolls on end.

1.06 PROJECT CONDITIONS

- A. Installation environment shall be stable and controlled.
- B. Room temperature shall be controlled to 75 degrees F plus or minus 5 degrees, during and after installation.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Wall and/or ceiling panels: Crane Composites, Fire-X Glasbord FM with Surfaseal, , Marlite FRP Panel P-100 Class A, Panolam Industries International Inc., or equal.
 - 1. Wall Panels: Class 1 (A) Interior Finish. Thickness to be .09 inch, embossed, color as selected by Architect.
 - 2. Class A Flame Spread: Less than 25, with Smoke Developed less than 450, per ASTM E84.
 - 3. Barcol Hardness scratch resistance: 39 as per ASTM D2583, Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
 - 4. IZOD Impact per ASTM D256: 11.
- B. Extruded PVC with integral color profiles. Provide inside corner and outside corners, panel division and edge trim.
- C. Adhesive and Sealants: VOC compliant, as recommended by manufacturer.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Examine backup surfaces to determine corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.
- B. Do not begin installation until backup surfaces are in satisfactory condition.

3.02 APPLICATION

- A. Perform cutting with carbide tipped saw blades or drill bits, or cut with snips.
- B. Install panels with manufacturer's recommended gap for panel field and corner joints.
- C. Fastener holes in the panels shall be predrilled 1/8 inch oversize.
- D. For trowel type and application of adhesive, follow adhesive manufacturer's recommendations.
- E. Utilizing products acceptable to manufacturer, install the system in accordance with panel manufacturer's printed instructions.

3.03 CLEANING

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

**SECTION 07 17 75
WATER REPELLENT**

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 DESCRIPTION

- A. Principal Work in this Section:
 - 1. Clear water-repellent coating on exposed surfaces of concrete masonry units, cast-in-place concrete walls and caps.
- B. Related Work:
 - 1. Painting: Section 09 90 00.

1.03 SUBMITTALS

- A. Procedure: In compliance with Section 01 30 00.
- B. Manufacturer's Data: Submit data of the proposed coating, including recommended coverage rates.
- C. Samples: Submit samples of water-repellent coating applied to brick samples which will be furnished by the Architect.
- D. Coating Manufacturer:
 - 1. When requested, provide the coating manufacturer with sufficient samples of the substrate to be coated to determine exact formulation and coverage rates.
 - 2. Submit letter from the coating manufacturer to verify its acceptance of the applicator and acceptance of substrates as satisfactory to receive water-repellent coating.
 - 3. Submit duplicate copies of manufacturer's affidavit with each shipment of materials delivered to the jobsite certifying that material furnished complies with specified requirements.

1.04 QUALITY ASSURANCE

- A. Applicator's Qualifications: Firm with a minimum of 3 consecutive years of experience in application of the coating proposed for use on projects of similar size and scope, and licensed or approved in writing by the coating manufacturer.
- B. Manufacturer's Inspections: Obtain materials only from manufacturers who will send a qualified technical representative to the Project site for the following.
 - 1. Before start of this work to verify substrate acceptability, and as required thereafter to review installation procedures and completed work, and to issue warranty specified.

2. Unsatisfactory conditions disclosed by the manufacturer's visits to the site shall be promptly and satisfactorily repaired and the areas reinspected by the manufacturer before work starts or resumes in affected areas.

C. Sample Panel:

1. Apply water-repellent coating to one side of the sample panel specified in Section 04 21 00; identify the coated side.
2. Do not proceed with application at the site until the Architect's approval of the coated sample panel is obtained.

- D. Performance criteria: Coating selected shall meet the criteria specified below and shall show no through water penetration when tested in compliance with ASTM E 514 at a test pressure equal to that prescribed in Chapter 16 of the UBC for the wall height and location, but not less than 10 psf.

1.05 JOB CONDITIONS

- A. Comply with manufacturer's recommendations regarding environmental requirements, and temperature and conditions of surfaces to receive coating.

1.06 WARRANTY

- A. Warrant coating against water penetration through treated surfaces, peeling, cracking, discoloration and other defects of the coating, caused by faulty materials and workmanship, for 5 years after Substantial Completion.
- B. The warranty shall include repair of any defects and failures in the coating during the warranty period, at no additional cost to the District.

2.00 PRODUCTS

2.01 COATING / MANUFACTURER

A. Manufacturers:

1. Hydrozo, Inc.
2. Huls American, Inc.
3. Nox-Crete Chemicals.
4. ProSoCo Inc.

- B. The manufacturers listed above make acceptable products for use on the Project. The Contractor shall, with the selected product manufacturer's cooperation, select the appropriate coating for the substrate which meets the criteria specified herein and will perform as specified within the warranty period.

- C. The coating shall be invisible after application and shall not change the color and sheen of the coated substrate.

3.00 EXECUTION

3.01 INSPECTION / PREPARATION

- A. Verify that surfaces to be coated are clean, dry and free of dust, dirt, oil, grease, and other foreign material which would affect the application and performance of the coating.
- B. Make sure that unsuitable conditions which would prevent proper and timely completion, and performance of this work are corrected before starting with application.

3.02 PROTECTION

- A. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of water repellent.
- B. Cover adjoining and nearby surfaces where there is possibility of water-repellent being deposited on these surfaces.
- C. Clean water-repellent coating from adjoining and nearby surfaces immediately after spillage. Comply with manufacturer's recommendations for cleaning.

3.03 APPLICATION

- A. Where feasible delay application of water-repellent coatings until installation of sealants has been completed in joints adjoining surfaces to be coated with water-repellent.
- B. Apply by manufacturer approved applicators using recommended methods and equipment. Do not exceed the application rate recommended by the manufacturer.

3.04 FIELD QUALITY CONTROL

- A. The District may employ a testing agency to test the in-place walls in compliance with ASTM E 514.
- B. Cost of test will be paid by the District, except that should the test disclose that the wall tested does not comply with these Specifications, the cost of the test and subsequent retests shall be paid by the Contractor.
- C. In the event test shows that the wall(s) is deficient, apply additional water-repellent and repeat of the above referenced procedure on all remaining previously treated surfaces will be at the Contractor's expense.

END OF SECTION

**SECTION 07 21 00
BUILDING INSULATION**

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

A. Principal Work in this Section:

1. Thermal insulation at following locations unless otherwise indicated or specified:
 - a. In the ceilings and roofs of air-conditioned spaces.
 - b. Exterior wood stud walls.
 - c. Rigid insulation not used.
2. Acoustical insulation in all interior stud walls.
3. Supplementary parts and components, such as clips, fasteners, supplementary framing, and other miscellaneous accessories required for a complete installation.

B. Related Work:

1. Pipe and Duct Insulation, see mechanical and plumbing drawings.
2. Rigid Insulation at Single-Ply Roof: Reference Section 07 54 23 – Single-Ply Roofing.

1.03 SUBMITTALS

- A. Procedure: Comply with Section 01 30 00.
- B. Data: Manufacturer's data for materials specified below.

1.04 HANDLING

- A. Procedure: Comply with Section 01 60 00.
- B. Storage: Store insulation under cover, protected from moisture and off the ground or floor. Remove insulation that becomes wet or damp immediately from the job site.

2.00 PRODUCTS

2.01 MATERIALS

- A. Thermal Insulation: Insulation shall have a minimum "R" value of 30 in attic space below roof deck and "R" value of 19 in exterior metal stud walls. Provide wire support below roof deck as required.

1. Glass fiber or mineral wool batt or blanket insulation complying with ASTM C 665, Type III, Class A, flame spread 25 or less, by Schuller International, Inc., US Gypsum Co., Partek Insulations, Inc., CertainTeed Corp., Knauf, or Owens-Corning Fiberglas Corp. Flame spread 25, smoke development 50.
- B. Rigid Insulation: GAF Energy Guard Ultra Polyiso Insulation 4 inches thickness, "R" Value 23.6.
- C. Acoustical Insulation: Fiberglass Sound Attenuation Blankets by Owens Corning Co., Pyro-Fiber Sound Control Blankets by Schuller International, Inc., SAB Insulation by Partek Insulation, Inc., or FBX Sound Control Fire Blanket by Fibrex, of the thickness indicated. 3-1/2 inches thick, flame spread 10, smoke development 10, typical at all interior metal stud walls.
- C. Miscellaneous Materials:
 1. Staples, zinc-coated wires and other devices for fastening insulation: As recommended by the insulation manufacturer.
 2. Insulation Tape: "FSK Copolymer" by Compac Corp. (800) 631-9347, General Purpose FSK Facing Tape by Venture Tape (800) 343-1076, or equal FSK-faced cold weather tape a minimum of 2 in. wide.
 3. Roof insulation shall be supported by 19-gage wire, 2'0" O.C., at right angle to direction of roof joists if applicable, at underside of roof deck.

3.00 EXECUTION

3.01 INSPECTION / PREPARATION

- A. Verify conditions and measurements affecting the work of this Section at site. Make sure that detrimental conditions are corrected before proceeding with installation.
- B. Before installing insulation in stud walls, thoroughly clean sill plate of debris.

3.02 INSTALLATION

- A. Install insulation where shown and specified. Cut to fit irregular spaces, butt edges into firm contact with each other and adjoining surfaces.
 1. Hand pack around pipes, ducts, conduits, electrical boxes, and other penetrations as required to thoroughly fill all voids and spaces between framing members and to form a continuous thermal or acoustical barrier.
 2. Do not compress insulation more than 10%.
 3. Where door and window frames occur in insulated assemblies, cut additional strips of insulation and handpack to fill all voids in and around the frames.
 4. Comply with the California Electrical Code (CEC) for installation in proximity to light fixtures. Do not install insulation closer than recommended by CEC.
 5. Install foil-faced insulation with foil facing the building interior.
- B. In stud walls more than 8 ft. high, and where the insulation is not self-supporting, attach acoustical insulation to gypsum board using staples with divergent points placed at each corner and at 24 in. o.c. thereafter.

- C. After installation is complete, tape penetrations and ruptures in vapor barrier at ceiling or roof insulation, and tape joints between batts continuously.
- D. In staggered stud partitions, install insulation horizontally and weave through the studs.

3.03 FIELD QUALITY CONTROL

- A. Prior to closing-in of insulated assemblies, or prior to Substantial Completion for insulation that will remain exposed in the building, refit, reinstall and/or replace wet, damaged and displaced insulation.

END OF SECTION

**SECTION 07 41 00
METAL ROOFING PANELS**

1.0 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including the Conditions of the Contract and Division 01 Specification Sections apply to this section.

1.2 SUMMARY

- A. Work described in this section includes pre-formed metal roofing system complete with clips, perimeter and penetration flashing, and closures.
- B. Scope of Work
1. Mechanically fasten insulation to the deck per ASCE 7-16. Install R-mer Seal underlayment 45 mil SBS peel-and-stick over insulation assembly.
 2. Install R-mer Span 24-gauge steel panels and clips per ASCE 7-16.
 3. Install gutters and downspouts fabricated from 24-gauge Kynar coated metal to match roof assembly color.
 4. Contractor to supply 5-year labor and materials warranty. The contractor responsible for submitting ASCE 7-16 calculations and must be geographic and site-specific.
 5. Manufacturer to supply 30-year No Dollar Limit Leak Warranty covering workmanship and materials to include low slop roof section for one 30 NDL warranty.

- A. CMAS Instructions: TBD

1. *All products in bold underlined will be partially furnished by the Owner. All products not in bold shall be furnished by the contractor. All the products in bold writing will be manufactured by The Garland Company and purchased by owner using its authority under the CMAS contract.
2. Contract #: 47QSWA20D002X
GSA Contract #: GS-07F-0130K (THE GARLAND COMPANY, INC.)
3. Owner will supply bidding contractors with the amount of purchased materials at the end of this section. All other materials required to complete construction per these construction documents are the sole responsibility of the contractor and shall be inclusive of the bid.
4. The Contractor is responsible for receiving of all Owner purchased material. Upon receipt contractor assumes full liability for owner purchased materials. Contractor will assume full responsibility for safe storage and protection of Owner purchased material. Unless otherwise agreed to contractor will receive owner purchased material via FOB Garland, unload and store materials.
5. Owner purchased material: TBD

- C. Related Sections:

1. Section 07 05 00 - Common Work Results for Thermal and Moisture Protection.
2. Section 07 01 41 - Maintenance of Manufactured Metal Roofing Panels.

D. Related Work Specified Elsewhere:

1. Division 05 Section - Metal Decking
2. Division 06 Section - Rough Carpentry for Wood Substrate Components
3. Division 07 Section - Roof Insulation
4. Division 07 Section - Above-Grade Vapor Barriers
5. Division 07 Section - Sheet Metal Flashing and Trim
6. Division 07 Section - Roof Specialties
7. Section 07 01 40 Maintenance of Manufactured Metal Roofing Panels
8. Division 08 Section - Roof Windows and Skylights
9. Division 26 Section - Facility Lightning Protection Systems

1.3 REFERENCES

A. American Architectural Manufacturer Association (AAMA):

1. AAMA 501.1 Standard Test Method for Metal Curtain Walls for Water Penetration using Dynamic Pressure.

B. American Iron and Steel Institute (AISI):

1. 1996 Edition Specification for the Design of Cold-Formed Steel Structural Members.

C. American Society of Civil Engineers (ASCE):

1. ASCE 7-05 Minimum Design Loads for Buildings and Other Structures.

D. American Society for Testing and Materials (ASTM):

1. ASTM A792 Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
2. ASTM A875 Standard Specification for Steel Sheet, Zinc-5% Aluminum Alloy-Coated by the Hot Dip Process.
3. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
4. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
5. ASTM D1056 Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
6. ASTM D3575 Standard Test Methods for Flexible Cellular Materials Made From Olefin Polymers.

7. ASTM E283 Standard Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
8. ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
9. ASTM E1592 Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
10. ASTM E1646 Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
11. ASTM E1680 Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
12. ASTM E2140 - Standard Test Method for Water Penetration of Metal Roof Panel Systems by Static Water Pressure Head

E. Testing Application Standards TAS

1. TAS 100 Test Procedure for Wind and Wind Driven Rain Resistance of Discontinuous Roof Systems
2. TAS 125 Standard Requirements for Metal Roofing Systems
3. TAS 114 app. G Test Procedure for Susceptibility to Leakage of Discontinuous Roof Systems

F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

1. Architectural Sheet Metal Manual, 5th edition.

G. Underwriters' Laboratories (UL):

1. UL 263 Fire Tests of Building Constructions and Materials.
2. UL 580 Tests for Uplift Resistance of Roof Assemblies.
3. UL 790 Tests for Fire Resistance of Roof Covering Materials.

H. Factory Mutual Research (FM):

1. FM 4471 Approval Standard for Class 1 Panel Roofs.

1.4 SUBMITTALS FOR REVIEW

- A. Shop Drawings showing layout of every roof panel and structural supporting member required in the installation with side laps and end laps marked within 1% deviation of their actual location.
 1. Provide details for edge conditions, seams, joints, corners, panel profiles, assembly anchoring techniques, round and square flashings and counter flashings.
- B. Samples illustrating thickness, finish, color and textures of materials.
- C. Product Data: Include manufacturer's detailed material and system description, panel and field seam installation instructions, engineering performance and finish specifications. Indicate hat channel and fastener spacing if applicable.

- D. Specimen Warranty: Provide an unexecuted copy of the warranty specified for this Project, identifying the terms and conditions required of the Manufacturer and the Owner.
- E. Any material submitted as equal to the specified material must be accompanied by a report signed and sealed by a professional engineer licensed in the state in which the installation is to take place. This report shall show that the submitted equal meets the Design and Performance criteria in this specification. Substitution requests submitted without licensed engineer approval will be rejected for non-conformance.

1.5 SUBMITTALS FOR INFORMATION

- A. Design and Test Reports: Provide the following certified test reports from an independent testing laboratory:
 - 1. Independent laboratory testing report for system design load and seam integrity.
 - 2. Professional engineer's documentation that roofing system incorporates sufficient allowance for stress and movement.
 - 3. A letter from an officer of the manufacturing company certifying that the materials furnished for this project are the same as represented in tests and supporting data.
 - 4. Manufacturer's verifications that the panels are factory roll formed.
 - 5. ASTM E1592: Test results must clearly demonstrate compliance with the following requirements:
 - a. The ultimate test failure load shall be reduced by the safety factor specified in article 1.11 to determine the allowable working load for the panel system.
 - b. The proposed system has been tested to insure that the allowable working load of the panel system meets or exceeds the specified negative wind uplift pressures listed in article 1.11 of this specification for all roof zones.
 - c. The test results are applicable for the thickness, width, and profile specified. Results are not applicable for systems that are thinner or wider than the system which was tested. If the tested material was not the specialty material specified herein (for instance, the tested material was galvalume steel), then the test results shall be reduced by the ratio of the yield strength (Fy) of the specified material to the tested material.
 - d. The results must clearly show that the allowable clip spacing meets or exceeds the requirements specified in section 3.3.C for all roof areas. Clip spacing shall not be reduced for any roof zone from that which is specified.
 - 6. ASTM E283 and E331: Test results must clearly demonstrate compliance with the performance requirements specified in article 1.11.
 - 7. ASTM E1646 and E1680: Test results must clearly demonstrate compliance with the performance requirements specified in article 1.11. Results are not applicable for systems that are thinner, wider, lower grade, or different material/profile than the system which was tested. The differential test pressures must be identical to those specified in article 1.11.
 - 8. UL 580: The proposed roof panel shall be listed as UL 580, Class 1-90.
 - 9. UL 790: The proposed roof panel shall be listed as a non-combustible roof covering material and be approved for use in a UL classification assembly.

10. UL 263: The proposed roof panel shall be listed for use in a UL fire rated construction assembly.
 11. FM 4471: Test report must be submitted for windstorm rating no less than that specified in article 1.11. The proposed roof system must have approval over the specified substrate with clips spaced as specified in article 3.3.C for roof Zone 1.
 12. AAMA 501.1: Test report shall show passed ratings for panel type as specified.
 13. TAS 100: Test report shall show passed ratings for panel type as specified.
 14. TAS 125: Test report shall show rating no less than that as specified in article 1.11.
 15. TAS 114 appendix G: Test report shall show passed ratings for panel type as specified.
 16. ASTM E2140: Test report shall show passed ratings for panel type as specified.
- B. Mill production reports certifying that the steel thicknesses are within allowable tolerances of the nominal or minimum thickness or gauge specified.
- C. Design Loads: Submit copy of manufacturer's minimum design load calculations according to ASCE 7-16, Method 2 for Components and Cladding. In no case shall the design loads be taken to be less than those detailed in Design and Performance Criteria article.
- D. Qualification Data for Roofing Installer: Refer to Quality Assurance Article below.
- E. Certification of work progress inspection frequency: Refer to Quality Assurance Article below.
- F. Pre-installation Roofing Conference Proceedings: Refer to Quality Assurance Article below.

1.6 CONTRACT CLOSEOUT SUBMITTALS

- A. General: Comply with Requirements of Division 01 Section Closeout Submittals.
- B. Special Project Warranty: Provide specified warranty for the Project, executed by the authorized agent of the Manufacturer.
- C. Roofing Maintenance Instructions: Provide a manual of manufacturer's recommendations for maintenance of installed roofing systems.
- D. Insurance Certification: Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.
- E. Demonstration and Training Schedule: Provide a schedule of proposed dates and times for instruction of Owner's personnel in the maintenance requirements for completed roofing work. Refer to Part 3 for additional requirements.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an Installer who has completed the Manufacturer's Approved Roofing Contractor course and is currently certified for the installation of this roof system.
- B. If required, fabricator/installer shall submit work experience and evidence of adequate financial Responsibility. The Owner's representative reserves the right to inspect fabrication facilities in determining qualifications.

- C. Source Limitations: Obtain all components of roof system from a single manufacturer, including roll goods materials if required. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer.
1. Upon request of the Architect or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.
 2. Manufacturer shall have direct authority and control over all fabrication of steel components as well as the raw materials used in their fabrication.
- D. Source Quality Control: Manufacturer shall have in place a documented, standardized quality control program such as ISO-9001 approval.
- E. Engage the Manufacturer's Field Representative to conduct required periodic inspections of work in progress as described herein and shall furnish written documentation of all such inspections.
- F. Manufacturer shall provide the project Owner with a written statement that they will provide a site inspection every day that confirms that the project is being constructed as specified, by an experienced, full time employee of the company.
- G. Alternate Manufacturers: The following manufacturer criteria must be submitted. Alternate systems will not be considered for approval unless each of these items has been submitted for review at least 10 business days prior to bid opening:
1. Submit each item listed in article 1.4 (A through E) for evaluation of the proposed system.
 2. Tests shall have been made for identical systems within the ranges of specified performance criteria.
 3. Empirical calculations for roof performance shall only be acceptable for positive loads.
 4. A list of a minimum of five (5) jobs where the proposed alternate material was used under similar conditions. The reference list shall include date of project, size of project, project address, and telephone number of architect/owner contact.
 5. A financial statement demonstrating a minimum of a 3:1 ratio of assets to liabilities.
 6. A written statement from the manufacturer stating that they will provide the building owner with a daily site inspection for a minimum of one (1) hour per day by an experienced, full time employee of the company.
 7. A written statement from the manufacturer stating that they will provide the engineer of record with a daily site inspection by an experienced full time employee of the company.
 8. A written statement from a corporate officer of the manufacturing company stating that he or she has reviewed the specifications and confirms that the proposed system meets or exceeds all performance requirements listed as well as meets the panel size, gauge, weight, clip design, sealant design, uplift pressures and height of the vertical seam
 9. A copy of manufacturer's 30 year warranty. Warranty must include coverage for all trim, flashing, and penetrations associated with this roof.
 10. Proof that the manufacturer has been in business for a minimum number of years equal to the warranty period required for this project.
- H. Site Formed Panels: Panels in excess of shippable length shall be formed on-site. Site formed panels shall meet each of the following requirements. Site formed panels are prohibited. All metal panels must be factory pre-manufactured and engineered for this project.

1. Panels shall be formed on heavy duty factory type roll formers. Roll formers shall gradually form the panel profile utilizing no fewer than twelve (12) forming stations to improve quality and minimize oil canning.
 2. All tooling shall be polished and tempered to a minimum hardness of Rockwell C - 52. Tooling shall be maintained clean and in good working condition. Tooling repairs or modifications made by means of welding, sawing, grinding, or the like are unacceptable, as they may contribute to poor quality, aesthetics, and performance of the end product.
 3. Panels shall be of identical profile and characteristics as factory formed panels and specimens used as the basis of performance tests.
 4. Sealant shall be factory applied in a separate factory formed snap on cap. Site/field applied seam sealant is unacceptable. Seam caps may be shipped in forty-five (45) feet or less length and lap spliced over full length panels in accordance with manufacturer's system details.
 5. Site roll forming equipment shall be operated by a trained full time experienced technician. The installer must provide additional personnel to handle raw materials and finished product as necessary.
- I. Mechanically Curved Panels: Panels shall be mechanically curved to the exact radius of each curved roof area. Panels may be mechanically curved in the factory or on site. Mechanical curving equipment shall be operated by a full time experienced technician.
1. Flat panels conformed to the roof shape are not acceptable and will be rejected.
- J. Tapered Panels: Tapered panels shall be formed from a single piece of metal. Tapered panels formed from multiple pieces of joined metal are unacceptable. All performance tests must be applicable for the greatest panel width of the tapered panels. Tapered panels must be designed to accommodate thermal expansion and contraction while fixed at the narrowest end of the panel.

1.8 PRE-INSTALLATION CONFERENCE

- A. Convene a pre-roofing conference approximately two (2) weeks before scheduled commencement of roofing system installation and associated work.
- B. Require attendance of installer of each component of associated work: installers of deck or substrate construction to receive roofing work; installers of rooftop units and other work in and around roofing which must precede or follow roofing work (including mechanical work if any); Architect; Owner; roofing system manufacturer's representative; and other representatives directly concerned with performance of the Work, including (where applicable) Owner's insurers, testing agencies and governing authorities.
- C. Objectives of conference to include:
 1. Review foreseeable methods and procedures related to roofing work, including set up and mobilization areas for stored material and work area.
 2. Tour representative areas of roofing substrates (decks) inspect and discuss condition of substrate, roof drains, curbs, penetrations and other preparatory work performed by others.
 3. Review structural loading limitations of deck and inspect deck for loss of flatness and for required attachment.
 4. Review roofing system requirements (drawings, specifications and other contract documents).
 5. Review required submittals both completed and yet to be completed.

6. Review and finalize construction schedule related to roofing work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
 7. Review required inspection, testing, certifying and material usage accounting procedures.
 8. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing (if not mandatory requirement).
 9. Record discussion of conference including decisions and agreements (or disagreements) reached. Furnish a copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.
 10. Review notification procedures for inclement weather or non-working days.
- D. The Owner's Representative will designate one of the conference participants to record the proceedings and promptly distribute them to the participants for record.
- E. The intent of the conference is to resolve issues affecting the installation and performance of roofing work. Do not proceed with roofing work until such issues are resolved to the satisfaction of the Owner and Engineer of Record. This shall not be construed as interference with the progress of Work on the part of the Owner or Engineer of Record.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Responsibilities:

1. All roof panels shall be shipped from the manufacturer with strippable film or similar packaging material separating the individual panels to minimize flexing, stressing, scratching or otherwise damaging the material during transit to the job.
2. Fully cover panels with tarpaulins or similar protective cover during transit to prevent dirt and debris from coming in contact with the finished goods.

B. Installer's Responsibilities:

1. Stack pre-finished materials to prevent twisting, bending, abrasion and denting and elevate one end to facilitate moisture run-off.
2. Unload roof panels using a boom or crane, supporting the panels in at least two locations during lifting, and never lift more than three panels at a time.
3. Protect moisture-sensitive and water-based materials from the weather.
4. Inspect materials upon delivery. Reject and remove physically damaged or marred material from project site.

1.10 PROJECT CONDITIONS

A. Determine that work of other trades will not hamper or conflict with necessary fabrication, storage and protection requirements for roofing system.

1. Protection:

- a. Protect completed roofing from subsequent construction operations. Comply with Manufacturer's recommendations.

- b. Do not overload roof with stored materials.
 - c. Support no roof-mounted equipment directly on the roofing system.
- B. Ascertain that work of other trades which penetrates the roof or is to be made watertight per Manufacturer's recommendations and approved prior to installation of roofing.

1.11 DESIGN AND PERFORMANCE CRITERIA

A. Thermal Expansion and Contraction:

1. Completed metal roofing and flashing system shall be capable of withstanding expansion and contraction of components caused by changes in temperature without buckling; producing excess stress on: structure, anchors or fasteners; or reducing performance ability.
2. The design temperature differential shall be not less than [insert design temperature differential (200° F)].
3. Interface between panel and clip shall provide for unlimited thermal movement in each direction along the longitudinal direction.
4. Location of metal roofing rigid connector shall be at roof ridge unless otherwise approved by the Project Architect. Metal ridge connector may require design as per job conditions by specified manufacturer.

B. Uniform Wind Load Capacity: TBD upon completion of ASCE 7-16 and ASTM E 1592

1. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with the following criteria. Anchor clips shall be installed exactly as spacing given in article 3.3.
 - a. Design Code: ASCE 7-16, Method 2 for Components and Cladding.
2. Capacity shall be determined using pleated airbag method in accordance with ASTM E1592, testing of sheet metal roof panels. Allowable safe working loads shall be determined by dividing the ultimate test load by the safety factor specified above.

C. Uniform Positive Load Capacity.

1. The installed roof system shall be capable of resisting the following positive uniform roof loads: Roof Live Load of 20 psf.
2. Capacity to resist positive loads shall be determined by empirical calculations in accordance with AISI. Calculation shall be sealed by a registered professional engineer.
3. Installed roof system shall carry positive uniform design loads with a maximum system deflection of L/180 as measured at the rib (web) of the panel.
4. Dead Load: Loading of the roof structure, due to tear off of existing, and/or installation of new roofing materials shall not exceed the present loading.

D. Underwriters' Laboratories, Inc., (UL) fire resistance P ratings for roof assemblies: If applicable, panel system shall be approved for use in an appropriate Construction Assembly, as defined by UL 263.

E. Underwriters' Laboratories, Inc., (UL), wind uplift resistance classification: Roof assembly shall be classified as Class 1-90, as defined by UL 580.

- F. Underwriters' Laboratories, Inc., (UL) Class A fire rating per UL 790.
- G. ASTM E283: Static pressure air infiltration (doors, windows, curtain walls):
 - 1. Pressure Leakage Rate
 - a. 1.57 PSF 0.0007 cfm/sq.ft.
 - b. 6.24 PSF 0.0002 cfm/sq.ft.
 - c. 20.0 PSF 0.0036 cfm/sq.ft.
- H. ASTM E331: Static pressure water infiltration (doors, windows, curtain walls):
 - 1. Pressure Result:
 - a. 5 Gal. /Hr. per S.F. and Static No Leakage
 - b. Pressure of 20.0 Psf. for 15 minutes
- I. ASTM E1680: Static pressure air infiltration (roof panels):
 - 1. Pressure Leakage Rate:
 - a. 1.57 PSF 0.0012 cfm/sq.ft.
 - b. 6.24 PSF 0.0001 cfm/sq.ft.
 - c. 20.0 PSF 0.0011 cfm/sq.ft.
 - 1. Pressure Leakage Rate:
 - a. 1.57 PSF 0.0054 cfm/sq.ft.
 - b. 6.24 PSF 0.0054 cfm/sq.ft.
 - c. 20.0 PSF 0.0027 cfm/sq.ft.
- J. ASTM E1646: Static pressure water infiltration (roof panels):
 - 1. Pressure Result:
 - a. 5 Gal. /Hr. per S.F. and Static No Leakage
 - b. Pressure of 20.0 Psf for 15 minutes
- K. Capacities for gauge, span or loading other than those tested may be determined by interpolation of test results within the range of test data. Extrapolations for conditions outside test range are not acceptable.
- L. Water penetration (dynamic pressure): No water penetration, other than condensation, when exposed to dynamic rain and 70 mph wind velocities for not less than five minutes duration, when tested in accord with principles of AAMA 501.1.
- M. Wind and wind driven rain resistance: No water penetration or panel movement when exposed to 110 mph wind velocities when tested in accordance with TAS 100.

- N. The installed roof system assembly shall show that it can resist the calculated roof pressure in section 1.11.B in accordance with the test results of TAS 125.
- O. Water penetration in low slope applications: No water penetration or panel movement when subject to 6" head of water for 6 hrs when tested in accordance with the ASTM E2140 and when subject to 6" head of water for 7 days when tested in accordance with the TAS 114 appendix G.

1.12 WARRANTIES

- A. Manufacturer shall execute a single warranty covering of the following criteria. Multiple-source warranties are not acceptable.
 - 1. Manufacturer's 30 NDL year watertight warranty, including coverage for all trim, flashings, penetrations, and low slope roof section associated with the roof area.
 - 2. 30 year coverage on finish including checking, crazing, peeling, chalking, fading and/or adhesion.
 - 3. Warranty shall commence on date of substantial completion or final payment, whichever is agreed by contract.
 - 4. Installer shall provide manufacturer with 5 year warranty covering roofing system installation and water tightness.
 - 5. Provide a single warranty by a single approved manufacturer for standing seam roof areas, membrane roof areas, and transitions between the two material types.

1.13 MANUFACTURER'S INSPECTIONS

- A. When the project is in progress, the roofing system manufacturer will inspect the work not less than 5 days per week. In addition, the manufacturer will:
 - 1. Keep the Architect or Owner informed as to the progress and quality of the work as observed.
 - 2. Report to the Architect in writing any failure or refusal of the Contractor to correct unacceptable practices called to the Contractor's attention.
 - 3. Confirm after completion that manufacturer has observed no application procedures in conflict with the specifications other than those that may have been previously reported and corrected.

2.0 PRODUCTS

2.1 PRODUCTS, GENERAL

- A. Refer to Division 01 Section "Common Product Requirements."
- B. Basis of Design: Materials, manufacturer's product designations, and/or manufacturer's names specified herein shall be regarded as the minimum standard of quality required for work of this Section. Comply with all manufacturer and contractor/fabricator quality and performance criteria specified in Part 1.

2.2 ACCEPTABLE MANUFACTURERS

- A. The design is based upon R-MER Span roofing systems engineered and manufactured by the Garland Company for owner.

The Garland Company
3800 East 91st Street
Cleveland, Ohio 44105
Sean Magee
Telephone: (310) 420 0713
smagee@garlandind.com

2.3 STANDING SEAM ROOFING SYSTEM

A. General.

1. The products, quality, and performance criteria specified shall be regarded as the minimum standard of quality required for the project.
2. Basis of Design: R-MER Span System manufactured by the Garland Company, Cleveland, OH.

B. Materials.

1. Panel Material: 24 ga. Galvanized steel, G90, smooth as per ASTM A653-96.
2. Flashing and flat stock material: Fabricate in profiles indicated on drawings of same material, thickness, and finish as roof system, unless indicated otherwise.
3. Flat stock material for fabrication, gutters, and downspouts must come from same coil and manufacture of Standing Seam panels.

C. Finish on Surfaces.

1. Exposed surfaces for coated panels:
 - a. Two coat coil applied, baked-on full-strength (70% resin) fluorocarbon coating system (polyvinylidene fluoride, PVF2), applied by manufacturer's approved applicator.
 - b. Coating system shall provide nominal 1.0 mil dry film thickness, consisting of primer and color coat.
 - c. Color: Custom color selected by architect. Color shall be
 - d. Fluorocarbon baked Kynar flat stock used for fabrication must be sourced from metal panel manufacturer to ensure continuity of color.
2. Unexposed surfaces for coated panels shall be baked-on polyester coating with .20 - .30 dry film thickness (TDF).
3. Exposed and unexposed surfaces for uncoated panels shall be as shipped from the mill.

D. Characteristics.

1. Provide the same panel profile from a single manufacturer for all standing seam roof areas.
2. Provide standing seam panels incorporating mechanically interlocked, concealed anchor clips allowing unlimited thermal movement, and of configuration which will prevent entrance or passage of water.

- a. Panel/Cap configuration must have a total of four (4) layers of steel surrounding anchor clip for prevention of water infiltration and increased system strength designed to limit potential for panel blow-off.
 - b. Profile of panel shall have mesa's every two (2) inches on center continuous throughout panel which are a minimum of one and one-half (1-1/2) inches wide.
 - c. Exposed fasteners, screws and/or roof mastic are unacceptable and will be rejected. System configuration only allows for exposed fasteners at panel overlap (if required) and trim details (as per manufacturer's guidelines).
 - d. Provide panels in continuous lengths from ridge to eave with no overlaps unless approved by manufacturer, in writing.
 - e. Panels lengths which exceed maximum shipping lengths shall be field rolled on equipment owned by the panel manufacturer. Seam sealant must be factory applied.
 - f. Seam caps shall be manufactured in the factory and may be installed with end laps. Seam sealant must be factory applied.
 - g. Curved panels shall be mechanically curved to the exact radius of each curved roof area. Panels may be mechanically curved in the factory or on site. Flat panels field-conformed to the roof shape are unacceptable and will be rejected.
 - h. Tapered Panels: Tapered panels shall be formed from a single piece of metal. Tapered panels formed from multiple pieces of joined metal are unacceptable. All performance tests must be applicable for the greatest panel width of the tapered panels. Tapered panels must be designed to accommodate thermal expansion and contraction while fixed at the narrowest end of the panel.
3. Seam must be two and three-eighths (2-3/8) inches minimum height for added upward pressures and aesthetic appeal. Seam shall have continuous anchor reveals to allow anchor clips to resist positive and negative loading and allow unlimited expansion and contraction of panels due to thermal changes. Integral (not mechanically sealed) seams are unacceptable.
 3. Concealed Standard Anchor Clips: Clips must be sixteen (16) gauge Galvalume steel, ONE (1) piece clip with projecting legs for additional panel alignment and provision for unlimited thermal movement in each direction along the longitudinal dimension.
 4. Seam cap: Snap-on cap shall be a minimum of [1" or 2"] wide "T" shaped of continuous length up to forty-five (45) feet according to job conditions and field seamed by means of manufacturer's standard seaming machine.
 - a. Cap shall be designed to receive two (2) beads of continuous hot applied gasketing sealant, which will be applied independent of anchor clip, to allow unlimited thermal movement of panel without damage to cap sealant.
 - b. Sealant shall be a SIS (Styrene-Isoprene-Styrene) block copolymer type thermoplastic rubber adhesive, non-fatigue water barrier.
 5. Standing Seam Panel Width: 18".
 7. Stiffening ribs: Located in flat of panel to minimize oil canning and telegraphing of structural members.

8. Replace ability: Panels shall be of a symmetrical design with snap on, mechanically seamed cap configuration such that individual panels may be removable for replacement without removing adjacent panels.
9. Panel ends shall be panned at ridge, headwall, and hip conditions, or where applicable.
10. Panel length: Full length without joints, including bends.

E. Accessories.

1. Gable anchor clips for:
 - a. Standing Seam style.
 - b. Galvalume steel, type AZ-55, minimum thickness: 16 gauge
2. Fasteners:
 - a. Concealed fasteners: Corrosion resistant steel fasteners (zinc plated, stainless steel or equal) designed to meet structural loading requirements. Provide #14 as the minimum fastener size.
 - b. Exposed fasteners: Series 410 stainless steel fasteners or one-eighth (1/8) inch diameter stainless steel waterproof rivets. All exposed fasteners shall be factory painted to match the color of the standing seam panels.
3. Closures: Factory precut closed cell foam meeting ASTM D1056 or ASTM D3575, enclosed in metal channel matching panels when used at hip, ridge, rake, and jamb.
4. Provide all miscellaneous accessories for complete installation.
5. Panel joint (end lap) sealant: Non-curing modified isobutylene tri-polymer tape of thickness to fully adhere to both surfaces being joined with indicated service life of 20 years.

2.4 ACCESSORY PRODUCTS

A. Sealant:

1. Acceptable product:
 - a. Concealed Application: Garland Non-curing butyl sealant.
 - b. Exposed Application: Garland SS sealant.
2. Colors: As selected by architect from sealant manufacturer's standard selection.

B. Underlayment:

1. Underlayment shall be applied over entire roof area.
 - a. Apply R-mer Seal 45 mil self adhering sheet shingle fashion over the entire roof area beginning at the low end of the roof section. Allow for four inch (4") side laps and eight inch (8") end laps.
 - b. Turn sheet up and over parapets and curbing.
 - c. Do not permit traffic over unprotected deck surface.

2.5 FABRICATION

- A. Shop fabricate metal roofing and flashing components to the maximum extent possible, forming metal work with clear, sharp, straight, and uniform bends and rises. Hem exposed edges of flashings.
- B. Form flashing components from full single width sheet in minimum ten (10) foot lengths. Provide shop fabricated, mitered corners, joined using closed end pop rivets and joint sealant.
- C. Fabricate roofing and related sheet metal work in accordance with approved shop drawings and applicable standards.

3.0 EXECUTION

3.1 EXECUTION, GENERAL

- A. Comply with requirements of Division 01 Section "Common Execution Requirements."

3.2 PREPARATION

- A. Design system so that the panel installation may be started and/or terminated at any given point in the area.
 - 1. It is understood that the ongoing operations of the Owner are of a critical nature as to leak sensitivity. Do not work on more roof area than can be restored completely watertight in one day.
- B. Remove existing loose material, dirt and debris from the roof area. All accumulations of asphalt or other repair materials shall be removed to provide a smooth, flat substrate without imperfections that will be evident in the finished work.
 - 1. Existing metal details and other metal accessories specified for re-use that interfere with the installation of the new roof system shall be carefully removed and set aside for re-use.
 - 2. Any metal described above that will come in contact with the new roof shall be checked for type and replaced or protected if galvanic action may be a problem.
- C. Strip existing contaminating material from all metal components that are indicated to be re-utilized. Protect these metal components. Replace damaged components with new of similar type and dimension.
- D. Replace wood blocks and/or sleepers indicated to be replaced with new redwood, or other form of blocking acceptable to the Manufacturer.
 - 1. Do not use pressure-treated wood or materials corrosive to steel. Provide Material Safety Data Sheets to the roofing manufacturer for verification prior to installation.
- E. Remove pipes, conduits or equipment indicated to be abandoned and removed.
- F. All curbs, soil stacks, and other interior flashing surfaces shall be extended to a minimum of eight (8) inches above the new horizontal roof surface or shall be pressure sealed at the top edge.

3.3 INSTALLATION, GENERAL

- A. Install roof system when the atmospheric dry bulb temperature is minimum forty (40) degrees Fahrenheit and rising.

- B. Install all components of the roof system in exact accordance with the manufacturer's standard published procedures as applicable to these project conditions and substrates.
- C. Install all required vapor retarder, air seals and preliminary tapered insulating substrates required per enclosed specifications.
- D. Lay out and anchor all roof framing sections or purlins according to the approved roof plan.

3.4 ROOFING AND FLASHING INSTALLATION

- A. Comply with all details and install roofing materials and flashings in accordance with approved shop drawings and manufacturer's product data within specified erection tolerances.
- B. Prepare roof for the installation of standing seam panels, including:
 - 1. Install all decking, framing, and/or furring members as indicated in this specification and bid documents.
 - 2. Install all insulation, vapor retarder, and/or air infiltration barriers as indicated in this specification and bid documents. Ensure insulation joints are offset and not aligned.
 - 3. Install all underlayment's and/or temporary water proofing materials as required in this specification and bid documents.
- C. Directly over the completed roof substrate, install one (1) piece panel anchor clips. [All anchor clips will be set on sixteen (16) gauge galvanized, pre-punched bearing plates to distribute the loads on the board insulation] All anchor clips will be fastened into the structural roof substrate based on the following spacing pattern.
 - 1. Clip spacing must be per ASCE 7-16 and shop drawings for Zone 1 (field)
 - 2. Clip spacing must be ASCE 7-16 and shop drawings for Zone 2 (eave, [ridge, hip,] and rake).
 - 3. Clip spacing must be per ASCE 7-16 and shop drawings for Zone 3 (corners)
 - 4. Clip spacing for Zones 2 & 3 per ASCE 7-16 and shop drawings.
- D. Installation of Roof Panels: Roof panels can be installed by starting from either end and working towards the opposite end. Due to the symmetrical design of the specified panel system, it is also acceptable to start from the middle of the roof and work toward each end.
 - 1. A stainless steel pop rivet shall be secured through the anchor reveal of the panel leg and extend into the arms of the panel clip located at the ridge of the system. Provide at each arm of the clip along the ridge. The panel is then anchored at both sides of the clip.
 - a. Capture all drilling debris during this operation with a rag or cloth placed on the panels at the drilling operation.
 - b. Panels are not securely attached to the roof until fixed to the anchor clip. To avoid damage and injury, all panels shall be fixed to the anchor clip immediately as they are installed.
 - 2. Un-installed panels which are temporarily stored on the ground or roof shall be secured in place at the end of each day's work to prevent possible damage or injury.

3. A hand crimping tool is used to crimp the cap around the top of two adjacent panels
 4. Caps shall then be permanently seamed with manufacturer's mechanical seamer.
 5. At the end of each day's work, seam caps shall be mechanically seamed or hand crimped (crimp 4 inches every 8 feet) to reduce the possibility of wind damage prior to completion of the project.
 6. Un-installed panels which are temporarily stored on the ground or roof shall be secured in place at the end of each day's work to prevent possible damage or injury.
- E. Isolate dissimilar metals and masonry or concrete from metals with bituminous coating. Use gasketed fasteners where required to prevent corrosive action between fastener, substrate, and panels.
- F. Limit exposed fasteners to extent indicated on shop drawings.
- G. Anchorage shall allow for temperature expansion/contraction movement without stress or elongation of panels, clips, or anchors. Attach clips to structural substrate using fasteners of size and spacing as determined by manufacturer's design analysis to resist specified uplift and thermal movement forces.
- H. Seal laps and joints in accordance with roofing system manufacturer's product data.
- I. Provide for temperature expansion/contraction movement of panels at roof penetrations and roof mounted equipment in accordance with system manufacturer's product data and design calculations.
- J. Installed system shall be true to line and plane and free of dents, and physical defects. In light gauge panels with wide flat surfaces, some oil canning may be present. Oil canning does not affect the finish or structural integrity of the panel and is therefore not cause for rejection.
- K. Maximum variation from true planes or lines shall be one-fourth (1/4) inch in twenty (20) feet and three-eighths (3/8) inch in forty (40) feet or more.
- L. Form joints in linear sheet metal to allow for one-fourth (1/4) inch minimum expansion at twenty (20) feet on center maximum and eight (8) feet from corners.
- M. At joints in linear sheet metal items, set sheet metal items in two (2) one-fourth (1/4) inch beads of butyl sealant. Extend sealant over all metal surfaces. Mate components for positive seal. Allow no sealant to migrate onto exposed surfaces.
- N. Remove damaged work and replace with new, undamaged components.
- O. Touch up exposed fasteners using paint furnished by roofing panel manufacturer and matching exposed panel surface finish.
- P. Clean exposed surfaces of roofing and accessories after completion of installation. Leave in clean condition at date of substantial completion. Touch up minor abrasions and scratches in finish.

3.5 CLEANING

- A. Clean installed work in accordance with the manufacturer's instructions.
- B. Replace damaged work than cannot be restored by normal cleaning methods.

3.6 CONSTRUCTION WASTE MANAGEMENT

- A. Remove and properly dispose of waste products generated during roofing procedures. Comply with requirements of authorities having jurisdiction

3.7 FINAL INSPECTION

- A. At completion of roofing installation and associated work, meet with Contractor, Architect, installer, installer of associated work, Owner, roofing system manufacturer's representative and other representatives directly concerned with performance of roofing system.
- B. Inspect roofing work and flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each party in attendance.
- C. Repair or replace deteriorated or defective work found at time of above inspection as required to produce an installation which is free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- D. Notify the Architect and Owner upon completion of corrections.
- E. Following the final inspection, provide written notice of acceptance of the installation from the roofing system manufacturer.
- F. Immediately correct roof leakage during construction. If the Contractor does not respond within twenty four (24) hours, the Owner will exercise rights to correct the Work under the terms of the Conditions of the Contract.

3.8 DEMONSTRATION AND TRAINING

- A. At a time and date agreed to by the Owner, instruct the Owner's facility manager, or other representative designated by the Owner, on the following procedures:
 - 1. Roof troubleshooting procedures.
 - 2. Notification procedures for reporting leaks or other apparent roofing problems.
 - 3. Roofing maintenance.
 - 4. The Owner's obligations for maintaining the roofing warranty in effect and force.
 - 5. The Manufacturer's obligations for maintaining the roofing warranty in effect and force.

END OF SECTION 07 41 00.001

SECTION 07 42 13 METAL WALL PANELS

This specification is applicable for IMETCO ELEMENT concealed clip rainscreen wall panel system.

1.0 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY.

- A. Work described in this section includes single-skin, labyrinth-joint metal cladding panels for rainscreen-principle wall system, complete with sub-structural metal framing, perimeter and penetration flashing, and closures.
- B. Related work specified elsewhere:
 - 1. Division 05: Steel studs, girts, and furring.
 - 2. Division 06: Gypsum sheathing, wood sheathing, rough carpentry.
 - 3. Division 07: Flashing and sheet metal, water resistive air barriers, thermal insulation, joint sealants.

1.5 DEFINITIONS

- A. American Architectural Manufacturer Association (AAMA):
 - 1. AAMA 509-09: Voluntary Test and Classification Method for Drained and Back Ventilated Rain Screen Wall Cladding Systems.
 - 2. AAMA 508-07: Voluntary Test and Specification for Pressure Equalized Rain Screen Wall Cladding Systems.
 - 3. AAMA 621-96: Voluntary/Standard Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) & Zinc-Aluminum Coated Steel Substrates
 - 4. AAMA 2605-11: Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- B. American Iron and Steel Institute (AISI):
 - 1. S100-07: 2007 Edition of the North American Specification for the Design of Cold-Formed Steel Structural Members.
- C. American Society for Testing and Materials (ASTM):
 - 1. A240-12: Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
 - 2. A653-03: Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

3. A755-03: Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Pre-painted by the Coil-Coating Process for Exterior Exposed Building Products.
 4. A792-03: Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 5. B69-08: Standard Specification for Rolled Zinc.
 6. B209-02a: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 7. B370-11e1: Standard Specification for Copper Sheet and Strip for Building Construction.
 8. D968-05e1: Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasion.
 9. E330-02(2010): Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
 10. E1886-02: Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
 11. E1996-09 Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
- D. ICC-ES Evaluation with CBC Supplement (must be valid)
- E. European Norm (EN):
1. EN988 (1996): Specifications for Zinc and Zinc Alloy Rolled Flat Products for Building.
- F. National Association of Architectural Metal Manufacturers (NAAMM)
1. Metal Finishes Manual for Architectural and Metal Products.
- G. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
1. Architectural Sheet Metal Manual, 6th edition.

1.6 DESIGN AND PERFORMANCE CRITERIA.

- A. General Performance: Metal wall panel assemblies shall be furnished and installed without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Rainscreen Wall System Performance Rating. The metal wall panel assemblies, and the substructural furring/framing system supporting the panels shall be tested in accordance with AAMA 509 and achieve the following performance results:
1. Water Infiltration: The water infiltration performance of the metal wall panel assembly shall not exceed the classification of W-1.
 2. Back Ventilation: The air ventilation performance of the rainscreen cavity air space shall have a minimum classification of V-4.

- C. Rainscreen Wall System Performance Rating. The metal wall panel assemblies, and the substructural furring/framing system supporting the panels shall be tested in accordance with AAMA 508-07 and achieve the following performance results: PASS.
- D. Thermal Expansion and Contraction.
 - 1. Completed metal wall panel and flashing system shall be capable of withstanding expansion and contraction of components caused by changes in temperature without buckling, or reducing performance ability.
 - 2. The design temperature differential shall be not less than 220 degrees Fahrenheit.
 - 3. Interface between panel and clip shall provide for unlimited thermal movement in each direction along the longitudinal direction.
- E. Uniform Wind Load Capacity.
 - 1. Installed wall system shall withstand negative wind pressures complying with the following criteria.
 - a. Design Code: ASCE 7, Method 2 for Components and Cladding.
 - b. Safety Factor: The metal panel system shall be tested to proof load of 1.5 times the design service load condition, as required by the ASTM E330 method.
 - c. Category III Building with an Importance Factor of 1.00.
 - d. Wind Speed: 127 mph [LRFD]; 95 mph [ASD].
 - e. Exposure Category: C.
 - f. Height at Top of Wall System: 12 feet.
 - g. Minimum Building Width: 50 feet.
 - h. Roof Pitch (Above Wall System): 2 inches per foot.

Wall Area Negative Wind Pressure:

Zone 4 - Field of Wall: -51.1 psf [LRFD]; -30.6 [ASD]

Zone 5 - Wall Edges: -60.4 psf [LRFD]; -36.2 [ASD]

The "a" dimension used to determine the width (measured from the corner of the building) of wall zone 5 shall be 4'-10" feet.

- 2. The ultimate capacity of the panel system shall be determined based on performance testing in accordance with ICC Report ESR-4646.

- F. The product used must be listed under a valid ICC-ES Evaluation Report.

1.7 SUBMITTALS.

- A. General, Rainscreen Wall Assembly Components: Complete submittals shall be made jointly and simultaneously for all components of the Rainscreen wall assembly, including:
 - 1. Exterior wall sheathing board, if applicable;
 - 2. Air and water resistive barrier;

3. Vapor retarders and/or barriers, if applicable;
4. Rainscreen wall continuous exterior insulation;
5. Metal rainscreen wall cladding panels and sub framing components;
6. All other trim, flashing, sealants, and components necessary for a complete rainscreen wall assembly as required by these specifications.

B. Shop drawings.

1. Show complete rain screen wall system with air and water barrier(s), vapor retarder (if applicable), continuous exterior insulation, sub framing system, metal cladding panels, ventilation components, flashings and accessories in elevation, sections, and details. Include metal thicknesses and finishes, panel lengths, joining details, anchorage details, flashings and special fabrication provisions for termination and penetrations. Indicate relationships with adjacent and interfacing work.
2. All components shall be integrated into a single comprehensive and complete shop drawing set prepared by the metal cladding system manufacturer.
3. Shop drawings shall identify each product and component by manufacturer, product name, and thickness, size, style, or other uniquely distinguishing characteristics.
4. Shop drawings shall be signed and sealed by a Professional Engineer or Registered Architect authorized to practice in the jurisdiction of the project location.

C. Warranty: Provide unexecuted specimen warranty documents for each warranty as required in specification article 1.10.

D. Design Test Reports.

1. Submit copies of design test reports for each of the performance testing standards listed in specification article 1.4.
2. Test reports shall be performed by independent, accredited testing laboratories, and shall bear the seal of a registered professional engineer.

E. Samples.

1. Submit sample of panel section, at least 6" x 6" showing seam profile, and also a sample of color selected.
2. Submit sample field applied sealants and all other system components.

1.8 QUALITY CRITERIA/INSTALLER QUALIFICATIONS.

- A. Engage an experienced metal wall panel contractor (erector) to install wall panel system who has a minimum of three (3) years experience specializing in the installation of Rainscreen metal wall systems.
- B. Contractor must be certified by manufacturer specified as a supplier of the metal wall system and obtain written certification from manufacturer that installer is approved for installation of the specified system.
- C. Successful contractor must obtain all components of Rainscreen wall system from a single manufacturer. Any secondary products that are required which cannot be supplied by the specified manufacturer must be recommended and approved in writing by primary manufacturer prior to bidding.

- D. Fabricator/Installer shall submit work experience and evidence of adequate financial responsibility. Architect reserves the right to inspect fabrication facilities in determining qualifications.

1.9 DELIVERY, STORAGE, AND HANDLING.

- A. Inspect materials upon delivery.
- B. Handle materials to prevent damage.
- C. Store materials off ground providing for drainage; under cover providing for air circulation and preventing direct UV exposure; and protected from any debris.

1.10 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit metal wall panel work to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Verify actual dimensions of construction contiguous with metal wall panels by field measurements before fabrication.

1.11 COORDINATION

- B. Coordinate sizes and locations of windows, doors, and wall penetrations with actual equipment provided.
- A. Coordinate metal wall cladding system with wall sheathing, masonry, air and water resistive barriers, thermal insulation, rain drainage work, flashing, trim, and construction of other adjoining work to provide a leak proof, secure, and noncorrosive installation.

1.13 WARRANTIES

- A. Special Manufacturer's Rainscreen Wall Assembly Warranty: The metal wall cladding system must be approved for use in the Rainscreen wall assembly in conjunction with the air and water resistive barrier and exterior continuous insulation system; the use of the specified metal wall cladding system shall not nullify any manufacturers' warranties required elsewhere in this specification. In particular, the use of the specified, substitute, or alternate metal wall cladding panel system shall be certified prior to bid by the air and water resistive barrier manufacturer as acceptable for furnishing the warranty required of the air and water resistive barrier manufacturer.
- B. The Manufacturer shall furnish the following warranties for materials and finishes:
 - 1. Exterior metal cladding system Manufacturer's 20 year warranty against defective materials and fabrication.
 - 1. Exterior metal cladding system Manufacturer's 20 year warranty for performance of prefinished finishes. The finish warranty shall provide coverage for the following:
 - a. Fade Resistance: For a period of 20-years from date of first exposure to UV or weathering, the post-painted material finishes shall exhibit no more than a 5 "delta E" rating for color change from original color standard.

- b. Chalk Resistance: For a period of 20-years from date of first exposure to UV or weathering, the post-painted material finishes shall exhibit a chalk rating of 8 or less, in accordance with ASTM D4214, Method A.
 - c. Film Integrity: For a period of 20-years from date of first exposure to UV or weathering, the post-painted material finishes shall not chip, peel, crack, or blister as a result of defective coatings, improper preparation of the substrate, improper application of the coatings, or improper curing of the coating system.
- 1. Exterior metal cladding system Manufacturer's warranty for performance of Post-painted aluminum finishes. The finish warranty shall provide coverage for the following:
 - a. Fade Resistance: For a period of 10-years from date of first exposure to UV or weathering, the post-painted material finishes shall exhibit no more than a 5 "delta E" rating for color change from original color standard.
 - b. Chalk Resistance: For a period of 10-years from date of first exposure to UV or weathering, the post-painted material finishes shall exhibit a chalk rating of 8 or less, in accordance with ASTM D4214, Method A.
 - c. Gloss Retention: For a period of 10-years from date of first exposure to UV or weathering, the post-painted material finishes shall retain at least 50% of original Specular Gloss, as measured in accordance with ASTM D523.
 - d. Film Integrity: For a period of 20-years from date of first exposure to UV or weathering, the post-painted material finishes shall not chip, peel, crack, or blister as a result of defective coatings, improper preparation of the substrate, improper application of the coatings, or improper curing of the coating system.
- B. Installer's 3 year warranty covering wall panel system installation and watertightness.
- C. Warranties shall commence on date of substantial completion.

2.0 PRODUCTS

1.16 PANEL MATERIALS

A. Painted Aluminum Sheet.

- 1. Recycle Content: Provide steel sheet with average recycled content such that postconsumer recycled content plus one-half of pre-consumer recycled content is at least 45 percent.
- 2. 0.080" aluminum alloy 3003, 3004, 3005, or 3105 with H14 or H24 heat treatment, as per ASTM B209/209M.
- 3. Texture: Smooth surface.
- 4. Prefinished Painted Aluminum:
 - a. Exposed Surfaces: 2-Coat Fluoropolymer finish in accordance with AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Manufacturers' approved applicator to prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

- b. Exposed surface coating system shall provide nominal 1.0 mil (0.025 mm) dry film thickness, consisting of primer and color coat.
- a. Color shall be IMETCO's Standard
- b. Color shall be selected from IMETCO's Standard Colors
- c. Color: Custom color selected by architect
- d. Color shall be: TBD.
- a. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

2. Post-Painted Aluminum

- a. Exposed Surfaces: 2-Coat Fluoropolymer finish in accordance with AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Coating manufacturer's approved applicator to prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- b. Exposed surface coating system shall provide nominal 1.2 mil (0.030 mm) dry film thickness, consisting of primer and color coat.
- a. Color: Custom color selected by architect.
- b. Color shall be: TBD.
- a. Concealed Finish: The unexposed sheet surfaces shall be bare as furnished by the mill. Overspray of primer and/or top coat(s) will not will not affect the use or performance of the unexposed surface of the material.

B. Sealants:

- 1. Sealant Tape: Non-curing, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1-inch- (13-mm-) wide and 1/16-inch- (3-mm-) thick.
- 2. Exposed Sealant: ASTM C 920; elastomeric tripolymer, polyurethane, or other advanced polymer sealant; of type, grade, class, and use classifications required to seal joints in metal wall panels and remain weathertight; and as recommended in writing by metal wall panel manufacturer.
- 3. Concealed Sealant: ASTM C 1311: Butyl-Based, Solvent-Release, One-Part Sealant.

2.13 METAL SUBFRAMING

- A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653, G90 (Z275) hot-dip galvanized
- B. Horizontal Hat-shaped Vented Girts:
 - 1. Dimensions:
 - a. Nominal Thickness: 0.043-inch (18 gauge) (1.1-mm) nominal thickness.
 - b. Depth: 1-inch (22 mm) nominal.
 - c. Top flange: 2-1/2 inches (63.5 mm) nominal.

- d. Bottom Flanges: 1-3/8 inches (35 mm) nominal with 1/4 inch (6 mm) holes punched at 8" on center in each flange.
 - 2. Free air flow: The vented girt shall not restrict chimney effect air convection in the vertical direction. The vented girt webs shall have slotted holes providing for 31% free air flow and weep holes for water drainage.
 - 3. Drainage: Web segments of vented girt shall be formed such that when installed in the horizontal orientation the web segments are inclined at least 15 degrees from horizontal to promote drainage and prevent retention of standing water.
 - 4. Provide certified testing report by 3rd party independent testing lab showing the loading of the sub-girt attached directly through the insulation. The max deflection of such test should be no more than 1/16".
- C. Fasteners for Metal Sub-framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal sub-framing members through insulation and sheathing boards into structural wall framing or substrates.

2.14 CONCEALED CLIP – REVEAL JOINT METAL WALL PANELS

- A. General: Provide factory-formed metal wall panels designed to be field assembled by interlocking seams and incorporating concealed fasteners.
- B. Concealed clip, longitudinal lap-seam panel with labyrinth-joint and reveal on four sides.
 - 1. Panel shall be IMETCO ELEMENT Wall system as manufactured by Innovative Metals Company, Inc. (IMETCO); Norcross, Georgia; telephone 1-800-646-3826.
 - 2. Alternate manufacturers are subject to full compliance with specification requirements, and shall be submitted for approval as follows.
 - a. Manufacturers not listed above must submit for approval, ten (10) days prior to bid date, the following: Manufacturer's literature; certification of testing in accordance with specification requirements and sections 1.4 and 1.5; sample warranties in accordance with specification section 1.10; installer qualifications in accordance with specification section 1.6, and a list of five (5) similar projects in size and scope of work.
 - b. No substitutions will be permitted after the bid date of this project.
 - 3. Material: Aluminum sheet, 0.080 inch (0.2.0 mm) thick. See 2.1 for finishes and color selection.
 - 4. Characteristics.
 - a. Fabrication: Panels shall be factory formed from specified metal.
 - b. The standard profile shall be flat pans with reveal joints on all four sides.
 - c. Panel orientation: Horizontal.
 - d. Configuration (Horizontal): Panel shall be 8-inches- (203-mm-) up to 30-inches- (406-mm-) high nominal by 12-inches- (305-mm-) up to 144-inches- (3658-mm-) long nominal, with interlocking seams incorporating concealed fasteners.
 - e. Panel Depth (Concealed Leg Height): 1 inch (25.0 mm), nominal.

- f. Reveal Joint: Panel seams shall join such that adjacent panels form vertical and horizontal reveal joints **3/4-inch- (19-mm-) min** or max **1-inch- (25-mm-)** wide.
 - 1) Horizontal reveal joints shall be aligned from panel to panel, as shown on drawings.
 - 2) Vertical reveal joints shall be aligned from panel to panel, as shown on drawings.
- g. End Folds: Panel ends shall be factory notched by automatic mechanical press equipment to form end tabs of **1 inch (25 mm)** nominal length. The end tabs shall be factory folded 90 degrees to produce a “box pan” effect and allow for reveal joints on all four sides of the panel. Vertically oriented panels to have a double end fold.
- h. Backer Board: Factory adhere a **5/8-inch- (15-mm-)** thick extruded polystyrene foam backer board in the panel cavity for improved panel flatness.

2.15 ACCESSORIES

- B. Wall Panel Accessories: Provide components approved by panel manufacturer and as required for a complete metal wall panel assembly including trim, corner units, closures, clips, flashings, sealants, gaskets, fillers, and similar items. Match material and finish of metal wall panels unless otherwise indicated.
 - 3. Anchor Clips: Clips shall be 18 gauge **[stainless]** steel designed to allow thermal movement of the panel in each direction along the longitudinal dimension.
 - 4. Gutter Splice at Vertical Reveal: At the vertical reveal joint, a sheet metal gutter splice shall be provided in the same material type and finish as the metal cladding panels for all visible space at the reveal joint. Gutter splice material thickness shall be as recommended by manufacturer based on panel height.
 - 5. Corner Units: Provide factory fabricated mitered corner units of the same profile(s) as specified. Corner units shall be furnished for outside and inside corner conditions.
 - 6. Ventilation strips shall be provided at top of wall panels, window sills, and transitions between metal panels and other exterior finish materials to allow for air exhaust at top of wall cavity. Vent strips shall be internally baffled to prevent wind driven rain from freely entering the wall cavity.
 - 7. Ventilation strips shall be provided at base of wall panels, window head, and transitions between metal panels and other exterior finish materials to allow for air intake and water weep holes at bottom of wall cavity.
- C. Flashing and Trim: Formed from same material, finish, and gauge as wall panels. Provide flashing and trim as required to provide finished appearance. Locations include, but are not limited to, head, sill, corners, jambs, framed openings, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

2.16 FABRICATION

- B. Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Form flashing components from full single width sheet in minimum 10'-0" (3 m) sections. Provide mitered trim corners, joined using closed end pop rivets and butyl-based, solvent released one-part sealant.
- E. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
 - 3. 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.
 - 4. Sealed Joints: Form nonexpanding but movable joints in metal to accommodate butyl-based sealant to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA's "Architectural Sheet Metal Manual" or by metal wall panel manufacturer for application, but not less than thickness of metal being secured.

2.17 FINISHES

- B. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- C. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Prevent unpainted metals from contact with oils or solvents, including fingerprints, which may cause staining of the natural finishes.
- E. 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. Note that some variation is anticipated and acceptable when natural (unpainted) material finishes are specified.

3.0 EXECUTION

2.18 EXAMINATION

- B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of the Work.

- A. Examine primary and secondary wall framing to verify that girts, studs, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal wall panel manufacturer.
- B. Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
- C. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.
- A. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PREPARATION

- A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.
- B. Establish straight, side and crosswise benchmarks
- C. All walls shall be checked for square and straightness. Inside and outside corners may not be plumb; set a true line for the corner flashing with string line.
- D. Measure the wall lengthwise to confirm panel lengths and verify clearances for thermal movement.

3.5 METAL SUBFRAMING INSTALLATION

- A. Install metal subframing directly over continuous thermal insulation. Metal subframing shall attach to the structural wall elements with screw fasteners. Metal subframing shall be spaced as necessary to accommodate the required clip spacing for the metal cladding panels.
- B. Attachments shall be as recommended by the metal claddings system manufacturer's approved shop drawings.

3.6 METAL WALL PANEL INSTALLATION

- A. All details will be installed in accordance with approved shop drawings and manufacturer's product data, within specified erection tolerances.

- A. Directly over the completed wall substrate, fasten the top flange of the panel to the metal subframing using panel clips. All panels clips will be fastened into the metal subframing as indicated on the metal cladding panel manufacturer's approved shop drawings.
- B. Installation of Wall Panels: Wall panels can be installed by starting from one end and working towards the opposite end (vertical orientation), or from the bottom of wall working towards the top of the wall (horizontal orientation).
- C. Metal wall panels and trim must be installed only in accordance with the manufacturer's recommendation for acceptable temperature range.
- D. Isolate dissimilar metals and masonry or concrete from metals with bituminous coating. Use gasketed fasteners where required to prevent corrosive action between fastener, substrate, and panels.
- E. Limit exposed fasteners to extent indicated on contract drawings.
- F. Seal laps and joints in accordance with metal cladding panel system manufacturer's product data.
- G. Coordinate flashing and sheet metal work to provide weathertight conditions at wall terminations. Fabricate and install in accordance with standards of SMACNA Manual.
- H. Provide for temperature expansion/contraction movement of panels at wall penetrations and wall mounted equipment in accordance with system manufacturer's product data and design calculations.
- I. Installed system shall be true to line and plane and free of dents, and physical defects. In light gauge panels with wide flat surfaces, some oil canning may be present. Oil canning does not affect the finish or structural integrity of the panel and is therefore not cause for rejection.
- J. At joints in linear sheet metal items, other than metal cladding panels which are intended to provide ventilation, set sheet metal items in two **1/4-inch- (6-mm-)** beads of butyl sealant. Extend sealant over all metal surfaces. Mate components for positive seal. Allow no sealant to migrate onto exposed surfaces.
- K. Remove damaged work and replace with new, undamaged components.
- L. Touch up exposed fasteners using paint furnished by the panel manufacturer and matching exposed panel surface finish.
- M. Clean exposed surfaces of wall panels and accessories after completion of installation. Leave in clean condition at date of substantial completion. Touch up minor abrasions and scratches in finish.

3.8 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal wall panel units within installed tolerance of **1/4 inch in 20 feet (6 mm in 6 m)** at location lines as indicated and within **1/16-inch (1.5-mm)** offset of adjoining faces and of alignment of matching profiles.

3.9 FIELD QUALITY CONTROL

- A. All Metal Panels delivered to the site should have ICC label on the boxes.**
- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect metal wall panel installation, including accessories. Report results in writing.

- B. Remove and replace applications of metal wall panels where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 CLEANING

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

END OF SECTION

SECTION 07 52 00
MODIFIED BITUMINOUS ROOFING WITH
KEE STONE FB 60 MIL MEMBRANE - COLD APPLIED-VOC FREE

1.0 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including the Conditions of the Contract and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

- A. Section includes modified bituminous roofing system KEE FB 60 two-ply system.

Scope of Work

1. Mechanically fasten polyisocyanurate insulation to wood deck in accordance with ASCE 7-16 to provide at least R-30 insulating value. Then, adhere ½" DensDeck Prime in InsuLock adhesive per ASCE 7-16.
2. Install FlexBase 80, 15% post-consumer recycled content, LEED 10% MR 4 recycled content, UL Environment Certified in Green Lock Membrane Adhesive
3. Install KEE-Stone fleece back cap sheet in KEE-Lock Foam Adhesive utilizing splatter pattern per ASCE 7-16. Prior to application brush or blow clean entire surface of the modified membrane. For the field application broom in and apply weighted roller.
4. All parapet wall flashing and curbs to have non-fleece back KEE-Stone 60 set in KEE-Lock Flashing adhesive.
5. Ensure all laps are kept clean to ensure proper heat welding of seams. Install KEE-Stone Utility Sheet in all inside and outside corners for reinforcement. Seal all termination bars with Tuff-Stuff non-sag urethane sealant. Install jacks on all penetrations.
6. Furnish and install Dura-Block supports at a minimum 8 ft. O.C. and install new clamps/hardware. Blocking to be adhered to a single ply separation layer and then separation layer to float freely on roof.
7. Install coping cap, gutters and downspouts in 24 gauge, Kynar-coated metal. Color to be selected by Architect
8. Contractor to supply with 5-year material and labor warranty. Manufacturer to supply 30 Year No Dollar limit leak Warranty.

- B. CMAS Instructions: N/A

1. *All products in bold underlined will be partially furnished by the City. All products not in bold shall be furnished by the contractor. All the products in bold writing will be manufactured by The Garland Company and purchased by City of Ridgecrest using its authority under the CMAS contract.

2. Contract #: 47QSWA20D002X
GSA Contract #: GS-07F-0130K (THE GARLAND COMPANY, INC.)

3. City of Ridgecrest will supply bidding contractors with the amount of purchased materials at the end of this section. All other materials required to complete construction per these construction documents are the sole responsibility of the contractor and shall be inclusive of the bid.

4. The Contractor is responsible for receiving of all Owner purchased material. Upon receipt contractor assumes full liability for Owner purchased materials. Contractor will assume full responsibility for safe storage and protection of Owner purchased material. Unless otherwise agreed to, contractor will receive Owner purchased material via FOB Garland, unload and store materials at designated City location.

5. Owner Purchased materials are: N/A

1.3 REFERENCES

A. American Society of Civil Engineers (ASCE):

1. ASCE 7-05, Minimum Design Loads for Buildings and Other Structures.

B. American Society for Testing and Materials (ASTM):

1. ASTM D41 Standard Specification for Asphalt Primer Used in Roofing, Dampproofing and Waterproofing.
2. ASTM D312 Standard Specification for Asphalt Used in Roofing.
3. ASTM D451 Standard Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products.
4. ASTM D1079 Standard Terminology Relating to Roofing, Waterproofing and Bituminous Materials.
5. ASTM D1227 Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
6. ASTM D1863 Standard Specification for Mineral Aggregate Used as a Protective Coating for Roofing.
7. ASTM D2178 Standard Specification for Asphalt Glass Felt Used as a Protective Coating for Roofing.
8. ASTM D2822 Standard Specification for Asphalt Roof Cement.
9. ASTM D2824 Standard Specification for Aluminum-Pigmented Asphalt Roof Coating.
10. ASTM D4601 Standard Specification for Asphalt Coated Glass Fiber Base Sheet Used in Roofing.
11. ASTM D5147 Standard Test Method for Sampling and Testing Modified Bituminous Sheet Materials.

12. ASTM D6162 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.
 13. ASTM D6163 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements.
 14. ASTM E108 Standard Test Methods for Fire Test of Roof Coverings.
- C. Factory Mutual Research (FM):
1. Roof Assembly Classifications.
- D. National Roofing Contractors Association (NRCA):
1. Roofing and Waterproofing Manual.
- E. Underwriters Laboratories, Inc. (UL):
1. Fire Hazard Classifications.
- F. Warnock Hersey (WH):
1. Fire Hazard Classifications.
- G. American National Standards Institute and Single Ply Roofing Institute (ANSI/SPRI)
1. ANSI/SPRI ES-1 Testing and Certification Listing of Shop Fabricated Edge Metal

1.4 SUBMITTALS FOR REVIEW

- A. Product Data: Provide manufacturer's technical product data for each type of roofing product specified. Include data substantiating that materials comply with specified requirements.
- B. Samples: Submit two (2) samples of the following:
- C. Specimen Warranty: Provide an unexecuted copy of the warranty specified for this Project, identifying the terms and conditions required of the Manufacturer and the Owner.

1.5 SUBMITTALS FOR INFORMATION

- A. Manufacturer's Installation Instructions: Submit installation instructions and recommendations indicating special precautions required for installing the membrane.
- B. Manufacturer's Certificate: Certify that roof system furnished is approved by Factory Mutual, Underwriters Laboratories, Warnock Hersey or approved third party testing facility in accordance with ASTM E108, Class A for external fire and meets local or nationally recognized building codes.
- C. Manufacturer's Certificate: Certify that materials are manufactured in the United States and conform to requirements specified herein, are chemically and physically compatible with each other, and are suitable for inclusion within the total roof system specified herein.
- D. Manufacturer's Certificate: Submit a certified copy of the roofing manufacturer's ISO 9001 compliance certificate.
- E. Test Reports: Submit test reports, prepared by an independent testing agency, for all modified bituminous sheet roofing, indicating compliance with ASTM D5147.

- F. Written certification from the roofing system manufacturer certifying the applicator is currently authorized for the installation of the specified roof system.
- G. Design Loads: Submit copy of manufacturer's minimum design load calculations according to ASCE 7-16 and ASNI/SPRI ES1, Method 2 for Components and Cladding, sealed by a registered professional engineer. In no case shall the design loads be taken to be less than those detailed in Design and Performance Criteria article of this specification.

1.6 CONTRACT CLOSEOUT SUBMITTALS

- A. General: Comply with Requirements of Division 01 Section - Closeout Submittals.
- B. Special Project Warranty: Provide specified warranty for the Project, executed by the authorized agent of the Manufacturer.
- C. Roofing Maintenance Instructions. Provide a manual of manufacturer's recommendations for maintenance of installed roofing systems.
- D. Insurance Certification: Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with not less than [12] years documented experience [and have ISO 9001 certification].
- B. Installer Qualifications: Company specializing in modified bituminous roofing installation with not less than [5] years experience and authorized by roofing system manufacturer as qualified to install manufacturer's roofing materials.
- C. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress. Maintain proper supervision of workmen.
- D. Maintain a copy of the Contract Documents in the possession of the Supervisor/Foreman and on the roof at all times.
- E. Source Limitations: Obtain all components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer.
 - 1. Upon request of the Architect or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.
- F. Source Quality Control: Manufacturer shall have in place a documented, standardized quality control program such as ISO-9001.

1.8 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Roofing Conference: Convene a pre-roofing conference approximately two (2) weeks before scheduled commencement of modified bituminous roofing system installation and associated work.
- B. Require attendance of installer of each component of associated work, installers of deck or substrate construction to receive roofing work, installers of rooftop units and other work in and around roofing that must precede or follow roofing work (including mechanical work if any), Architect, Owner, roofing system manufacturer's representative, and other representatives directly

concerned with performance of the Work, including (where applicable) Owner's insurers, testing agencies and governing authorities. Objectives of conference include:

1. Review foreseeable methods and procedures related to roofing work, including set up and mobilization areas for stored material and work area.
 2. Tour representative areas of roofing substrates (decks), inspect and discuss condition of substrate, roof drains, curbs, penetrations and other preparatory work performed by others.
 3. Review structural loading limitations of deck and inspect deck for loss of flatness and for required attachment.
 4. Review roofing system requirements (drawings, specifications and other contract documents).
 5. Review required submittals both completed and yet to be completed.
 6. Review and finalize construction schedule related to roofing work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
 7. Review required inspection, testing, certifying and material usage accounting procedures.
 8. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing (if not mandatory requirement).
 9. Record discussion of conference including decisions and agreements (or disagreements) reached and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.
 10. Review notification procedures for weather or non-working days.
- C. The Owner's Representative will designate one of the conference participants to record the proceedings and promptly distribute them to the participants for record.
- D. The intent of the conference is to resolve issues affecting the installation and performance of roofing work. Do not proceed with roofing work until such issues are resolved to the satisfaction of the Owner. This shall not be construed as interference with the progress of Work on the part of the Owner.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site with seals and labels intact, in manufacturer's original containers, dry and undamaged.
- B. Store and handle roofing sheets in a dry, well-ventilated, weather-tight place to prevent moisture exposure. Store rolls of felt and other sheet materials on pallets or other raised surface. Stand all roll materials on end. Cover roll goods with a canvas tarpaulin or other breathable material (not polyethylene).
- C. Do not leave unused materials on the roof overnight or when roofing work is not in progress unless protected from weather and other moisture sources.
- D. Secure all material and equipment on the job site. If any material or equipment is stored on the roof, assure that the integrity of the deck is not compromised at any time. Damage to the deck

caused by the Contractor's actions will be the sole responsibility of the Contractor, and the deck will be repaired or replaced at his expense.

1.10 MANUFACTURER'S INSPECTIONS

- A. When the Project is in progress, the roofing system manufacturer will provide the following:
 - 1. Report progress and quality of the work as observed.
 - 2. Provide job site inspections three days per week.
 - 3. Report to the Owner in writing any failure or refusal of the Contractor to correct unacceptable practices called to the Contractor's attention.
 - 4. Confirm after completion that manufacturer has observed no application procedures in conflict with the specifications other than those that may have been previously reported and corrected.

1.11 PROJECT CONDITIONS

- A. Proceed with roofing work only when existing and forecasted weather conditions will permit a unit of work to be installed in accordance with manufacturer's recommendations and warranty requirements.
- B. Do not apply roofing insulation or membrane to damp deck surface.
- C. Do not expose materials subject to water or solar damage in quantities greater than can be weatherproofed during same day.
- D. All slopes greater than 2:12 require back-nailing to prevent slippage of the ply sheets. Use ring or spiral-shank one (1) inch cap nails, or screws and plates at a rate of one (1) fastener per ply (including the membrane) at each insulation stop. Place insulation stops at 16 ft o.c. for slopes less than 3:12 and four (4) ft o.c. for slopes greater than 3:12. On non-insulated systems, nail each ply directly into the deck at the rate specified above. When slope exceeds 2:12, install all plies parallel to the slope (strapping) to facilitate backnailing. Install four (4) additional fasteners at the upper edge of the membrane when strapping the plies.

1.12 SEQUENCING AND SCHEDULING

- A. Sequence installation of roofing with related units of work specified in other Sections to ensure that roof assemblies, including roof accessories, flashing, trim and joint sealers, are protected against damage from effects of weather, corrosion and adjacent construction activity.
- B. Complete all roofing field assembly work each day. Phased construction will not be accepted.

1.13 WARRANTY

- A. Upon completion of installation, and acceptance by the Owner and Architect, the Manufacturer will supply to the Owner a 30 year no dollar limit leak warranty.
- B. Installer will submit a 5-year warranty to the membrane manufacturer with a copy directly to Owner.

1.14 DESIGN AND PERFORMANCE CRITERIA

- A. Uniform Wind Uplift Load Capacity

1. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with ASCE 7-16 and ANSI/SPRI ES1. Calculations must be job an site specific.

B. Live Load: Consult with AOR and IOR prior to increasing live load.

2.0 PRODUCTS

2.1 PRODUCTS, GENERAL

- A. Refer to Division 01 Section Common Product Requirements.
- B. Basis of Design: Materials, manufacturer's product designations, and/or manufacturer's names specified herein shall be regarded as the minimum standard of quality required for work of this Section. Comply with all manufacturer and contractor/fabricator quality and performance criteria specified in Part 1.

2.2 ACCEPTABLE MANUFACTURERS

- A. The design is based upon roofing systems engineered and manufactured by The Garland Company for City of Ridgecrest standard:

The Garland Company
3800 East 91st Street
Cleveland, Ohio 44105
Austin Hansen
Telephone: (714) 745-5317
ahansen@garlandind.com

2.3 DESCRIPTION

- A. Modified bituminous roofing work including but not limited to:
 1. One (1) ply of Garland Flexbase 80_base sheet bonded to the prepared substrate with Green Lock Membrane adhesive.
 2. Green Lock Membrane adhesive: ASTM D93 having the following characteristics:
 - a. Non-Volatile ASTM D4586 100%
 - b. Flash Point 400°F
 - c. Density @ 77°F ASTM D1475
 - d. VOC 0 g/L
 3. Base Flashing Ply: One (1) ply of Flexbase 80E environmental SBS base flashing ply covered by an additional layer of modified bitumen membrane and set in bitumen.
 5. Surfacing: KEE Stone FB 60 Membrane

2.4 BITUMINOUS MATERIALS

- A. KEE Membrane Mastic: KEE Lock Membrane, ASTM D412. VOC free
- B. Roofing Mastic: KEE-Lock Mastic

C. Interply Adhesive: Green Lock Membrane Adhesive, ASTM D1475.

.5 SHEET MATERIALS

A. Base Ply Flexbase80: Fiberglass scrim with the following minimum performance requirements according to ASTM D5147. Properties (Finished Membrane):

1. Tensile Strength (ASTM D2523)
 - a. 2 in/min. @ 73.4 ± 3.6°F MD 225 lbf/in CMD 225 lbf/in
 - b. 50mm/min. @ 23 ± 3°C MD 39 kN/m CMD 39 kN/m
2. Tear Strength (ASTM D4073)
 - a. 2 in/min. @ 73.4 ± 3.6°F MD 300 lbf CMD 300 lbf
 - b. 50mm/min. @ 23 ± 3°C MD 4003 N CMD 4226 N
3. Elongation at Maximum Tensile (ASTM D2523)
 - a. 2 in/min. @ 73.4 ± 3.6°F MD 7 % CMD 7 %
 - b. 50mm/min@ 23 ± 3°C MD 7 % CMD 7 %

C. Modified Flashing Ply:

1. Flexbase 80:

Tensile Strength (ASTM D5147)

- a. 2 in/min. @ 73.4 ± 3.6°F MD 550 lbf/in CMD 650 lbf/in
- b. 50 mm/min. @ 23 ± 3°C MD 54.2 kN/m CMD 54.2 kN/m

Tear Strength (ASTM D5147)

- a. 2 in/min. @ 73.4 ± 3.6°F MD 1000 lbf CMD 1000 lbf
- b. 50 mm/min. @ 23 ± 3°C MD 2224 N CMD 2224 N

Elongation at Maximum Tensile (ASTM D5147)

- a. 2 in/min. @ 73.4 ± 3.6°F MD 9% CMD 9%
- b. 50 mm/min. @ 23 ± 3°C MD 9% CMD 9%
- c. Low Temperature Flexibility (ASTM D5147): Passes -40°F (-40°C)

D. Finished Membrane Ply:

1. KEE FB 60:

Breaking Strength (ASTM D751)

- a. 375 lbf (1668N)

Tearing Strength (ASTM D751)

- b. 120 lbf. Min. (534N)
- c. Puncture: 161 lbs
- d. Factory Seam Strength: 620 lbf. Min.

Eco-Facts

- e. Reflective: .87
- f. Emittance: 88
- g. SRI: 110

2.6 SURFACINGS

- A. N/A
 - 1. N/A

2.7 RELATED MATERIALS

- A. Roof Insulation: In accordance with specification.
- B. Roof Insulation Fasteners as recommended and approved by materials manufacturer.
- C. Base Sheet: HPR Glasbase Type II ASTM D4601; as recommended and furnished by the modified membrane manufacturer.
- D. Nails and Fasteners: Non-ferrous metal or galvanized steel, except that hard copper nails shall be used with copper; aluminum or stainless steel nails shall be used with aluminum; and stainless steel nails shall be used with stainless steel. Fasteners shall be self-clinching type of penetrating type as recommended by the manufacturer of the deck material. Nails and fasteners shall be flush-driven through flat metal discs of not less than one (1) inch diameter. Omit metal discs when one-piece composite nails or fasteners with heads not less than one (1) inch diameter are used.
- E. Metal Discs: Flat discs or caps of zinc-coated sheet metal not lighter than twenty eight (28) gauge and not less than one (1) inch in diameter. Form discs to prevent dishing. Bell or cup shaped caps are not acceptable.
- F. Sealant: Green Lock zero VOC Single component, 100% solids structural adhesive as furnished and recommended by the membrane manufacturer.
 - 1. Elongation (ASTM D412) 300%
 - 2. Hardness, Shore A (ASTM C920) 50
 - 3. Shear Strength (ASTM D1002) 300 psi
- G. Butyl Tape: 100% solids, asbestos free and compressive tape designed to seal as recommended and furnished by the membrane manufacturer.

- H. Glass Fiber Cant: Continuous triangular cross Section made of inorganic fibrous glass used as a cant strip as recommended and furnished by the membrane manufacturer.
- I. Plumbing stacks should be 4lb (1.8kg) sheet lead formed and rolled.
- J. Metal Sheet Flats: Garland 24 gauge 30 year warranty Kynar flat stock:

3.0 EXECUTION

3.1 EXECUTION, GENERAL

- A. Comply with requirements of Division 01 Section "Common Execution Requirements."

3.2 EXAMINATION

- A. Verify that deck surfaces and project conditions are ready to receive work of this Section.
- B. Verify that deck is supported and secured to structural members.
- C. Verify that deck is clean and smooth, free of depressions, projections or ripples, and is properly sloped to eaves.
- D. Verify that adjacent roof substrate components do not vary more than [¼] inch in height.
- E. Verify that deck surfaces are dry.
- F. Confirm that moisture content does not exceed [twelve (12)] percent by moisture meter tests. On concrete deck pour hot asphalt on to deck if it bubbles / foams and once cooled does not adhere to the substrate, the moisture levels are too high.
- G. Verify that openings, curbs, pipes, conduit, sleeves, ducts, and other items which penetrate the roof are set solidly, and that [wood cant strips] [wood nailing strips] [and reglets] are set in place.

3.3 DECK PREPARATION

- A. Concrete/LWC/Wood
 - 1. Verify that deck is in proper condition to receive roofing.
 - 2. Coordinate with Architect, owner, and Garland PM any repairs to decking.
 - 3. Reference fastener values and pattern per ASCE 7-16.

3.4 GENERAL INSTALLATION REQUIREMENTS

- A. Cooperate with manufacturer, inspection and test agencies engaged or required to perform services in connection with installing the roof system.
- B. Insurance/Code Compliance: Where required by code, install and test the roofing system to comply with governing regulation and specified insurance requirements.
- C. Protect other work from spillage of roofing materials and prevent materials from entering or clogging drains and conductors. Replace or restore other work damaged by installation of the coal tar modified bituminous roofing system.
- D. Coordinate installation of roofing system components so that insulation and roofing plies are not exposed to precipitation or left exposed overnight. Provide cut-offs at end of each day's work to

cover exposed ply sheets and insulation with two (2) plies of #15 organic roofing felt set in full moppings of bitumen and with joints and edges sealed with roofing cement. Remove cut-offs immediately before resuming work.

E. Insulation Adhesive:

1. Install insulation adhesive per ASCE 7-16.
2. Install KEE Lock foam adhesive at the rate specified by manufacturer.

F. Green Lock Membrane Adhesive Coverage Rate/hot asphalt mopping rate:

1. Interply Membrane: Apply Green Lock membrane adhesive at the rate of approximately 2 gallons per square.
2. Flood Coat: N/A.

G. Substrate Joint Penetrations: Prevent bitumen from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

H. Apply roofing materials as specified by manufacturer's instructions.

1. Keep roofing materials dry before and during application.
2. Do not permit phased construction.
3. Complete application of roofing plies, modified sheet and flashing in a continuous operation.
4. Begin and apply only as much roofing in one day as can be completed that same day.

I. Cut-Offs (Waterstops): At end of each day's roofing installation, protect exposed edge of incomplete work, including ply sheets and insulation. Provide temporary covering of two (2) plies of #15 organic roofing felt set in full moppings of bitumen with joints and edges sealed.

J. Broadcast minerals into the bleed out of bitumen while bitumen is at its recommended EVT temperature to achieve uniform color throughout.

3.5 VAPOR RETARDER INSTALLATION: N/A

3.6 INSULATION INSTALLATION

- A. Deck type: Wood/Metal/Concrete/LWC
- B. Insulation assembly per ASCE 7-16.
- C. Tapered insulation assembly by TDC. Darryl Carnevale 714 719 6601. taper@tdcroof.com

3.7 BASE PLY INSTALLATION

- A. Fiberglass Plies: Install (1) one Flexbase 80E Fiberglass base sheet in Green Lock Membrane adhesive shingled uniformly to achieve one ply over the entire prepared substrate. Shingle in direction of slope of roof to shed water on each area of roof. Do not step on base rolls, fish mouths should be cut and patched.
- B. Lap ply sheet ends eight (8) inches (203mm). Stagger end laps twelve (12) inches (304mm) minimum

- C. Extend plies two (2) inches (50mm) beyond top edges of cants at wall and roof projections and equipment bases.
- D. Install base flashing ply to all perimeter and projection details after membrane application.

3.8 KEE STONE FB 60 MEMBRANE APPLICATION

- A. Apply KEE Stone FB 60 Flashing with cold-applied KEE Lock adhesive. Refer to manufacturers data sheet for coverage rates.
- B. Once the membrane is in place, roll the membrane with a single ply roller or a dry paint roller to ensure contact with the adhesive and remove any air pockets from behind the membrane.
- C. If the height of the continuous membrane exceeds 36" horizontal reinforcement must be added using screws and plates or a termination bar.
- D. Once the KEE Stone FB 60 Flashing is installed, heat weld the KEE Stone Utility Roll over the seam of the membrane. Last, use KEE Lock Mastic to seal the leading edge of KEE Stone RB 60 Flashing where it ties into the field of the modified roof.

3.9 FLASHING MEMBRANE INSTALLATION

- A. Seal all curb, wall and parapet flashings with an application of KEE Lock Flashing Adhesive and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.
- B. Prepare all walls, penetrations, expansion joints [and where shown on the drawings] to be flashed with asphalt primer at the rate of one hundred (100) square feet per gallon. Allow primer to dry tack free.
- C. Use the KEE Lock spatter spray adhesive with the flashing membrane. Adhere to the underlying base flashing ply with specified adhesive unless otherwise noted in these specifications.
- D. Solidly adhere the entire sheet of flashing membrane to the substrate.
- E. Heat weld all vertical lap seams for the KEE Membrane.
- F. Coordinate counter flashing, cap flashings, expansion joints, and similar work with modified bitumen roofing work as specified in other Sections.
- G. Coordinate roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices with the roofing system work as specified in other Sections.

3.10 APPLICATION OF SURFACING: N/A

3.11 FIELD QUALITY CONTROL

- A. Perform field inspection and [and testing] as required [under provisions of Division 01 Section Quality Requirements].
- B. Correct defects or irregularities discovered during field inspection.
- C. Require attendance of roofing [and insulation] materials manufacturers' representatives at site during installation of the roofing system. A copy of the specification should also be on site at all times.

3.12 CLEANING

- A. Remove adhesive drippings from all walls, windows, floors, ladders and finished surfaces.
- B. In areas where finished surfaces are soiled by asphalt or any other sources of soiling caused by work of this Section, consult manufacturer of surfaces for cleaning instructions and conform to their instructions.
- C. Repair or replace defaced or disfigured finishes caused by work of this Section.

3.13 CONSTRUCTION WASTE MANAGEMENT

- A. Remove and properly dispose of waste products generated during roofing procedures. Comply with requirements of authorities having jurisdiction.

3.14 FINAL INSPECTION

- A. At completion of roofing installation and associated work, meet with Contractor, Architect, installer, installer of associated work, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.
- B. Walk roof surface areas of the building, inspect perimeter building edges as well as flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each party in attendance.
- C. The roofing system manufacturer reserves the right to request a thermographic scan of the roof during final inspection to determine if any damp or wet materials have been installed. The thermographic scan shall be provided by the [Roofing] Contractor.
- D. If core cuts verify the presence of damp or wet materials, the [Roofing] Contractor shall be required to replace the damaged areas at his own expense.
- E. Repair or replace deteriorated or defective work found at time above inspection as required to produce an installation which is free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- F. Notify the Owner upon completion of corrections.
- G. Following the final inspection, provide written notice of acceptance of the installation from the roofing system manufacturer.
- H. Immediately correct roof leakage during construction. If the Contractor does not respond within twenty four (24) hours, the Owner will exercise rights to correct the Work under the terms of the Conditions of the Contract.

3.15 DEMONSTRATION AND TRAINING

- A. At a time and date agreed to by the Owner, instruct the Owner's facility manager, or other representative designated by the Owner, on the following procedures:
 - 1. Roof troubleshooting procedures.
 - 2. Notification procedures for reporting leaks or other apparent roofing problems.
 - 3. Roofing maintenance.

END OF SECTION 07 52 00

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SECTION INCLUDES

- A. Coping, parapet, cap, sill, lintel, and other flashings and sheet metal work.

1.03 RELATED SECTIONS

- A. Section 07 54 23 – Single Ply Roofing System
- B. Section 07 41 00 – Metal Roof Panels
- C. Section 07 63 10 – Gutters and Downspouts
- D. Section 07 70 00 – Roof Accessories
- E. Section 07 90 00 – Joint Sealers
- F. Section 09 90 00 – Painting: Prime and finish painting.

1.04 REFERENCES

- A. ASTM A525 – Steel Sheet, Zinc Coated, (Galvanized) by the Hot-Dip Process.
- B. NRCA (National Roofing Contractors Association) – Roofing Manual.
- C. SMACNA – Architectural Sheet Metal Manual.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Shop Drawings: Indicate material profile, jointing pattern, corners jointing details, fastening methods, flashings, terminations, and installation details.
- C. No exposed fastening devices will be allowed unless approved by shop drawings.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA and NRCA standard details and requirements.

1.07 QUALIFICATIONS

- A. Fabricator and Installer: Company specializing in sheet metal flashing work with 5 years experience.

1.08 GUARANTEE

- A. Issue a written guarantee to maintain the sheet metal and flashing work in a watertight condition for a period of five (5) years after date of completion and acceptance of the Contract Work.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00.
- B. Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- C. Prevent contact with materials which may cause discoloration or staining.

1.10 COORDINATION

- A. Coordinate work under provisions of Section 01 31 00.

2.00 PRODUCTS

2.01 SHEET MATERIALS

- A. Galvanized Steel: ASTM A446, Grade A, G90 zinc coating 1.25 oz/sf hot dipped; 24 gage minimum or as noted on drawings.

2.02 ACCESSORIES

- A. Nails, Rivets, and Fasteners: Use only soft iron rivets having rust-resistive coating, galvanized nails, and cadmium plated screws and washers in connection with galvanized iron and steel.
- B. Sealant: Specified in Section 07 90 00.
- C. Bedding Compound: Butyl type.
- D. Plastic Cement: ASTM D4586, Type I., II.

2.03 SHEET METAL FABRICATION AND WORKMANSHIP

- A. Sheet metal work shall be accurately formed to dimensions and shapes detailed, using best shop practice methods. Soldering shall be done slowly, neat, full flowing and as thin as consistent with good joints. Materials at joints shall be thoroughly cleaned and tinned prior to soldering. Exposed soldering on finished surfaces shall be scrapped smooth. Lock seam work shall be made flat, true to line form pieces in longest lengths possible.

- B. All sheet metal work shall be so formed and installed as to allow for expansion and contraction without causing undue stresses in any part or the work.
- C. Weatherproofing:
 - 1. Finish all flashing watertight and weathertight.
 - 2. Make lock seam work flat and true to line, and watertight.
 - 3. Joints shall be "Butt-type" with back-up plates 6" long of same gauge metal and profile and buttered both ends with sealant.
 - 4. Expansion joints shall be similar to 5. With buttered back-up plate on one-half only and occurring at lengths more than 40'0", except where closer spacing is indicated in the Drawings or required for proper installation.
 - 5. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- D. Nailing:
 - 1. Whenever possible, secure metal by means of clips or cleats, without penetrating the exterior metal.
 - 2. In general, space nails, rivets, and screws not more than 8" apart. Where exposed to exterior set in sealant.
 - 3. For nailing into wood, use barbed roofing nails 1-1/4-inches long by 11 gauge.

3.00 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

3.03 INSTALLATION

- A. Conform to details as indicated on drawings and included in the SMACNA & NRCA manual.
- B. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted by Architect.
- C. Apply plastic cement compound between metal flashings and felt flashings.

- D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
 - E. Seal metal joints watertight.
- 3.04 DESCRIPTION OF ITEMS
- A. Those items which are of standard or stock design or which are sufficiently detailed or described on the drawings to permit their fabrication and installation, are not covered herein even though they may be included in the scope.
 - B. Backing plates in connection with studs and furring necessary for engaging and fastening of all items of wall hung or wall supported equipment shall be provided in locations indicated, or as necessary. Plates shall be of sufficient thickness to support the intended equipment, but not less than 16 gage. Securely fasten backing plates to supporting members in required position. Finish with rust inhibitive prime coat.
 - C. Brackets Supporting Cabinets: Provide as indicated or required.
- 3.05 FIELD QUALITY CONTROL
- A. Field inspection will be performed under provisions of Section 01 40 00.
 - B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 07 63 10
GUTTERS AND DOWNSPOUTS

1.00 GENERAL:

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SECTION INCLUDES

- A. Precoated Galvanized steel gutters and downspouts.
- B. Precast concrete splash pads.

1.03 RELATED SECTIONS

- A. Section 07 41 00 - Metal Roof Panels.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim.
- C. Section 09 90 00 - Painting: Field painting of metal surfaces.

1.04 REFERENCES

- A. ASTM A167 - Stainless and Heat-Resisting, Chromium-Nickel Steel Plate.
- B. ASTM A446 - Steel Sheet, Zinc Coated, (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
- C. ASTM B32 - Solder Metal.
- D. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.
- E. ASTM B370 - Copper Sheet and Strip for Building Construction.
- F. ASTM B486 - Paste Solder.
- G. FS O-F-506 - Flux, Soldering, Paste and Liquid.
- H. FS TT-C-494 - Coating Compound, Bituminous, Solvent Type, Acid Resistant.
- I. SMACNA - Architectural Sheet Metal Manual.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.

- C. Product Data: Provide data on prefabricated components.
- D. Samples: Submit two (2) samples, 12 inch long illustrating component design, finish, color, and configuration.

1.06 QUALITY ASSURANCE

- A. Conform to SMACNA Manual for sizing components for rainfall intensity determined by a storm occurrence of 1 in 10 years.
- B. Maintain one (1) copy of each document on site.

1.07 REGULATORY REQUIREMENTS

- A. Conform to applicable code for size and method of rain water discharge.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site to prevent damage.
- B. Stack preformed [and prefinished] material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- C. Prevent contact with materials during storage which may cause discoloration, staining, or damage.

1.09 COORDINATION

- A. Coordinate the work with downspout discharge pipe inlet.

2.00 PRODUCTS:

2.01 MATERIALS

- A. Pre-Coated Galvanized Steel: ASTM A446, Grade A, G90 zinc coating; 20 gage core steel, shop pre-coated with modified silicone coating color selection by Architect.

2.02 COMPONENTS

- A. Gutters: SMACNA 5"x6" Rectangular profile.
- B. Downspouts: SMACNA Rectangular profile.
- C. Accessories: Profiled to suit gutters and downspouts.
- D. Splash Pads or Blocks: Precast concrete type, of size and profile indicated; minimum 3000 psi (21 Mpa) at 28 days, with minimum 5 percent air entrainment.

2.03 ACCESSORIES

- A. Anchorage Devices: SMACNA requirements.
- B. Gutter Supports: Brackets.
- C. Downspout Supports: Straps.
- D. Fasteners: Finish exposed fasteners same as flashing metal.
- E. Primer: Zinc chromate
- F. Protective Backing Paint: Zinc chromate alkyd.
- G. Solder: ASTM B32; 50/50 type.
- H. Flux: FS O-F-506

2.04 FABRICATION

- A. Form gutters and downspouts of profiles and size indicated.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. [Allow for expansion at joints.]
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; solder watertight.

2.05 FINISHES

- A. Prepare surfaces in accordance with Section 09 90 00.
- B. Apply bituminous protective backing on surfaces in contact with dissimilar materials.

3.00 EXECUTION:

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install gutters, downspouts, and accessories in accordance with SMACNA standards or manufacturer's instructions.
- B. Join lengths with seams soldered watertight. Flash and solder gutters to downspouts and accessories.

- C. Install gutters level with trim.
- D. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- E. Connect downspouts to storm sewer system. Seal connection watertight.
- F. Use Cast Iron pipe under walkways make transition to PVC as required.
- G. Set splash blocks under downspouts where indicated. See plans for locations.

END OF SECTION

SECTION 07 84 13
PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
2. Mineral fiber insulation, fire safing, and safing edge of floor slabs and curtain walls.
3. Damming material, clips, and closures.
4. Gaps between the top of walls and ceilings or roof assemblies.
5. Expansion joints in walls and floors.
6. Openings around structural members which penetrate floors or walls.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 31 00 - Cast-in-Place Concrete.
3. Section 04 22 00 - Concrete Unit Masonry.
4. Section 04 22 23 – Architectural Concrete Masonry.
5. Section 07 21 00 - Building Insulation.
6. Section 07 90 00 - Joint Sealants.
7. Section 09 25 00 - Gypsum Board.
8. Division 22 - Plumbing.
9. Division 23 - Mechanical.
10. Division 26 - Electrical.
11. Division 27 – Low Voltage.

1.02 REFERENCES

A. ASTM Standards:

1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 2. ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
 3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 4. ASTM E1399 – Standard Test Method for Cyclic Movement and Measuring Minimum and Maximum Joint Widths on Architectural Joint Systems.
 5. ASTM E1966 – Standard Test Methods for Fire-Resistive Joint Systems.
 6. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops
 7. ASTM E2307 – Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus.
 8. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- B. Underwriters Laboratories, Inc.
1. UL Fire Resistance Directory.
 2. UL 263 – Standard for Fire Tests of Building Construction and Materials.
 3. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.
 4. UL 1479 – Fire Tests of Through Penetration Firestops.
 5. UL 2079 – Test for Fire Resistance of Building Joint Systems.
- C. Testing Services:
1. Intertek ES SAT.
 2. Southwest Research Institute.
 3. Underwriters Laboratories.
- D. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.
- E. California Building Code, Chapter 7 Fire Tests of Through-Penetration Fire Stops.
- F. F. Firestop Contractors International Association (FICA) Manual of Practice.

1.03 SYSTEM DESCRIPTION

- A. Provide fire stops and smoke seals to prevent the passage of fire, smoke, toxic gasses or water from one floor or area to another. Seal openings in floors, fire rated walls and permanent partitions penetrated by pipes, ducts, conduits and other items as shown, specified, and as required for the type of construction.

- B. Mineral fiber insulation installed as fire safing at non-rated penetrations not containing pipes, ducts, conduits, and other items in floor slabs, wall partitions, construction-joint conditions between slabs and adjacent construction and where indicated or required.
- C. Provide damming material, clips, and closures as required for support and containment of dams, and other insulation materials required for tested and rated fire stop systems.

1.04 QUALITY ASSURANCE

- A. Performance Criteria:
 - 1. Provide materials and Work to conform to source quality control criteria specified herein and CBC requirements in fire resistant wall and floor assemblies to prevent the passage of fire, smoke, and toxic gases.
 - 2. Installed fire stops shall be of sufficient thickness, width, and density to provide a fire resistance rating at least equal to the floor, wall, or partition construction into which it is installed.
- B. Comply with CBC requirements for fire rated construction.
- C. Qualifications of Manufacturer: Products furnished for fire stopping and smoke seals shall be manufactured by a firm which has been continuously and regularly employed in the manufacture of these materials for a period of at least 5 years; and which can provide evidence of these materials being satisfactorily installed on at least 5 projects of similar size and type within such period.
- D. Qualifications of Installer: The Work of this section shall be installed by a firm which has been in the business of installing similar materials for at least 5 consecutive years; and can provide evidence of satisfactory completion of 5 projects of similar size and scope. Installer shall have applicators trained and certified by manufacturer for performing this Work. Comply with requirements of FICA Manual of Practice.
- E. For those firestop applications that exist for which no UL tested system is available through a manufacturer, an engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.
- F. Firestopping tests shall be performed by a qualified testing and inspection agency. A qualified testing and inspection agency shall be UL, Intertek or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction. Firestopping products shall bear the classification marking of a qualified testing and inspection agency.

1.05 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's Product Data for each type of fire stop and smoke seal material proposed for installation. Indicate product characteristics, typical installations, performance, and limitation criteria and test data.
 - 2. Submit manufacturer's printed installation instructions for each type of product, system, and construction required for the Work. Indicate fire resistance rating of each installation.

3. Submit fire test reports from independent testing agency indicating the following:
 - a. Fire test report of fire stop material installed to substrate and penetration materials similar to the Work of this section. Test to indicate both Fire Resistance (F) and Temperature (T) Ratings.
 - b. Test reports of products to be installed shall indicate conformance to ASTM E814 or UL 1479 for penetrations, ASTM E1966 or UL 2079 for joints, and ASTM E2307 for perimeter fire barrier (edge-of-slab) systems.
- B. Field Samples: No less than 10 days before commencing the Work of this section, provide field installed Samples of fire stop materials and systems.
 1. Apply one Sample of fire stop material for each different penetration and related fire rating required for the Work.
 2. Sample areas shall comply with thickness, fire resistance ratings, and finished appearance.
- C. Manufacturer's Qualifications: Submit evidence of conformance with qualification requirements specified above.
- D. Installer's Qualifications: Submit evidence of conformance with qualification requirements specified above.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to the Project site in manufacturer's original, unopened containers bearing correct UL labeling.
- B. Fire stop material shall be stored above grade in an area protected from detrimental weather and moisture conditions and in compliance with manufacturer's requirements, including temperature restrictions.
- C. Fire stop and seal materials shall be installed before expiration of shelf life.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Unless otherwise noted, products of this section shall be as manufactured by:
 1. 3M Fire Protection Products.
 2. Hilti, Inc.
 3. Nelson Firestop Products.
 4. Specified Technologies, Inc. (STI).
 5. Tremco, Inc.
 6. Equal.

- B. Provide materials and systems of specified manufacturers to suit penetration and substrate as determined by various conditions of installation.
- C. Provide firestopping composed of components that are compatible with the substrates forming openings and the items penetrating the firestop, under conditions of service and application, as demonstrated by the fire stopping manufacturer based on testing and field experience.

2.02 MATERIALS

- A. Cast-in Firestop Devices: Pre-installed firestop devices penetrating cast-in-place concrete decks and concrete over metal decks, for use with combustible and non-combustible pipe, (closed and open systems) insulated pipe, conduits and cable bundles. Provide metal deck adapters and top seal plugs.
 - 1. 3M: Fire Barrier Cast-in-Place Devices.
 - 2. Hilti: CP 680 Cast-in-Place FS Device
 - 3. Tremco: CIPP Plastic, CIPP Metal.
 - 4. Specified Technologies, Inc. (STI): Cast-In Firestop Devices.
 - 5. Equal.
- B. Firestop Collar: Made of galvanized steel housing and Intumescent inserts for firestopping combustible pipes through walls and floors. For use with concrete, masonry, wood floor and gypsum wall assemblies. Provide two collars on walls, one on each side, and one collar on underside of floors.
 - 1. 3M: Plastic Pipe Device PPD.
 - 2. Hilti: CP 643N and CP 644.
 - 3. Tremco: TREMstop D.
 - 4. Nelson Firestop Products: PCS Pipe Choke System.
 - 5. Specified Technologies, Inc. (STI): Intumescent Firestop Collars, type LCC, SSC or RTC.
 - 6. Equal.
- C. Fire Pillows and Blocks: Intumescent flexible pillows consisting of a mineral fiber core sealed with a water-resistant intumescent membrane, heat-sealed in a durable fire-retardant poly bag; or intumescent block based on a two component foam, for use in walls and floors and concrete, masonry and gypsum wall assemblies. For large openings containing multiple penetrations: wall openings up to 48 inches by 48 inches and floors up to 36 inches by 36 inches.
 - 1. 3M: Fire Barrier Self-Locking Pillow.
 - 2. Hilti: FS 657.
 - 3. Tremco: TREMstop PS1, TREMstop PS2.
 - 4. Nelson Firestop Products: Fire Brick, Pillows.

5. Specified Technologies, Inc. (STI): SSB Firestop Pillows.
 6. Equal.
- D. Firestop Mortar: Fire-resistant mortar suitable for firestopping large horizontal or vertical, concrete or masonry openings penetrated by single or multiple non-combustible pipes or cable trays.
1. 3M: Fire Barrier Mortar.
 2. Hilti: CP 637.
 3. Tremco: TREMstop Mortar.
 4. Nelson Firestop Products: CMP Firestop Mortar.
 5. Specified Technologies, Inc. (STI): SSM Firestop Mortar.
 5. Equal.
- E. Firestop Putty Stick: Intumescent, non-hardening, firestop putty for single or bundled cables and non-combustible pipe penetrations. For use in horizontal or vertical, concrete, masonry or gypsum wall assemblies.
1. 3M: MP + Stix.
 2. Hilti: CP 618 and CP 619T.
 3. Tremco: TREMstop MP Putty Stick.
 4. Nelson Firestop Products: FSP AA445, AA439.
 5. Specified Technologies, Inc. (STI): SSP Firestop Putty.
 6. Equal.
- F. Firestop Putty Pad: Moldable firestop putty for protection of electrical outlet boxes.
1. 3M: MPP+.
 2. Hilti: CP 617.
 3. Tremco: TREMstop MP Putty Pad.
 4. Nelson Firestop Products: FSP AA452, AA439.
 5. Specified Technologies, Inc. (STI): SSP Putty Pads or Electrical Box Insert.
 6. Equal.
- G. Firestop Sealant: Smoke, gas and water resistant. For use in horizontal or vertical, concrete, masonry or gypsum wall assemblies.
1. Single component intumescent sealant for protection of combustible and non-combustible pipe, conduit and cable penetrations.

- a) 3M: CP-25WB+, IC-15WB+, 3000WT.
 - b) Hilti: FS ONE.
 - c) Tremco: TREMstop IA+ or FyreCaulk.
 - d) Nelson Firestop Products: ES1399.
 - e) Specified Technologies, Inc. (STI): LCI or SSS Intumescent Firestop Sealant.
 - f) Equal.
2. Silicone based system that provides maximum movement in fire-rated joint applications and pipe penetrations.
- a) 3M: 2000+, 2000 NS.
 - b) Hilti: CP 601S.
 - c) Tremco: TREMstop Fyre-sil.
 - d) Nelson Firestop Products: CLK AA529, AA542, AA492.
 - e) Specified Technologies, Inc. (STI): SIL Silicone Firestop Sealant SIL300 or SIL300SL (self-leveling).
 - f) Equal.
3. Acrylic based system that provides movement capability in fire rated joints and seals through penetration applications.
- a) 3M: FD 150+.
 - b) Hilti: CP 606.
 - c) Tremco: TREMstop Acrylic GG.
 - d) Nelson Firestop Products: FSC3.
 - e) Specified Technologies, Inc. (STI): ES Elastomeric Firestop Sealant.
 - f) Equal.
4. Self-leveling silicone-based firestop sealant for use with through penetrations and construction joints in horizontal floor/ceiling assemblies.
- a) 3M: 1000 SL.
 - b) Hilti: CP 604.
 - c) Tremco: TREMstop Fyre-sil S.L.
 - d) Nelson Firestop Products: CLK AA539, AA552.
 - e) Specified Technologies, Inc. (STI): SIL Silicone Firestop, type SIL300SL.

f) Equal.

H. Firestop Wrap Strip: Wrap strip of intumescent, flexible firestop for use with plastic and insulated pipe penetrations. For use in horizontal or vertical, concrete, masonry or gypsum wall assemblies.

1. 3M: Ultra GS, FS-195.
2. Hilti: CP 648-S, CP 648-E.
3. Tremco: TREMstop SuperStrip or TREMstop WS.
4. Nelson Firestop Products: MCT, MPS.
5. Specified Technologies, Inc. (STI): SSW Intumescent Wrap Strips, type BLU, BLU2, RED or RED2.
6. Equal.

I. Spray: Sprayable or brush applied fire-rated mastic for construction joints where maximum movement is required. For use in horizontal or vertical, concrete, masonry or gypsum wall assemblies, at top of wall joints, curtain wall/slab edge and expansion joints.

1. 3M: FD 200.
2. Hilti: CP 672.
3. Tremco: TREMstop Acrylic SP spray.
4. Nelson Firestop Products: FSC3.
5. Specified Technologies, Inc. (STI): AS200 Elastomeric Spray with or without SpeedFlex® Joint Strip, or Fast Tack® Firestop Spray.
6. Equal.

J. Drywall Track Gaskets: Intumescent cover for drywall ceiling track providing fire, smoke and acoustical ratings for head-of-wall joints between gypsum walls and concrete floor slabs.

1. Hilti: CFS-TTS Top Track Seal.
2. Specified Technologies, Inc. (STI): TTG Track Top Gasket.
3. Equal.

K. Fire Rated Cable Pathways: Gangable device modules capable of being retrofitted around existing cables and comprised of steel raceway with built-in intumescent material allowing 0 to 100 percent cable fill and requiring no additional action in the form of plugs, twisting closure, putty, pillow, or sealant to achieve fire and leakage ratings.

1. 3M: Fire Barrier Pass-Through Device.
2. Hilti: CP 653 Firestop Speed Sleeve.
3. Specified Technologies, Inc. (STI): EZ-Path Fire Rated Pathway.

4. Equal.
- L. Fire Rated Grommet or Disc: For single or dual cable penetrations through the same small opening.
1. Hilti: CFS-D Firestop Cable Disc.
 2. Specified Technologies, Inc. (STI): EZ-Path Firestop Grommets
 3. Equal.
- M. Metal Deck Strips and Plugs: Precut preformed mineral wool plugs and strips to fit flutes of metal deck profile and gap between top of wall and metal deck.
1. 3M: PM4.
 2. Hilti: CP 777 Speed Plugs; CP 767 Speed Strips.
 3. Tremco.
 4. Nelson Firestop Products.
 5. Equal.
- N. Fire Safing, Mineral Fiber or Ceramic Wool Non-Combustible Insulation:
1. Mineral Fiber: Density 4 pounds per cubic foot, USG Thermafiber, Johns Manville Industrial Insulation Group (IIG), Roxul AFB, or equal.
 2. Ceramic Wool: Density 6 pounds per cubic foot, Johns Manville "Ceramic Fiber Insulation", Unifrax "Fiberfrax" ceramic fiber, or equal. Provide material in tested thickness for required hour rating.
 - a. Flame Spread: Less than or equal to 25.
 - b. Smoke developed: Less than or equal to 50.
 3. For mineral fiber, provide 20 gage minimum size metal retainer clips and plates for fire safing support in vertical applications and in compliance with tested system design.
- O. Supplemental Material: Provide supplementary materials required for complete, fire rated, installation.

2.03 SOURCE QUALITY CONTROL

- A. Fire stop and smoke seal material shall be tested by an independent testing agency for conformance to Flame (F) and Temperature (T) requirements of ASTM E814/UL 1479, ASTM E1966/UL 2079, or ATSM E2307.
- B. Conform to UL Fire Hazard Classification Requirements. Material shall be classified as a fill, void, or cavity material and system for UL through Penetration Firestop System.
- C. Material shall be tested and shall display Flame Spread Index of 25 or less, and Smoke Developed Index of 450 or less when tested in accordance with ASTM E84.

PART 3 - EXECUTION

3.01 APPLICATION REQUIREMENTS

- A. Provide single component fire stop sealant or putty:
 - 1. Within penetrations subject to movement including conduit, cable bundles, buss duct, and noncombustible pipe.
 - 2. As a sealant or caulking for smoke barrier construction, fire, and smoke dampers, mechanical/electrical framed elements in masonry and gypsum board partition systems, and other conditions.
- B. Provide mineral fiber insulation for fire safing at joints and openings through floor slabs, walls, and partitions not indicated to be grouted, gaskets, sealed or otherwise made sound or air tight in this or other sections. Fire safing shall be packed and wedged solidly from both sides of walls and partitions, and from both top and bottom sides of slabs with noncombustible mineral fiber insulation.

3.02 PREPARATION

- A. Examine the areas and conditions where fire stops and smoke seals are to be installed for conditions detrimental to the proper completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected for rated fire protection.
- B. Surface to receive fire stops or smoke seals shall be free of dirt, dust, grease, form release agents, or other matter that would impair the bond of the fire stop material to the substrate or penetrating items. Substrate shall be frost free and when required, dry.
- C. Voids and cracks in substrate shall be filled and unnecessary projections removed before installation of fire stops.
- D. Assure that all pipes, conduit, cable, and other items, which penetrate fire rated construction, have been permanently installed before installation of fire stops. Schedule and sequence the Work to assure that partitions and other construction, which would conceal penetrations, are not installed before the installation of fire stops and smoke seals.
- E. Comply with manufacturer's recommendations for temperature and humidity conditions before, during, and after installation of fire stops and smoke seals.

3.03 INSTALLATION

- A. General: Provide installation in accordance with manufacturer's installation procedures, as required. Install fire stops in accordance with fire test reports, UL Fire Resistance Directory, Intertek Testing Services Directory or SpecDirect, and reviewed Sample installations.
- B. Dam Construction:
 - 1. Install dams when required to properly contain fire stopping materials within openings and as required to achieve fire resistance rating as tested and rated.
 - 2. Provide in conformance with installation requirements for type of floor, wall, and partition construction, and as recommended by fire stop manufacturer.

3. Combustible damming material shall be removed after appropriate curing. Noncombustible damming material may be left as a permanent component of the fire stop system.
4. Placement of dams shall not interfere with function, or adversely affect the appearance, of adjacent construction.

C. Installation of Single Component Fire Stop Sealant:

1. Provide noncombustible insulation as required to achieve fire resistance rating.
2. Install with manual or powered sealant gun. For up to four hour rating, install to the thickness required by the Listed System Designs as directed for wall and floor applications.
3. Surface of gun grade fire stop sealant shall be tooled in accordance with manufacturer's recommendations.
4. Remove excess materials from adjacent surfaces within 10 minutes, with either water or other material compatible with sealant and recommended by sealant manufacturer, leaving the Work in a neat, clean condition.

D. Installation of Cementitious Fire Stop Mortar:

1. Mixing: Add dry powder to water and mix with mechanical mixer or hand mixing tools. Ratio and duration of mix shall be as instructed by fire stop mortar manufacturer. Average wet density of mortar shall be 70 pounds per cubic foot (plus or minus 5).
2. Wet surfaces before installation of fire stop mortar. Mortar may be hand installed or pumped into the opening.
3. When installing around layered and grouped cables, vibrate or move the cables slightly to prevent voids from forming between the cables.
4. Exposed surfaces shall be finished with conventional plastering tools before curing.
5. Allow at least 48 hours for initial cure before form removal. For full cure allow 28 days.

3.04 FIELD QUALITY CONTROL

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- B. Repair damaged areas and restore integrity of assembly.
- C. Keep areas of work accessible until inspection by authorities having jurisdiction.
- D. OWNER will engage a qualified independent inspection agency to inspect through-penetration firestop systems in accordance with ASTM E2174, or joint systems in accordance with ASTM E2393. Manufacturer representatives shall not perform inspections of installed firestopping systems.

3.05 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.06 CLEANUP

- A. Clean surfaces adjacent to sealed openings and joints and remove excess of firestopping materials.
- B. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

**SECTION 07 90 00
JOINT SEALERS**

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SECTION INCLUDES

- A. Preparing substrate surfaces.
- B. Sealant and joint backing.
- C. Work includes interior and exterior caulking and sealing, in not less than the following circumstances:
 - 1. Wherever expansion and contraction occurs.
 - 2. Between materials and products where infiltration of moisture, water, light or air blown particles may occur.
 - 3. Between materials and products in, or penetrating sound insulated walls, portion and related construction.
 - 4. Between exposed dissimilar materials.

1.03 REFERENCES

- A. ASTM C790 – Use of Latex Sealing Compounds.
- B. ASTM C804 – Use of Solvent-Release Type Sealants.
- C. ASTM C834 – Latex Sealing Compounds.
- D. ASTM C919 - Use of Sealants in Acoustical Applications.
- E. ASTM C920 – Elastomeric Joint Sealants.
- F. ASTM D41056 – Flexible Cellular Materials – Sponge or Expanded Rubber.
- G. ASTM D1565 – Flexible Cellular Materials – Vinyl Chloride Polymers and Copolymers (Open-Cell Foam).
- H. SWRI (Sealant, Waterproofing and Restoration Institute) – Sealant and Caulking Guide Specification.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.

- B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations and color availability.
- C. Samples: Submit two samples, illustrating sealant colors for selection. Custom colors maybe required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, perimeter conditions requiring special attention.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform acoustical sealant application work in accordance with ASTM C919 and C1193.
- C. Comply with applicable codes and regulations of governmental agencies with ASTM C919 and C1193.
- D. Where provisions of applicable codes, regulations and standards conflict with the requirements of this Specification, comply with the more stringent provisions.
- E. Tests: Material for which physical characteristics have been stipulated shall have such characteristics independently confirmed by laboratory tests employing industry-recognized procedures. Both the laboratory performing the tests and the test methods employed will be subject to the approval of the Architect.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years' experience.
- B. Applicator: Company specializing in performing the work of this section with a minimum five (5) years' experience.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.08 COORDINATION

- A. Coordinate the work with all sections referencing this section.

1.09 WARRANTY

- A. Provide five (5) year warranty under provisions of Section 01 74 00.
- B. Warranty: Include coverage for installed sealants and accessories which fail to achieve air tight seal and water tight seal, and exhibit loss of adhesion or cohesion, or do not cure.

2.00 PRODUCTS

2.01 SEALANT MATERIALS

A. Polysulfide Sealant:

1. Polysulfide base sealing compound. Sealant shall conform to performance standards of Thiokol Chemical Corp. and all containers of sealant delivered to project shall bear Thiokol "tested and approved" seal. Provide Type I (self-leveling) for joints in horizontal surfaces and Type II (non-sag) in joints vertical or overhead surfaces. Class A or Class B shall be used for structural movements subject to 25 percent or 50 percent joint elongation respectively.

a. Two-part: FS TT S 00227.

- B. Polyurethane Sealant: Multi-part, self-leveling, FS TT S-00227, Type I, Class A. Equivalent to THC-900 by Tremco.
- C. Acrylic Terpolymer Sealant: One-part non-sag, FS TT S-00230. Equal to "Mono" by Tremco. Use for structural movement up to 150 percent of joint width.
- D. Laytex Acrylic Caulk: Elastoseal Latex manufactured by Pacific Polymers, or equal.
- E. Silicon: One-part, primerless, paintable and highly flexible, shrink and stain resistant, as manufactured by U.S.C., or equal.
- F. Custom colors may be required as determined by the architect.

2.02 BACK ROD

- A. Materials: Open or expended polyurethane, open or closed cell as recommended by sealant manufacturer, compatible with sealant.
- B. Non-Staining Primer: Type as recommended by manufacturer of sealant material.
- C. Bond Breaker: Pressure sensitive adhesive polythlene tape.
- D. Masking Tape: Pressure sensitive adhesive paper tape.

3.00 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces and joint openings are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

- A. Remove loose materials and foreign matter which might impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions.

- D. Protect elements surrounding the work of this section from damage or disfiguration.
- E. Mask areas adjacent to joints.

3.03 PRODUCT USAGE

- A. Exterior:
 - 1. Horizontal Traffic Bearing Joints: Multi-part polyurethane, self-leveling type.
 - 2. Exterior Vertical Joint: Multi-component, polysulfide type.
- B. Interior:
 - 1. Interior Static Joints: Solvent release acrylic type.
 - 2. Ceramic Tile and Plumbing Fixture Conditions: One-part primerless silicone type.
- C. Standard or custom colors to match adjacent work as required by architect.
- D. Use only materials recommended by manufacturer for specific application.
- E. Acoustical sealant shall be provided in, around and between building construction members such as framing, panel boxes, cutouts for penetrations of other materials or equipment, etc. where walls and floors are designed to be sound attenuated or acoustically treated.
- F. Caulk around doors/windows, hollow metal frames where gypsum board inserts are behind the metal frame and hollow frame joints not fully welded interior and exterior.
- G. All window stops shall be set into clear sealant or the color sealant used to match the color of the window glass as selected by the architect.
- H. Insure that all windowsills and door thresholds have a continuous bead of sealant interior and exterior applied for water/weather tightness.
- I. Apply sealant around, at laps, and/or mitered corners of all exposed flashing, metal reveals, louvers, coping, etc. and color sealant used shall match color of adjacent color.

3.04 APPLICATION

- A. Install backing material in joints using blunt instruments to avoid puncturing. Do not twist rod while installing. Install backing so that joint depth is 50 percent of joint width, but a minimum of 1/4 inch deep.
- B. Install bond breaker where joint backing is not used.
- C. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- D. Apply sealant in joints using pressure gun with nozzle cut to fit joint width. Make sure sealant is deposited in uniform, continuous beads without gaps or air pockets. Replace where gaps or air pockets occur.

- E. Tool joints to required configuration within ten minutes of sealant application. If masking materials are used, remove immediately after tooling. Use an approved method of removing excess sealant where applies or where asked to have excess sealant removed by the Architect.

3.05 CLEANING

- A. Remove excess materials adjacent to joints by mechanical means or with xylol (xylene) or mineral spirits as work progresses to eliminate evidence of spillage or damage of adjacent surfaces.
- B. Leave finished work in neat, clean condition with no evidence of spill over onto adjacent surfaces.
- C. All exposed sealants used shall be of a type that can receive any of all paint as specified under the painting section if required.

3.06 PROTECTION OF FINISHED WORK

- A. Protect finished installation under provision of Section 01655.
- B. Protect sealants until cured.

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "General Conditions".
2. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
3. Division 08 Section "Flush Wood Doors".
4. Division 08 Section "Stile and Rail Wood Doors".
5. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
6. Division 08 Section "Door Hardware".
7. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40" above sill) or UL 10C.
 1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 3. Smoke Control Door Assemblies: Comply with NFPA 105.
 - a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
- D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

- E. Storm Shelter Openings: Provide complete door systems for hurricane or tornado storm shelters, and other areas of refuge, complying and tested according to ICC 500 (2014/2020), ICC/NSSA Standard for the Design and Construction of Storm Shelters.
 - 1. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- F. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.6 COORDINATION

- A. Coordinate installation of anchorages 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. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:
 - 1. CECO Door Products (C).
 - 2. Curries Company (CU).

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 38 percent.
- D. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.
- B. Exterior Doors (Energy Efficient): Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model, ANSI/SDI A250.4 for physical performance level, and HMMA 867 for door construction.
 - 1. Design: Flush panel.
 - 2. Core Construction: Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 "Laminated Core".
 - a. Provide 22-gauge steel stiffeners at 6 inches on-center internally welded at 5" on-center to integral core assembly, foamed in place polyurethane core chemically bonded to all interior surfaces. No stiffener face welding is permitted.

- b. Thermal properties to rate at a fully operable minimum U-Factor 0.37 and R-Value 2.7, including insulated door, thermal-break frame and threshold.
 - c. Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.38 and R-Value 2.6, including insulated door, kerf type frame, and threshold.
 - 3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053 inch - 1.3-mm) thick steel, Model 2.
 - 4. Vertical Edges: Vertical edges to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
 - 5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
 - 6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".
 - 7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- C. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
- 1. Design: Flush panel.
 - 2. Core Construction: Manufacturer's standard polystyrene. Where indicated, provide doors fabricated as thermal-rated assemblies with a minimum R-value of 2.8 or better.
 - 3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
 - 4. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
 - 5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
 - 6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 - 7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- D. Interior Doors (Energy Efficient): Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A366 or 620. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
- 1. Design: Flush panel.
 - 2. Core Construction: Steel stiffened laminated core with fiberglass filler with no stiffener face welds, in compliance with HMMA 867 "Laminated Core".

- a. Provide 22-gauge steel-stiffeners at 6 inches on-center internally welded at 5" on-center to integral core assembly, No stiffener face welding is permitted.
 - b. Acoustical sound transmission rating shall be no less than STC 38 complying with ASTM E 90 and must be visible on factory applied labels.
 3. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
 4. Vertical Edges: Vertical edges-to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
 5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
 6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".
 7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Design: Flush panel.
 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 3. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
 4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
 5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- F. Manufacturers Basis of Design:
1. Curries Company (CU) - Polystyrene Core - 707 Series.
 2. Curries Company (CU) - Energy Efficient - 777 Trio-E Series.

2.4 HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

- B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.
 - 1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 - 2. Manufacturers Basis of Design:
 - a. Curries Company (CU) – M Series.
- C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.
 - 1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 - 2. Manufacturers Basis of Design:
 - a. Curries Company (CU) - M Series.
- D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.
- E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
 - 3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LIGHT OPENINGS AND GLAZING

- A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.
- B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

- C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.
- D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.7 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.8 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
 - 2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
 - 3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" 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.
 - 4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
- D. Hollow Metal Frames:
 - 1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping

and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

- E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 - 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 - 2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
 - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 - 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.9 STEEL FINISHES

- A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 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.
- B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.
- E. Verify tolerances against manufacturers installations instructions for tornado and hurricane storm shelter openings.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.
 - 1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
 - 4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and

replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.5 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
 - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION 08 11 13

**SECTION 08 20 00
WOOD DOORS**

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SCOPE: Furnish materials and perform labor required to execute this work as indicated on the drawings, as specified and as necessary to complete the Contract, including, but not limited to, these major items:

- A. Solid Core Wood Doors.
- B. U.L. Labeled Doors (where required).
- C. Louvers (where indicated).
- D. Provision for Glazing (where indicated).

1.03 RELATED WORK SPECIFIED ELSEWHERE AS REQUIRED

- A. Furnishing and installing finish hardware – Section 08 71 00.
- B. Hollow Metal Door and Frames – Section 08 11 13.
- C. Glazing – Section 08 80 00
- D. Fire-Resistant Glazing- Section 08 88 13
- E. Painting – Section 09 90 00

1.04 GENERAL REQUIREMENTS

- A. Shop Drawings: Submit in accordance with Section 01 30 00. Show locations and details of all cutouts.
- B. Samples: In accordance with Section 01 30 00, submit 8" samples of doors to receive transparent finish.
- C. Storage: Store in clean dry spaces in a manner to prevent damage from any cause. Lay all doors flat, above the floor, on level supports.
- D. Warranty: In accordance with General Conditions Division 0, submit written warranty, in approved form, that all defective materials or workmanship reported within a period of 2 years after final acceptance, will be promptly repaired or replaced to the satisfaction of the Owner. Cover the following items specifically.
 - 1. Delamination in any degree.
 - 2. Warp or twist of 1/4" or more.
 - 3. Telegraphing of core unit through face veneer to cause surface variation of 1/100" in any 3" span.

- 4. Any defect which may affect performance or appearance.
- E. Labeled Openings: Where labeled openings are scheduled or are required by codes, construct doors in accordance with the requirements of UL and attach labels of the indicated classification. Attach labels to the hinge jamb only.
- F. Reference Standard: Provide materials and workmanship conforming to the Woodwork Institute of California "Manual of Millwork", Section 12 or 13 for Custom grade doors. Provide Certified Compliance grade stamp on every door.
- G. Approved Manufacturers: Mohawk, General Veneer Co., Weyerhaeuser, or Curtis Door Division of Georgia-Pacific.
- H. Reinforce tops of doors with steel edge protector.

2.00 PRODUCTS

2.01 SOLID CORE DOORS

- A. Core: Kiln-dried, low density, 2 1/2" wide, random length wood blocks edge-glued with joints well staggered.
- B. Cross Bands: 1/16" kiln-dried hardwood, full width of door, with grain perpendicular to face grain.
- C. Edge Bands: Kiln-dried hardwood, not less than 5/8" thick after trimming. Stile bands of same species as face veneer.
- D. Face Veneers: 1/28" thick kiln-dried Sound grade (Paint Grade) Beech or Birch, unselected for color where opaque finish is indicated; good grade Beech or Birch, uniform light or dark, for transparent finish. Exterior doors shall be factory finished medium density overlay - phenolic resin.
- E. Glue: Use CS35 Type II for bonding core blocks; use Type I (fully waterproof) for all other work.
- F. Acoustical Rating: STC 45

2.02 LABELED DOORS (Where Required)

- A. Core: Fiber reinforced mineral, 22 lbs./c.f. density, except 20 minute label - see paragraph 2.01,A.
- B. Cross-Bands, Edge-Bands and Face Veneers: As specified for solid core doors.
- C. Construction and labels. Construct doors to meet UL requirements for the fire-rating label required. Affix UL label as required by the drawings. Fire assembly per NFPA A80

2.03 NON-LABELED DOORS

- A. Solid lumber core staggered block core.

2.04 DOOR REINFORCEMENT

- A. Reinforce tops of doors with steel edge protectors.

2.05 CUTOUTS (Where Required)

- A. Openings for louvers and glass (where indicated): Fully frame cutouts in core prior to applying face veneers. Locate as indicated but not closer than 5" from any edge.

2.06 LOUVERS (Where Required)

- A. Anemostat, Model AFDL, with vandal proof screws, or other as approved. Construct of 20 gauge cold-rolled steel. Labelled assemblies- Anemostat, Model FLDL-UL.
- B. Finish: Factory applied rust-inhibitive prime coat.

3.00 EXECUTION

3.01 PREPARATION FOR SHIPMENT

- A. Separators: Doors intended for opaque finish may be shipped in individual cartons or may be packaged in properly protected bundles with heavy separators between doors.

END OF SECTION

SECTION 08 31 00
ACCESS DOORS AND PANELS

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Access doors and panels not provided by other trades but required for access to concealed equipment and assemblies.
- B. Work Installed but Furnished in Other Sections:
 - 1. Access doors and panels furnished by other trades.
- C. Related Work:
 - 1. Finish Painting Access Doors and Panels, Except Stainless Steel Surfaces: Reference Section 09 90 00.
 - 2. Furnishing Access Doors and Panels as per Mechanical, Plumbing and Electrical Drawings

1.03 SUBMITTALS

- A. Procedure: In accordance with Section 01 30 00.
- B. Manufacturer's Data: For access doors and panels, including compliance with Code requirements for those in fire-rated assemblies.
 - 1. Supplement with shop drawings where required to show special installation conditions.
- C. Closeout Submittals: Deliver keys properly tagged to District.

1.04 QUALITY ASSURANCE

- A. All access doors and panels for the Project shall be made by the same manufacturer.
- B. In fire-rated construction, provide fire-rated assemblies bearing the label of a testing agency acceptable to the Building Department for the fire resistance indicated.

2.00 PRODUCTS

2.01 ACCESS DOORS AND PANELS

- A. One of the following trimless, prime-coated units, except where stainless steel is specified, equipped with flush, key-operated cam lock, or equal by Elmdor Manufacturing Co., Karp Associates, Inc., JL Industries or Milcor.

1. In Gypsum Board Surfaces, Except as Specified Below for Toilet Room Walls: Nystrom Type WB.
 - a. Material: Commercial grade cold-rolled steel with 16 gauge frame and 14 gauge door.
 - b. Finish Trim: 22 gauge steel drywall bead.
 2. In Plaster Surfaces: Nystrom Type RP where the door is plastered; Type PW where door is painted.
 - a. Material: Commercial grade cold-rolled steel with 16 gauge frame and 14 gauge door.
 - b. Finish Trim: 22 gauge steel plaster bead with expanded metal lath.
 3. Toilet Rooms Walls: Nystrom Type WB.
 - a. Material: Stainless steel, 16 gauge frame and 14 gauge door.
 - b. Finish Trim: 22 gauge steel drywall bead.
 4. Fire-Rated Access Doors: Nystrom Type FRW or FRP as required by surrounding material.
 - a. Material: Commercial grade cold-rolled steel with 16 gauge frame and 20 gauge door.
 - b. Insulation: 2 in. thick fire-rated insulation sandwiched between two pieces of 20 gauge steel.
 - c. Finish Trim: 22 gauge steel drywall bead.
- B. Size: Unless otherwise indicated on the Drawings, provide 24 in. square opening where a serviceman needs to enter the space accessible through the access door or panel; elsewhere not less than 12 in. square.

2.02 MATERIALS

- A. General:
1. Provide sheet metal selected for its surface flatness, smoothness and freedom from surface blemishes where exposed to view in the finished unit.
 2. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, variations in flatness exceeding those permitted by referenced standards for stretcher-leveled metal sheet, stains, discoloration or other imperfections.
- B. Galvanized Steel Sheet: ASTM A 526 (commercial quality), or ASTM A 527 (lock-forming quality), Coating Designation G90, mill phosphatized, stretcher leveled.
- C. Steel Sheet: Commercial quality cold-rolled carbon steel sheet, stretcher-leveled, complying with the following requirements at the fabricator's option.
1. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591, with Class C zinc coating;

chemically treated in mill with phosphate solution and light chromate rinse.

- 2. Uncoated Steel Sheet: ASTM A 366, Class I, matte finish.
- D. Stainless Steel Sheet: ASTM A 167, Type 302 or 304, stretcher-leveled.
- E. Hardware:
 - 1. Hinges: Concealed spring hinges or concealed continuous piano hinge set to open 175 deg. For fire-rated units, provide self-closing mechanism.
 - 2. Locking Device: Flush, screwdriver-operated cam lock of number required to hold door in flush, smooth plane when closed.
 - a. Where shown or scheduled, provide one cylinder lock per access door. Furnish 2 keys per lock. Key all locks alike, unless otherwise noted.
 - b. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.
 - c. Where lock is provided, provide panel with interior latch mechanism to allow door to be opened from the inside without a key.

2.03 FABRICATION

- A. Fabricate to profiles indicated without exposed cut edges. Produce flat, flush surfaces without cracking and grain separation at bends.
- B. Continuously weld exposed joints and seams; grind, fill, and dress welds to produce smooth flush exposed surfaces in which welds are invisible after final finishing is completed.
- C. Finish:
 - 1. When installed in ceramic tile surfaces, provide stainless steel access panels finished with an AISI No. 4 (brushed) finish.
 - 2. When installed in an exterior wall or soffit fabricate assemblies from commercial quality carbon steel sheets complying with ASTM A 526, hot-dip galvanized to comply with ASTM A 525, G 90, or hot-dip galvanize after fabrication to provide an equivalent zinc coating weight.
 - 3. Elsewhere provide access panels with a baked-on rust-inhibitive primer.

3.00 EXECUTION

3.01 INSPECTION

- A. Inspect adjacent construction and supports.
- B. Make sure that openings are within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface, and that other conditions detrimental to the proper or timely completion of this work are corrected before proceeding with installation.

3.02 INSTALLATION

- A. Install at indicated locations, plumb, level, and square with adjacent construction.
 - 1. Make sure that all openings are framed.
 - 2. Attach securely to supports.
 - 3. When installed in ceramic tile surfaces, coordinate panel location with the tilework so that the panel will align and fit within the tile module with no tile cutting, or a minimum of cutting.
- B. Adjust hardware so that panels operate freely, but not loosely, without sticking or hinge binding, with hardware adjusted and functioning properly.

END OF SECTION

**SECTION 08 33 00
ROLLUP SERVICE DOOR**

PART 1 – GENERAL

1.1 SUMMARY

- A. **Section Includes:** Electric operated overhead insulated rolling doors
- B. **Related Sections:**
 - 1. 05 50 00 Metal Fabrications. Door opening jamb and head members.
 - 2. 06 10 00 Rough Carpentry. Door opening jamb and head members.
 - 3. Division 26. Electrical wiring and conduit, fuses, disconnect switches, connection of operator to power supply, and installation of control station and wiring.
- C. **Products That May Be Supplied, But Are Not Installed Under This Section:**
 - 1. Control Station

1.2 SYSTEM DESCRIPTION

- A. **Design Requirements:**
 - 1. **Cycle Life:**
 - a. Design doors of standard construction for normal use of up to 20 cycles per day maximum, and an overall maximum of 50,000 operating cycles for the life of the door
 - 2. **Insulated Door Slat Material Requirements:**
 - a. Flame Spread Index of 0 and a Smoke Developed Index of 10 as tested per ASTM E84
 - b. Minimum R-value of 8.0 (U-value of 0.125) as calculated using the ASHRAE Handbook of Fundamentals
 - c. Insulation to be CFC Free with an Ozone Depletion Potential (ODP) rating of zero

1.3 SUBMITTALS

- A. Reference Section 01 33 00 Submittal Procedures; submit the following items:
 - 1. **Product Data**
 - 2. **Shop Drawings:** Include special conditions not detailed in Product Data. Show interface with adjacent work.
 - 3. **Quality Assurance/Control Submittals:**
 - a. Provide manufacturer ISO 9001:2015 registration
 - b. Provide manufacturer and installer qualifications - see below
 - c. Provide manufacturer's installation instructions
 - 4. **Closeout Submittals:**
 - a. Operation and Maintenance Manual
 - b. Certificate stating that installed materials comply with this specification

1.4 QUALITY ASSURANCE

- A. **Qualifications:**
 - 1. **Manufacturer Qualifications:** ISO 9001:2015 registered and a minimum of five years experience in producing doors of the type specified
 - 2. **Installer Qualifications:** Manufacturer's approval

1.5 DELIVERY STORAGE AND HANDLING

- A. Reference Section 01 66 00 Product Storage and Handling Requirements
- B. Follow manufacturer's instructions

1.6 WARRANTY

- A. Standard Warranty: Two years from date of shipment against defects in material and workmanship.
- B. Maintenance: Submit for owner's consideration and acceptance of a maintenance service agreement for installed products

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. **Manufacturer:**
Cornell: 24 Elmwood Avenue, Mountain Top, PA 18707. Telephone: (800) 233-8366
- B. Alternates:
 - 1. Cookson
 - 2. Clopay

2.2 PRODUCT INFORMATION

- A. **Model:** ESD20

2.3 MATERIALS

- A. **Curtain:**
 - 1. **Fabrication:**
 - a. **Slat Material:** No. 6F, (Listed Exterior/Interior):
 - 1) **Galvanized Steel/Galvanized Steel:** Manufacturer recommended gauge based on performance requirements. Minimum 22/22 gauge, Grade 40, ASTM A 653 galvanized steel zinc coating.
 - b. **Insulation:** 7/8 inch foamed-in-place, closed cell urethane
 - c. **Total Slat Thickness:** 15/16 inch
 - d. **Flame Spread Index** of 0 and a **Smoke Developed Index** of 10 as tested per ASTM E84
 - e. **R-value:** 8.0
 - 2. **Slat Finish:**
 - a. **SpectraShield® Coating System:**
 - 1) ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding, gray baked-on base coat and gray baked-on polyester finish coat
 - 2) Zirconium treatment followed by baked-on polyester powder coat, with color as selected by Architect from manufacturer's standard color range, over 180 colors; minimum 2.5 mils cured film thickness; ASTM D-3363 pencil hardness: H or better
 - 3) **SpectraShield Ultra** – Ultra Powder Coat to be applied as a protective top coat over SpectraShield finish. Top coat is a polyester based structured wear resistant clear powder coat of 2.5-3.5 mils cured film thickness. ASTM D-3363 pencil hardness: 2H or better. Tested per ASTM B117
- B. **Endlocks:** Fabricate interlocking sections with high strength nylon endlocks on alternate slats each secured with two 1/4" rivets.

- C. **Bottom Bar**

1. **Insulated Bottom Bar:** Reinforced extruded aluminum interior face with full depth insulation and exterior skin slat to match curtain material and gauge. Minimum 4" tall x 1-1/16" thickness.
 2. **Finish:**
 - a. Powder coat to match slats
- D. **Guides:**
1. **Fabrication:**
 - a. Minimum 3/16 inch structural steel angles. Provide windlock bars of same material when windlocks are required to meet specified wind load. Top of inner and outer guide angles to be flared outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar.
 2. **Finish:**
 - a. **SpectraShield® Coating System:** Zirconium treatment followed by baked-on polyester powder coat, color as selected by Architect from manufacturer's standard color range, over 180 colors; minimum 2.5 mils cured film thickness; ASTM D-3363 pencil hardness: H or better
- E. **Counterbalance Shaft Assembly:**
1. **Barrel:** Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot of width
 2. **Spring Balance:** Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs. Provide wheel for applying and adjusting spring torque.
- F. **Brackets:**
Fabricate from minimum 3/16 inch steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures
1. **Finish:**
 - a. **SpectraShield® Coating System:** Zirconium treatment followed by baked-on polyester powder coat, color as selected by Architect from manufacturer's standard color range, over 180 colors; minimum 2.5 mils cured film thickness; ASTM D-3363 pencil hardness: H or better
- G. **Hood:**
Minimum 24 gauge galvanized steel with reinforced top and bottom edges. Provide minimum 1/4 inch steel intermediate support brackets as required to prevent excessive sag.
1. **Finish:**
 - a. **SpectraShield® Coating System:**
 - 1) ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding, gray baked-on base coat and gray baked-on polyester finish coat
 - 2) Zirconium treatment followed by baked-on polyester powder coat, with color as selected by Architect from manufacturer's standard color range, over 180 colors; minimum 2.5 mils cured film thickness; ASTM D-3363 pencil hardness: H or better
- H. **Weatherstripping:**
1. **Bottom Bar:** Sensing/weather edge with neoprene astragal extending full width of door bottom bar
 2. **Guides:** Replaceable vinyl strip on guides sealing against fascia side of curtain
 3. **Lintel Seal:** Nylon brush seal fitted at door header to impede air flow

2.4 OPERATION

- A. **Motor – Standard Use – Model MG (Industrial Duty Gear Head) Operator:** The operator must not extend above or below the door coil when mounted front-of-coil. Rated for a maximum of 20 cycles per hour (not to be used for consecutive hours) cULus listed (to comply with UL requirements in The United States and Canada), Totally Enclosed Non Ventilated gear head operators rated 1/2 hp as recommended by door manufacture for size and type of door, 120 Volts, 1 Phase. Provide complete with electric motor and factory pre-wired motor control terminals, maintenance free solenoid actuated brake and control station. Motor shall be high starting torque, industrial type, protected against overload with an auto-reset thermal sensing device. Primary speed reduction shall be heavy-duty, lubricated gears with mechanical braking to hold the door in any position. Operator shall be equipped with an emergency manual chain hoist assembly that safely cuts operator power when engaged. A disconnect chain shall not be required to engage or release the manual chain hoist. Operator drive and door driven sprockets shall be provided with #50 roller chain. Operator drive and door driven sprockets shall be provided with minimum #50 roller chain. Operator shall be capable of driving the door at a speed of up to 9" per second or as recommended for door size. Fully adjustable, driven linear screw type cam limit switch mechanism shall synchronize the operator with the door. The electrical contractor shall mount the control station and supply the appropriate disconnect switch, all conduit and wiring per the overhead door wiring instructions.
- B. **Control Station:**
1. **Surface mounted:** "Open/Close/Stop" push buttons; NEMA 1
- C. **Control Operation:**
1. **Momentary Contact to Close:**
Fail-safe, UL325-2010 Compliant Entrapment Protection for Motor Operation.
 - a. **SafetyGard UL325 Light Curtain with Dynamic Sequential Blanking:**
Provide monitored, non-contact light curtain consisting of a transmitter and a receiver to be mounted to the guide assembly of the door in the provided mounting channel, projecting a thru beam across the width of the door for the height of the light curtain (3ft or 6ft depending on opening size of the door). Interruption of beam before door fully closes shall cause door to immediately stop downward travel and reverse direction to the fully opened position
 - b. **Continuously monitored, wireless sensing/weather edge** seal extending full width of door bottom bar. Contact before door fully closes shall cause door to immediately stop downward travel and reverse direction to the fully opened position.

2.5 ACCESSORIES

- A. Covers:
1. **Operator and Bracket Mechanism Cover:** Minimum 24 gauge galvanized steel sheet metal cover to enclose exposed moving operating components at coil area of unit. Finish to match door hood.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates upon which work will be installed and verify conditions are in accordance with approved shop drawings
- B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates
- C. Commencement of work by installer is acceptance of substrate

3.2 INSTALLATION

- A. General: Install door and operating equipment with necessary hardware, anchors, inserts, hangers and supports
- B. Follow manufacturer's installation instructions

3.3 ADJUSTING

- A. Following completion of installation, including related work by others, lubricate, test, and adjust doors for ease of operation, free from warp, twist, or distortion

3.4 CLEANING

- A. Clean surfaces soiled by work as recommended by manufacturer
- B. Remove surplus materials and debris from the site

3.5 DEMONSTRATION

- A. Demonstrate proper operation to Owner's Representative
- B. Instruct Owner's Representative in maintenance procedures

END OF SECTION

SECTION 08 41 13
ALUMINUM FRAMED ENTRANCE AND STOREFRONT

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

A. Section includes:

- 1. Aluminum-Framed Storefront.
 - a. Arcadia, Inc., AFG451T Series, 2" x 4-1/2", Thermally Broken; offset glazed system, screw spline, shear block, compensating stick or punched opening fabrication for 1" glass (exterior).

B. Related Sections:

- 1. Section 06 16 43 – Gypsum Sheathing
- 2. Section 07 42 13 – Element Wall Panels
- 3. Section 07 62 00 – Sheet Metal Flashing and Trim
- 4. Section 07 90 00 – Joint Sealants
- 5. Section 08 32 13 – Sliding Aluminum-Framed Glass Doors
- 6. Section 08 51 13 – Aluminum Windows
- 7. Section 08 80 00 - Glazing
- 8. Section 09 22 16 – Non-Structural Metal Framing
- 9. Section 09 24 00 – Lath and Portland Cement Stucco
- 10. Section 09 94 00 – Fluorocarbon Resin Coating

1.03 REFERENCES

- A. American Architectural Manufacturers Association (AAMA).
- B. American Society for Testing and Materials (ASTM).
- C. Aluminum Association (AA).

1.04 SYSTEM DESCRIPTION

- A. General: In addition to requirements shown or specified, comply with:
 - 1. Applicable provisions of AAMA Aluminum Storefront and Entrance Manual for

design, materials, fabrication and installation of component parts.

B. Design Requirements:

1. Arcadia AFG451T Series is a framing system that provides a flush glazing on all sides without projected stops, with glass forward or inward of the frame. Framing system suitable for outside or inside glazing.

C. Performance Requirements:

1. Limit air leakage through assembly to 0.06 CFM/min/sq.ft. (.00003 m³/sm²) of wall area at 6.24 PSF (300 Pa) as measured in accordance with ASTM E 283.
2. Water Resistance: No water leakage when measured in accordance with ASTM E 331 with a static test pressure of 8 PSF (383 Pa).
3. Limit mullion windload deflection of L/175 with full recovery of glazing materials, when measured in accordance with ASTM E 330.
4. System shall not deflect more than 1/8" at the center point, or 1/16" at the center point of a horizontal member, once deadload points have been established.
5. System shall accommodate expansion and contraction movement due to surface temperature differential of 180 degrees F.
6. Seismic testing shall conform to AAMA recommended static test method for evaluating performance of curtain walls and storefront wall systems due to horizontal displacements associated with seismic movements and building sway.
7. Thermal Performance - When tested in accordance with AAMA 1503.1, the following results should be attained: U-Maximum .63/CRF – minimum of 59.
8. National Fenestration Rating Council (NFRC) specific application evaluation.

1.05 QUALITY ASSURANCE

A. Single Source Responsibility:

1. Obtain entrances, storefronts, ribbon walls, window walls, curtain walls, window systems, and finish through one source from a single manufacturer.

B. Provide test reports from AAMA accredited laboratories certifying the performances as specified in 1.04.

1.06 WARRANTY

- A. System shall be warranted against failure and/or deterioration of metals due to manufacturing process for a period of two (2) years.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Arcadia, Inc., 2301 East Vernon, Vernon, CA.
Telephone 323) 269-7300, Fax 323) 269-7390.

B. Acceptable Products:

1. Arcadia, Inc., AFG451T Series.

2.02 FRAMING MATERIALS AND ACCESSORIES

- A. Framing Members, Transition Members, Mullions, Adaptors, and Mounting: Extruded 6063-T6 aluminum alloy (ASTM B 221 – Alloy G.S. 10a T6).
- B. Screws, Fastening Devices, and Internal Components: Aluminum, stainless steel, or zinc-plated steel in accordance with ASTM A 164. Perimeter anchors shall be aluminum or steel, providing the steel is properly isolated from aluminum.
- C. Glazing Gasket:
 1. Compression-type design, replaceable, molded or extruded, or ethylene propylene diene monomer (EPDM).
 2. Shall be of type that locks securely into the glazing reglet to prevent glazing gaskets from disengaging.

2.03 FINISH

- A. Finish all exposed areas of aluminum and components as indicated (excluding hardware):
 1. An Architectural Class II or I anodic coating conforming with AA-M12C22A31/AA-M12C22A41.
 - a. Anodize finish color shall be Colornodic AC-2 (#11 Clear) or
 - b. Fluorocarbon Coating: AAMA 2605.
 - 1) Resin: 70% PVDF Kynar 500/Hylar 5000.
 - 2) Substrate: Cleaned and pretreated with chromium phosphate.
 - 3) Primer: Manufacturer's standard resin base compatible coating. Dry film thickness.
 - a) Extrusion: Minimum 0.20 mil.
 - 4) Color Coat: 70% PVDF, dry film thickness.
 - a) Extrusion: 1.0 mil.
 - 5) Color: #36 Anodic Clear.
 - 6) Acceptable Coatings Manufacturers:
 - a) PPG Industries, Inc.

2.04 SYSTEM FABRICATION

- A. Continuous sub-sill shall be provided under sill members to collect water infiltration and divert from the interior of the system.
- B. Framing members shall be internally reinforced and secured at head and sill as necessary for structural performance requirements, for hardware attachment, and as indicated.

- C. Fasteners shall be so located as to ensure concealment from view in the final assembly.

3.00 EXECUTION

3.01 EXAMINATIONS

- A. Examine conditions and verify substrate conditions are acceptable for product installation.

3.02 INSTALLATION

- A. Install in accordance with approved shop drawings and manufacturer's installation instructions.

3.03 FIELD QUALITY CONTROL

- A. Test the storefront for water leaks in accordance with AAMA 501.2. Conduct test in the presence of the Architect. Correct deficiencies observed as a result of this test.

END OF SECTION

SECTION 08 41 13
GLAZED ALUMINUM CURTAIN WALL

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

A. Section includes:

- 1. Aluminum-Framed Storefront.
 - a. Arcadia, Inc., T500 Series (OPG-6000), 2-1/4" x 6", Captured 2 sided and 4 sided structural silicone glazed for 1/4", 3/8", 1/2", 1", 1-1/8" glass.

B. Related Sections:

- 1. Section 06 16 43 – Gypsum Sheathing
- 2. Section 07 42 13 – Element Wall Panels
- 3. Section 07 62 00 – Sheet Metal Flashing and Trim
- 4. Section 07 90 00 – Joint Sealants
- 5. Section 08 32 13 – Sliding Aluminum-Framed Glass Doors
- 6. Section 08 51 13 – Aluminum Windows
- 7. Section 08 80 00 - Glazing
- 8. Section 09 22 16 – Non-Structural Metal Framing
- 9. Section 09 24 00 – Lath and Portland Cement Stucco
- 10. Section 09 94 00 – Fluorocarbon Resin Coating

1.03 REFERENCES

- A. American Architectural Manufacturers Association (AAMA).
- B. American Society for Testing and Materials (ASTM).
- C. Aluminum Association (AA).

1.04 SYSTEM DESCRIPTION

- A. General: In addition to requirements shown or specified, comply with:
1. Applicable provisions of AAMA Aluminum Storefront and Entrance Manual for design, materials, fabrication and installation of component parts.
- B. Design Requirements:
1. Arcadia AFG451T Series is a framing system that provides a flush glazing on all sides without projected stops, with glass forward or inward of the frame. Framing system suitable for outside or inside glazing.
- C. Performance Requirements:
1. Limit air leakage through assembly to 0.06 CFM/min/sq. ft. (.00003 m3/sm2) of wall area at 6.24 PSF (300 Pa) as measured in accordance with ASTM E283.
 2. Water Resistance: No water leakage when measured in accordance with ASTM E331 with a static test pressure of 15PSF.
 3. Dynamic Water Resistance: No water leakage, when measured in accordance with AAMA 501.1-94 with a dynamic test pressure of 15PSF.
 4. Uniform Load Deflection under () psf positive and () psf negative design wind pressure normal to the plane of the wall, shall not exceed L/175 of the clear span or 3/4", when tested in accordance with ASTM E 330.
 5. Uniform Load Structural at a pressure 1.5 times the design wind pressure in accordance with ASTM E 330.
 6. System shall not deflect more than 1/8" at the center point, or 1/16" at the center point of a horizontal member, once deadload points have been established.
 7. System shall accommodate expansion and contraction movement due to surface temperature differential of 180 degrees F.
 8. Condensation Resistance Factor (CRF) in accordance with AAMA 1503.1-88 shall not be less than 55.
 9. Thermal Transmittance (U-Value) in accordance with AAMA 1503.1-88 shall not be more than .65 BTU/hr/degree F/SF.
 10. Seismic testing shall conform to AAMA recommended static test method for evaluating performance of curtain walls and storefront wall systems due to horizontal displacements associated with seismic movements and building sway.
 11. Sound transmission in accordance with ASTM E 90.
 12. National Fenestration Rating Council (NFRC) specific application evaluation.

1.05 QUALITY ASSURANCE

- A. Single Source Responsibility:
1. Obtain entrances, storefronts, ribbon walls, window walls, curtain walls, window

systems, and finish through one source from a single manufacturer.

- B. Provide test reports from AAMA accredited laboratories certifying the performances as specified in 1.03.

1.06 WARRANTY

- A. System shall be warranted against failure and/or deterioration of metals due to manufacturing process for a period of two (2) years.

2.00 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Arcadia, Inc., 2301 East Vernon, Vernon, CA.
Telephone 323) 269-7300, Fax 323) 269-7390.
- B. Acceptable Products:
 - 1. Arcadia, Inc., T500 Series (OPG-6000).

2.02 FRAMING MATERIALS AND ACCESSORIES

- A. Framing members, transition members, mullions, adaptors, and mounting: Extruded 6063-T6 aluminum alloy (ASTM B221 – Alloy G.S. 10a T6).
- B. Screws, fastening devices, and internal components: Aluminum, stainless steel, or zinc-plated steel in accordance with ASTM.A-164. Perimeter anchors shall be aluminum or steel, providing the steel is properly isolated from aluminum.
- C. Glazing Gasket (Silicone Compatible):
 - 1. Compression-type design, replaceable, molded or extruded santoprene, polyvinyl chloride (PVC), or ethylene propylene diene monomer (EPDM).

2.03 FINISH

- A. Finish all exposed areas of aluminum and components as indicated (excluding hardware):
 - 1. An Architectural Class II or I anodic coating conforming with AA-M12C22A31/AA-M12C22A41.
 - a. Anodize finish color shall be Colornodic AC-2 (#11 Clear) or
 - b. Fluorocarbon Coating: AAMA 2605.
 - 1) Resin: 70% PVDF Kynar 500/Hylar 5000.
 - 2) Substrate: Cleaned and pretreated with chromium phosphate.
 - 3) Primer: Manufacturer's standard resin base compatible coating. Dry

film thickness.

a) Extrusion: Minimum 0.20 mil.

4) Color Coat: 70% PVDF, dry film thickness.

a) Extrusion: 1.0 mil.

5) Color: #36 Anodic Clear.

6) Acceptable Coatings Manufacturers:

a) PPG Industries, Inc.

2.04 SYSTEM FABRICATION

- A. Continuous sub-sill shall be provided under sill members to collect water infiltration and divert from the interior of the system.
- B. Framing members shall be internally reinforced and secured at head and sill as necessary for structural performance requirements, for hardware attachment, and as indicated.
- C. Fasteners shall be so located as to ensure concealment from view in the final assembly.

3.00 EXECUTION

3.01 EXAMINATIONS

- A. Examine conditions and verify substrate conditions are acceptable for product installation.

3.02 INSTALLATION

- A. Install in accordance with approved shop drawings and manufacturer's installation instructions.

3.03 FIELD QUALITY CONTROL

- A. Test the storefront for water leaks in accordance with AAMA 501.2. Conduct test in the presence of the Architect. Correct deficiencies observed as a result of this test.

END OF SECTION

SECTION 08 43 33
FOLDING GLASS STOREFRONTS

PART 1 GENERAL

1.01 SUMMARY

- A. Related Documents and Sections: Contractor to examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to, the following:
1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 General Requirements, Specification Sections, apply to this Section.
 2. Section 06 10 00 - Rough Carpentry
 3. Section 06 20 00 - Finish CarpentrySection 07 27 00 - Air Barriers
 5. Section 07 62 00 - Sheet Metal Flashing and Trim
 6. Section 07 90 00 - Joint Sealers
 7. Section 08 42 23 - Glass Entrance Swing Doors
 8. Section 09 22 16 - Non-Structural Metal Framing

1.02 REFERENCES

- A. Reference Standards in accordance with Division 01 and current editions from the following:
1. AAMA. American Architectural Manufacturers Association; www.aamanet.org
 - a. AAMA 502, Voluntary Specification for Field Testing of Newly Installed Fenestration Products.
 - b. AAMA 520, Voluntary Specification for Rating the Severe Wind-Driven Rain Resistance of Windows, Doors and Unit Skylights.
 - c. AAMA 611, Voluntary Specification for Anodized Architectural Aluminum.
 - d. AAMA 920, Operation / Cycling Performance.
 - e. AAMA 1304, Voluntary Specification for Forced Entry Resistance of Side-Hinged Door Systems.
 - f. AAMA 2604, Voluntary Specifications, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - g. AAMA 2605, Voluntary Specifications, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
 - h. AAMA/WDMA/CSA 101/I.S.2/A440, NAFS, North American Fenestration Standard - Specification for Windows, Doors and Skylights.

2. ANSI. American National Standards Institute; www.ansi.org
 - a. ANSI Z97.1, Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.
3. ASTM. ASTM International; www.astm.org
 - a. ASTM C1036, Standard Specification for Flat Glass.
 - b. ASTM C1048, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
 - c. ASTM E90-09, Standard Test Method for Laboratory Measurements of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - d. ASTM E283, Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 - e. ASTM E330, Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 - f. ASTM E331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
 - g. ASTM E413, Classification for Rating Sound Insulation.
 - h. ASTM E547, Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.
 - i. ASTM E1332, Standard Classification for Rating Outdoor-Indoor Sound Attenuation.
 - j. ASTM E2268, Standard Test Method for Water Penetration of Exterior Windows, Skylights, and Doors by Rapid Pulsed Air Pressure Difference.
 - k. ASTM F842, Standard Test Methods for Measuring the Forced Entry Resistance of Sliding Door Assemblies.
4. CPSC. Consumer Product Safety Commission; www.cpsc.gov
 - a. CPSC 16CFR-1201, Safety Standard for Architectural Glazing Materials
5. CSA Group (Canadian Standards Association); www.csagroup.org/global/en/home
 - a. CSA A440S1 - The Canadian supplement to North American (NAFS) standards
6. DIN. "Deutsches Institut für Normung" (German institute for standardization); www.en-standard.eu/din-standards
 - a. DIN EN 1191, Windows and doors – Resistance to repeated opening and closing – Test method; German version EN 1191: 2000.
 - b. DIN EN ISO 717-1, Acoustics – Rating of sound insulation in buildings and building elements.
 - c. DIN EN ISO 9001, 2015 quality management system registration.
 - d. DIN EN ISO 10140-1, 2, 4 & 5, Airborne sound measurement.
 - e. DIN EN ISO 12400, Window and pedestrian doors- Mechanical durability – Requirements and classification.
 - f. DIN EN ISO 14001, 2015 environmental management system registration.

- g. DIN 52210-3, Testing of acoustics in buildings - Airborne and impact sound insulation - Laboratory measurements of sound insulation of building elements and field measurements between rooms.
 - h. DIN 52210-4, Tests in Building Acoustics - Airborne and Impact Sound.
 - 7. Energy Star, U.S. Environmental Protection Agency (EPA) Program; www.energystar.gov
 - 8. Metro-Dade County, FL Building Code Compliance Office Protocols; www.miamidade.gov/building/products/windows.asp (SL73 only)
 - a. TAS 201, Impact Test Procedures
 - b. TAS 202, Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components Using Uniform Static Air Pressure
 - c. TAS 203, Criteria for Testing Products Subject to Cyclic Wind Pressure Loading
 - 9. FL. Florida Building Commission – Product Approval; https://floridabuilding.org/pr/pr_app_srch.aspx
 - 10. NFRC. National Fenestration Rating Council; www.nfrc.org
 - a. NFRC 100, Procedure for Determining Fenestration Product U-factors
 - b. NFRC 200, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence
 - c. NFRC 400, Procedure for Determining Fenestration Product Air Leakage
 - d. NFRC 500, Procedure for Determining Fenestration Product Condensation Resistance Rating Values
- 1.03 ADMINISTRATIVE REQUIREMENTS
- A. Coordination: Coordinate Folding Glass Storefront system and framing R.O.
 - B. Pre-installation Meetings: See Section 01 30 00.
- 1.04 SUBMITTALS
- A. For Contractor submittal procedures see Section 01 30 00.
 - B. Product Data: Submit manufacturer's printed product literature for each Folding Glass Storefront system to be incorporated into the Work. Show performance test results and details of construction relative to materials, dimensions of individual components, profiles, and colors.
 - C. Product Drawings: Indicate Folding Glass Storefront system component sizes, dimensions and framing R.O., configuration, swing panels, direction of swing, stacking layout, typical head jamb, side jambs and sill details, type of glazing material, handle height and field measurements.
 - D. Installation, Operation and Maintenance Data: Submit Owner's Manual from manufacturer. Identify with project name, location and completion date, and type and size of unit installed.
- 1.05 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Manufacturer capable of providing complete, precision built, engineered, pre-fitted units with a minimum thirty (30) years' experience in the

sale of folding-sliding door systems for large openings in the North American market.

- B. Installer Qualifications: Installer experienced in the installation of manufacturer's products or other similar products for large openings. Installer to provide reference list of at least three (3) projects of similar scale and complexity successfully completed in the last three (3) years.

- 1. Installer to be trained and certified by manufacturer.

- C. Single Source Responsibility: Furnish Folding Glass Storefront system materials from one manufacturer for entire Project.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's instructions and recommendations, Section 01 60 00 requirements, and as follows:

- 1. Deliver materials to job site in sealed, unopened cartons or crates.
 - a. Upon receipt, inspect the shipment to ensure it is complete, in good condition and meets project requirements.
 - 2. Store material under cover in a clean and dry location, protecting units against weather and defacement or damage from construction activities, especially to the edges of panels.

1.07 FIELD CONDITIONS

- A. Field Measurements: Contractor to field verify dimensions of rough openings (R.O.) **and threshold depressions to receive sill**. Mark field measurements on product drawing submittal.

1.08 WARRANTY

- A. Manufacturer Warranty: Provide Folding Glass Storefront system manufacturer's standard limited warranty as per manufacturer's published warranty document in force at time of purchase, subject to change, against defects in materials and workmanship.

- 1. Warranty Period beginning with the earliest of 120 days from Date of Delivery or Date of Substantial Completion:
 - a. Rollers and Glass Seal Failure: Ten (10) years
 - b. All Other Components Except Screens: Ten (10) years
 - 1). Exception: Five (5) years if NOT installed by manufacturer's specific system approved or certified trained installer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product by Manufacturer: **NanaWall SL45, SL70 & SL73 by NANA WALL SYSTEMS, INC.** (www.nanawall.com)

NANA WALL SYSTEMS, INC.

100 Meadow Creek Drive, Corte Madera, CA 94925

Toll Free: (800) 873-5673

Telephone: (415) 383-3148

Fax: (415) 383-0312

Email: info@nanawall.com

1. Substitution Procedures: See Section 01 20 00; Submit, completed, and signed:
 - a. Document 00 43 25, Substitution Request Form (During Procurement)
 - b. Document 00 63 25, Substitution Request Form (During Construction)

2.02 PERFORMANCE/ DESIGN CRITERIA

NOTE: Items below are common to all systems.

- | | |
|--|--|
| A. Forced Entry (AAMA 1304 / ASTM F842): | Meets requirements for +F1 |
| B. Thermal Performance (U-factor): | NFRC 100 rated, certified, and labeled |
| C. Solar Heat Gain Coefficient (SHGC) + Visible Light Transmission (VT): | NFRC 200 rated, certified, and labeled |

NOTE: Applicable for SL70 and SL73 only.

- | | |
|--|--|
| D. Air Leakage: | NFRC 400 rated, certified, and labeled |
| E. Condensation Resistance Factor (CRF): | NFRC 500 rated, certified, and labeled |

NOTE: The NFRC 100, 200, 400 and 500 ratings of the SL70 and SL73 Folding Glass Storefront System meet Prescriptive Method requirements for U-factor, SHGC, Air Leakage and CRF of California Title 24, Chapter 3, Building Envelope Requirements. For the listing of Nana Wall product NFRC testing reports go to the following website <http://search.nfrc.org/search/searchdefault.aspx>; click on **Door** (Find Ratings for Door Products); click on the **Search by Manufacturer** button; click **Manufacturers**, scroll down to and click on **Nana Wall Systems, Inc.**, and click on the **Find Products** button.

- | | |
|---------------------|--|
| F. EPA Energy Star: | Meets requirements with specific glass.(SL70 & SL73) |
|---------------------|--|

NOTE: **Energy Star** values for DOORS with > 50% glass can be achieved through the use of specific glass units meeting the following requirements:
Northern & North-Central Region: < 0.30 U-factor 0.40 SHGC
South-Central & Southern Region: < 0.30 U-factor 0.25 SHGC
Energy Star Air Leakage Rating Requirements (ASTM E283 in accordance with NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440-11):
Swinging Door: $\leq 0.5 \text{ cfm/ft}^2$ (2.56 L/s/m²)
For guidance only as Nana Wall Systems is not a participant of the Energy Star Program.

G. Design Criteria

1. Sizes and Configurations: As indicated by the Drawings for selected number and size of panels, location of swing panels, and location of track and stacking.
2. Unit Operation: Sliding and folding hardware with top and bottom tracks.

2.03 THERMALLY BROKEN ALUMINUM FRAMED FOLDING SYSTEM: NANAWALL SL70

- A. Basis of Design: **Model SL70.** Monumental floor supported system designed for angle

changes, segmented curves. Manufacturer's standard or post reinforced frame and panel profiles, with top track, side jambs and panels with dimension as shown on Drawings.

1. System Components: Aluminum frame, threshold, panels, sliding-folding and locking hardware, weather stripping, glass and glazing, insect screen (optional) and accessories.
 2. Mounting Type: Floor track supported
 3. Panel Type: Hinged
 - a. Entry/Egress panel hinged to side jamb
 4. Configuration
 - a. Panel Configuration: Straight
 - b. Stack Storage Configuration: Outswing type
 5. Panel and Frame
 - a. Panel: Single lite
 - b. Panel Size (W x H): 939.64 X 2375 mm As indicated in drawing.
 - 1). Rail Depth: 2-3/4 inch (70 mm)
 - 2). Top Rail and Stile Width: 2-1/4 inch (57 mm)
 - 3). Bottom Rail Width: 2-1/4 inch (57 mm)
 - 4). Bottom Rail Width: Manufacturer's standard kickplate with height 10" (254 mm)
 - c. Frame: Matching top track and side jambs
 - 1). Top Track and Side Jamb Width: 2-9/16 inch (65 mm)
 - 2). Top Track and Side Jamb Depth: 3-1/8 inch (80 mm)
 - 3). Sill Type: Low Profile Saddle sill (thermally broken)
 - 4). Window Sill Type:
 - 5). Sill Finish: Aluminum with clear anodized finish
 - 6). For ADA Compliance: Provide gasket to cover the channel in the sill at swing doors.
 - d. Aluminum Extrusion: AlMgSi0.5 alloy, 6063-T5 (F-22 - European standard)
 - 1). Thickness: 0.078 inch (2.0 mm) nominal
 - 2). Thermal Break: 3/4 to 15/16 inch (20 to 24 mm) wide polyamide plastic reinforced with glass fibers. Thinner or poured and de-bridged type thermal breaks not acceptable.
 6. Panel and Frame Aluminum Finish: color(s) inside and outside (AAMA 611- Anodized and AAMA 2604- Powder Coat)
 - a. Finish Type: Choose from 50 Standard Color
- B. Performance Criteria

NOTE: Edit for weeps. Weeps, when provided, are to be drilled in the field by the installer to manufacturer's requirements.

Air infiltration and water penetration testing results are only applicable if the unit matches the tested panel and unit size, direction of opening and type of sill.

Structural load testing results are only applicable for the test unit size and type of locking and rods.

Comparative analysis charts published by manufacturer shows which panel sizes, if any, meets the structural loading design pressures specifically required for the project. Check for limitations on the use of these charts in the jurisdiction of the project.

Forced entry testing results are only applicable for the test unit type of locking.

See manufacturer's latest published data regarding performance.

It is expected that the installed system's performance would be not more than 2/3rds of the following certified laboratory test data in accordance with AAMA 502.

1. Performance Criteria (Lab Tested): **Low Profile Saddle Sill - Outward Opening**
 - a. Air Infiltration (ASTM E283):
 - 1). 0.14 cfm/ft² (0.71 L/s/m²) at a static air pressure difference of 1.57 psf (75 Pa)
 - 2). 0.30 cfm/ft² (1.52 L/s/m²) at a static air pressure difference of 6.24 psf (300 Pa)
 - b. Water Penetration (ASTM E331, ASTM E547):
 - 1). No uncontrolled water leakage at a static (with weeps) test pressure of 6.00 psf (300 Pa)
 - c. Structural Loading (ASTM E330):
 - 1). Windload Resistance: Pass; C4
 - 2). Design Pressure Positive: 70 psf (3350 Pa)
 - 3). Design Pressure Negative: 70 psf (3350 Pa)
2. Items below are common to all sill types, except as noted.
 - a. Swing Panel - Operation / Cycling Performance (AAMA 920): 500,000 cycles
 - b. System - Life Cycle Performance (DIN EN 1191/12400): 20,000 cycles
 - c. Folding Glass Storefront Units tested to AAMA/WDMA/CSA 101/I.S.2/A440.
 - d. Glass Acoustical Performance (DIN 52210-3,4): STC (Rw)

NOTE: Acoustical system STC and Rw ratings per ASTM E413 and DIN EN ISO 717-1 are from testing of full panel systems by an independent and accredited acoustical laboratory in accordance with ASTM E90-09 and DIN EN ISO 10140-1,2, 4 & 5 test procedure. A complete and unedited written test report is available upon request.

- 1). [System STC (Rw) 43 (43) and OITC 35 with 1-1/2 inch (38 mm) double IGU, 10 mm + 8 mm STC 48 laminated glass]

- 2). [System STC (Rw) 41 (41) and OITC 33 with 1-7/16 inch (36 mm) double IGU, 8 mm laminated and 6 mm tempered STC 43 glass]
- 3). [System STC (Rw) 33 (33) and OITC 27 with 15/16 inch (24 mm) double IGU, 4 mm and 4 mm STC 32 tempered glass]

NOTE: Acoustical system STC ratings below are engineer-calculated conversions of European tests per ASTM E413 and ASTM E1332 for the full panel system with the flush sill.

- 4). [System STC (Rw) 42 (42) with 1-5/16 inch (34 mm) double IGU, 6 mm + 6 mm STC 44 enhanced laminated glass]
- 5). [System STC (Rw) 41 (41) with 1 inch (25 mm) double IGU, 6 mm + 6 mm STC 42 laminated glass]
- 6). [System STC (Rw) 38 (38) with 1/2 inch (12 mm) STC 39 enhanced laminated glass]
- 7). [System STC (Rw) 36 (36) with 1/4 inch (6 mm) STC 36 enhanced laminated glass]
- 8). [System STC (Rw) 35 (35) with 1/4 inch (6 mm) STC 35 laminated glass]
- 9). [System STC (Rw) 32 (32) with 1/4 inch (6 mm) STC 31 tempered glass]

NOTE: Retain Florida Product Approval subparagraph below when needed to meet wind loading requirements.

3. Florida Product Approval Units with panel sizes up to 3' 2-7/8" (94 cm) wide x 9' 8-3/4" (292 cm) high) subject to manufacturer size chart:
FL 35025

NOTE: FL 35025 web-link is:

https://www.floridabuilding.org/pr/pr_app_dtl.aspx?param=wGEVXQwtDqtw2pk%2fDHN%2ftFHFoneAOCxFfOtVMIGq3gdyNEQjBsRtsA%3d%3d

C. Glass and Glazing (German production):

1. Safety Glazing: In compliance with ASTM C1036, ASTM C1048, ANSI Z97.1 and CPSC 16CFR 1201.
 - a. Glass: Standard Low E Insulated Tempered Solarban 70

2.04 LOCKING HARDWARE AND HANDLES

1. Main Entry Panel(s) for Models WITH a Swing Panel or Pair of Swing Panel(s):
 - a. A lockset with a lockable latch.
 - b. Multi-point locking with a dead bolt and rods at the top and bottom on primary panel **only**.
 - c. Rods to be concealed and not edge mounted.
 - d. Operation: After turn of key or thumb-turn, depression of handles withdraws latch. Lifting handles engages rods and key or thumb turn engages deadbolts and operates lock.

- e. Secondary Swing Panel: Provide matching dummy lever handles on both sides and concealed flush bolts that operate the rods at the top and the bottom for the secondary swing panel. (Standard with pairs in SL70 & SL73)

NOTE: Hardware for Secondary Panel below is an option.

- f. Secondary Swing Panel: Provide two-point locking with standard shaped handles on inside only for the secondary swing panel. (SL70 & SL73)
- g. Locking: Standard profile cylinder
- 2. Main Entry Panel for Models WITH a **Pair of** Swing Panel(s): Provide lever handles on the inside and outside with single action, emergency egress, interconnected lock. (SL70 & SL73)
- 3. Main Entry Panel for Models WITH a Swing Panel: Provide manufacturer's push/pull handles with separate lock set and dead bolt and one-point locking at the top and bottom consisting of locking rods operated by a 180° turn of a flat handles on the inside.

NOTE: Option above recommended with a door closer, but note that, when sliding the swing panel, the door closer will need to be disengaged if the swing panel is not attached to a side jamb.

- a. Push-pull handles in a brushed stainless-steel finish
- 4. Main Entry Panel for Models WITH a [**Pair of**] Swing Panel(s): No hardware or locking provided by manufacturer; Field installed panic device(s) by Section 08 71 00. (SL45 & SL70)

NOTE: Structural test load results will not apply for locking devices by others.

- 5. Main Entry Pair of Panels on Models WITHOUT a Swing Panel: Provide manufacturer's standard L-shaped handles on the inside and outside, including a lock set with profile cylinder. Operation of lockset is by turn of key from outside and thumb-turn inside with two-point locking hardware operated by 180° turn of the handle.
- 6. Main Entry **Pair of** Panel(s) for Outswing Models WITHOUT Swing Panel(s): Provide manufacturer's standard flat handle on both sides and a lock set with a profile cylinder. Operation of lock set is by turn of key from the outside and from the inside with a two-point locking hardware operated by 180° turn of the handle.

NOTE: Key operation from the inside may not meet egress requirements.

- 7. Main Entry **Pair of** Panel(s) for Models WITHOUT Swing Panel(s): Provide manufacturer's standard handle on inside only with concealed two-point locking hardware operated by 180° turn of handle. Main entry panel is operable from inside only and that there is no latch.

NOTE: Below option is applicable to SL70 & SL73.

- 8. Main Entry Panel: Provide manufacturer's standard U/L-shaped handle on inside only with concealed two-point locking hardware operated by 180° turn of handle. Main entry panel is operable from inside only and there is no latch.

NOTE: Below option is applicable to all systems.

9. Secondary Panels and Pairs of Folding Panels: Provide manufacturer's **Standard secondary handles** and concealed two-point locking hardware operated by 180° turn of handle between each pair. Face applied flush bolt locking NOT acceptable.
10. Handle Height: 41-3/8 inch (105 cm) centered from bottom of panel.
11. Aluminum locking rods with standard fiberglass reinforced polyamide end caps at the top and bottom. Rods to have a stroke of 15/16 inch (24 mm).
12. Additional profile cylinders: **keyed differently**.

NOTE: Below option is applicable to SL70 & SL73.

- B. Sliding-Folding Hardware: Provide manufacturer's standard combination sliding and folding hardware with top and bottom tracks and threshold. All running carriages to be with sealed, self-lubrication, ball bearing multi-rollers. Surface mounted hinges and running carriages NOT acceptable. Weight of panels borne by the bottom of the guide channel in the sill is NOT acceptable.
1. Lower Running Carriage Carrying Capacity: 440 lbs. (200 kgs)
 2. Upper guide carriage and lower running carriage provided with four vertical stainless-steel wheels and two horizontal polyamide wheels.
 3. Vertical wheels to ride on top of stainless-steel guide track covers over the full length of the sill track and lie above the water run-off level.
 4. Wheels riding below water run-off level and wheels riding on aluminum surfaces are NOT acceptable.
 5. Swing Panel Hinges: Stainless-steel hinges and security hinge pins with set screws.

NOTE: Finishes to match are closest matches available by the manufacturer. Review for acceptability.

6. Adjustment: Provide folding-sliding hardware capable of compensation and adjustments without needing to remove panels from tracks, in width, 1/16 inch (1.5 mm) per hinge and in height, 5/64 inch (2 mm) up and down.

NOTE: Finishes to match are closest matches available by the manufacturer. Review for acceptability.

7. Adjustment: Provide 1/16 inch (1.5 mm) in width per hinge adjustments without removing panels from tracks and without needing to remove panels from tracks
- C. Weather stripping: Manufacturer's double layer EPDM between panels, EPDM gasket and Q-lon gasket, or brush seal between panel and frame, or brush seals with a two-layer fiberglass reinforced polyamide fin attached at both inner and outer edge of bottom of door panels with a recessed sill or on frame for sealing between panels and between panel and frame.

NOTE: The manufacturer's weather stripping is determined at the factory by the direction of swing, the panel configuration, the type of locking and the type of sill. UniverSILL available for SL70 and SL73 only.

1. UniverSILL: For outswing low profile saddle sill, UniverSILL gasket add on available for additional air and water protection.

- D. Fasteners: Tapered pins or stainless-steel screws for connecting frame components.

2.05 FABRICATION

- A. Folding Glass Wall: Extruded aluminum frame and panel profiles, corner connectors and hinges, sliding and folding hardware, locking hardware and handles, glass and glazing and weather stripping.
 - 1. Each unit factory pre-assembled and shipped with complete system components and installation instructions.
 - 2. Exposed work to be carefully matched to produce continuity of line and design with all joints.
 - 3. No raw edges visible at joints.

2.06 ACCESSORIES

- A. **Insect Screen:** Fully retractable non-pleated screen made of ultra-strong, UV resistant fiberglass mesh housed in a single cartridge riding on a single track.
 - 1. Basis-of-Design Product by Manufacturer: **The Horizon by Wizard Industries, Inc.**

WIZARD INDUSTRIES, INC.

4263 Phillips Ave, Burnaby, BC, Canada V5A 2X4

Toll Free: (888) 949-3667

Telephone: (604) 299-8878

Fax: (604) 299-4496

Email: sales@wizardindustries.com

<https://www.wizardscreens.com/>

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examination and Acceptance of Conditions per Section 01 70 00 and as follows:
 - 1. Carefully examine rough openings with Installer present, for compliance with requirements affecting Work performance.
 - a. Examine surfaces of openings and verify dimensions; verify rough openings are level, plumb, and square with no unevenness, bowing, or bumps on the floor; and other conditions as required by the manufacturer for readiness to receive Work.
 - b. Verify structural integrity of the header for deflection with live and dead loads limited to the lesser of L/720 of the span or 1/4 inch (6 mm). Provide structural support for lateral loads, and both wind load and eccentric load when the panels are stacked open.

NOTE: Prior to installing NanaWall, it is recommended that all building dead loads be applied to the header. Allow a reasonable amount of time for the dead load's effect on the header; only then can the building's live load be used to meet the above requirements of L/720 or 1/4 inch (6 mm). If this is not done, both dead and live loads need to be considered.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Install Folding Glass Storefront system in accordance with the Drawings, approved submittals, manufacturer's recommendations, and installation instructions, and as follows:
 1. Properly flash, waterproof and seal around opening perimeter.
 2. Securely attach anchorage devices to rigidly fit frame in place, level, straight, plumb, and square. Install frame in proper elevation, plane, and location, and in proper alignment with other work.
 3. When lower track is designed to drain, provide connections to allow for drainage.
 4. Install panels, handles, lockset, screens, and other accessories in accordance with manufacturer's recommendations and instructions.

3.03 FIELD QUALITY CONTROL

- A. Field Tests and Inspections per Section 01 40 00 of the following:
 1. Verify the Folding Glass Storefront system operates and functions properly. Adjust hardware for proper operation.
- B. Non-Conforming Work: Repair or replace non-conforming work as directed by the Architect; see General and Supplementary Conditions, and Division 01, General Requirements.

3.04 CLEANING AND PROTECTION

- A. Keep units closed and protect Folding Glass Storefront installation against damage from construction activities.
- B. Remove protective coatings and use manufacturer recommended methods to clean exposed surfaces.

END OF SECTION

**SECTION 08 51 13
ALUMINUM WINDOWS**

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

- A. Section includes:
 - 1. Sliding Metal Doors.
- B. Related Sections:
 - 1. Section 06 16 43 – Gypsum Sheathing.
 - 2. Section 07 42 13 – Metal Wall Panels.
 - 3. Section 07 62 00 – Sheet Metal Flashing and Trim.
 - 4. Section 07 90 00 – Joint Sealers.
 - 5. Section 08 41 13 – Aluminum-Framed Entrances and Storefronts.
 - 6. Section 08 41 14 – Aluminum Glazed Curtain Wall
 - 7. Section 08 88 00 - Glazing
 - 8. Section 09 22 16 – Non-Structural Metal Framing.

1.03 REFERENCES

- A. American Architectural Manufacturers Association (AAMA).
- B. American Society for Testing and Materials (ASTM).
- C. Aluminum Association (AA).

1.04 SYSTEM DESCRIPTION

- A. General: In addition to requirements shown or specified, comply with:
 - 1. Applicable provisions of AAMA Aluminum Storefront and Entrance Manual for design, materials, fabrication and installation of component parts.
- B. Design Requirements: Arcadia 5000 Series SGD-HC60/AW55 (thermal/non-thermal) Heavy Commercial Sliding Doors 4-3/4" depth.
- C. Performance Requirements: Each assembly shall be tested by a recognized testing laboratory or agency in accordance with specified test methods.

1. Conformance to SGD-HC60/AW55 specifications in AAMA/NWWDA 101/I.S. 2-97
 - a. Air Infiltration: Accordance with ASTM E 283.
 - b. Water Resistance: Accordance with ASTM E 331.
- 1.05 QUALITY ASSURANCE
- A. Single Source Responsibility:
 1. Obtain entrances, storefronts, ribbon walls, window walls, curtain walls, window systems, and finish through one source from a single manufacturer.
 - B. Provide test reports from AAMA accredited laboratories certifying the performances as specified in 1.03.
- 1.06 WARRANTY
- A. Warranted against failure and/or deterioration of metals due to manufacturing process for a period of one (1) year providing the product was installed in accordance with Arcadia's installation instructions and maintained in accordance with Arcadia's operations and maintenance manual.
- 2.00 PRODUCTS**
- 2.01 MANUFACTURERS
- A. Acceptable Manufacturers:
 1. Arcadia Architectural Products, Inc., 3225 East Washington Blvd., Vernon, CA. Telephone 323) 269-7300, fax 323) 269-7390.
 - B. Acceptable Products:
 1. Arcadia, 5000 Series (thermal/non-thermal) heavy Commercial Sliding Doors, 4-3/4" depth
- 2.02 MATERIALS AND ACCESSORIES
- A. All doors shall be fabricated from aluminum extrusions of 6063-T5 alloy and temper with a minimum wall thickness of 0.100" for the sill member and a minimum of 0.072" for all other members, including frame, sash and optional sash dividers. The aluminum shall be free of defects which impair strength and appearance.
 - B. Component parts and accessories shall be of aluminum alloy, stainless steel or non-metallic materials, which will neither deteriorate nor promote corrosion.
 - C. The thermal break barrier shall provide a thermal separation throughout the perimeter of the frame and sash. The thermal barrier shall be continuous and consist of a low thermal conductive material (polyurethane) poured into a special pocket in the aluminum extrusion that cures hard and strong. The underside of this pocket is then fully "de-bridged" or ripped so as to separate the connected aluminum wall leaving the polyurethane as the only bond between the outside and inside walls of the extrusion. In some instances, the underside of this pocket is partially removed in a skipping pattern where every 18-20" of aluminum is fully debridged and in between, a 1-2" bridge in the aluminum remains. This is called "skip debridging". Either method constitutes a "thermally broken product".
 - D. Sill shall have a full-length roll-formed 0.025" thick, stainless steel track cap.
 - E. Operable sash shall be equipped with two steel tandem ball bearing (all stainless steel tandem rollers and housings optional).

- F. Locking device Adams-rite maximum security lock MS+1850 with stainless steel hook bolt standard. Fully stainless steel MS 1950 lock available as an option.
- G. Operational panels shall have an extruded ¾" diameter 8" O.C. aluminum wire pull handle set in either clear or black anodize finish – other colors available.
- H. Fixed and/or sliding sash members shall be constructed to allow for either factory or field glazing. Sash glazing shall be accomplished using a "marine" style reusable, wraparound black flexible PVC or EPDM material per commercial standard CS230-60 without the need for separate glazing beads or putty style bedding compounds. The glazing channel shall be provided with the unit for either 1" insulating glass or 3/16" or ¼" single glass.
- I. All assembly and installation screws shall be 18-8 or 410 stainless steel.
- J. Screens made of extruded aluminum frame and screened with 18 X 16 fiberglass mesh.

2.03 FINISH

- A. Finish all exposed areas of aluminum and components as indicated (excluding hardware):
 - 1. An Architectural Class II or I anodic coating conforming with AA-M12C22A31/AA-M12C22A41.
 - a. Anodize finish color shall be Colornodic AC-2 (#11 Clear) or Fluorocarbon Coating AAMA 2605.2.
 - 1) Resin: 70% PVDF Kynar 500/Hylar 5000.
 - 2) Substrate: Cleaned and pretreated with chromium phosphate.
 - 3) Primer: Manufacturer's standard resin base compatible coating. Dry film thickness.
 - (a) Extrusion: Minimum 0.20 mil.
 - 4) Color Coat: 70% PVDF, dry film thickness.
 - (a) Extrusion: 1.0 mil.
 - 5) Color: #36 Anodic Clear.
 - 6) Acceptable Coatings Manufacturers:
 - (a) PPG Industries, Inc.

2.04 WINDOW FABRICATION

- A. Standard frame is 4-3/4" depth.
- B. Frame sections must have an integral extruded reglet at interior head, sill and jamb to accept an optional interior screen track.
- C. Jambs are milled and coped to the contour of the sill and head to ensure a weather resistant seal and must be back caulked.
- D. Frame corner joint shall be secured with two stainless steel screws which heads must be caulked.
- E. Profile of the fixed jamb and the latching jamb shall include two weatherstripped pockets

to receive the fixed and latching stiles.

- F. Fixed and sliding panels shall have a nominal 1-1/2" depth and shall have overlapped joints of the mortise type to provide extra strength and interlocking mechanically fastened hairline joints.
- G. Interlockers and latching stiles shall be heavy gauge tubular sections assuring precise alignment and to resist twisting under load conditions.

3.00 EXECUTION

3.01 EXAMINATIONS

- A. Examine conditions and verify substrate conditions are acceptable for product installation.

3.02 INSTALLATION

- A. Install in accordance with approved shop drawings and manufacturer's installation instructions.

3.03 FIELD QUALITY CONTROL

- A. Contractor's responsibility to make all necessary final adjustments to attain normal operation of each window and its mechanical hardware.

END OF SECTION

SECTION 08 62 50
TUBULAR DAYLIGHTING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tubular daylighting devices (TDD) and accessories.

1.2 RELATED SECTIONS

- A. Section 07 62 00 - Flashing and Sheet Metal: Metal curb flashings.

1.3 REFERENCES

- A. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA/WDMA/CSA 101/I.S.2/A440 - Standard/Specification for Windows, Doors, and Unit Skylights; 2011.
- B. American National Standards Institute (ANSI):
 - 1. ANSI C63.4-2014 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
- C. ASTM International (ASTM):
 - 1. ASTM A463/A463M - Standard Specification for Steel Sheet, Aluminum Coated, by the Hot Dip Process.
 - 2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized), by the Hot Dip Process.
 - 3. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - 4. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 5. ASTM D635 - Test Method for Rate of Burning and/or Extent of Time of Burning of Self-Supporting Plastics in a Horizontal Position.
 - 6. ASTM D1929 - Test Method for Ignition Properties of Plastics.
 - 7. ASTM D2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.
 - 8. ASTM F1642 - Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loading.
 - 9. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 10. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings.
 - 11. ASTM E283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - 12. ASTM E308 - Standard Practice for Computing the Colors of Objects by Using

- the CIE System.
13. ASTM E330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors.
 14. ASTM E547 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain walls by Cyclic Air Pressure Difference.
 15. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missiles and Exposed to Cyclic Pressure Differentials.
 16. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricane.
 17. ASTM F2912 - Standard Specification for Glazing and Glazing Systems Subject to Airblast Loading.
- D. California State OSHA Fall Protection Code of Regulations, Title 8, Section 3212 (e)(1).
- E. Code of Federal Regulations (CFR):
1. CFR 47 - Code of Federal Regulations (CFR) Rules and Regulations for FCC, FCC Part 15 - Radio Frequency Devices, Subpart B - Unintentional Radiators, Section 15.107 - Conducted Limits, and 15.109 - Radiated Emission Limits
- F. CSA Group (CSA):
1. CSA C22.2 No. 250.0 - Luminaires.
- G. Factory Mutual (FM):
1. FM Standard 4431 - The Approval Standard for Skylights.
- H. Federal Emergency Management Agency (FEMA):
1. FEMA P-361 - Safe Rooms for Tornadoes and Hurricanes.
- I. General Services Administration (GSA):
1. GSA-TS01-2003: Standard Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loadings.
- J. International Building Code (IBC):
1. IBC Section 1710 - Load Test Procedure for Wind Load Testing on Rooftop Daylight Collecting System - Structural Performance Testing - Devised by ATI PE); 2012.
 2. IBC Section 2606.7.2 - Installation - Diffuser Fall Out Test (Devised by PE); 2012.
- K. International Code Council (ICC):
1. ICC 500 - Standard for the Design and Construction of Storm Shelters.
- L. OSHA 29 CFR - 1910.23 (e)(8) (Guarding Requirements for Skylights); 1926 Subpart M (Fall Protection); 1926.501(b)(4)(i); 1926.501(i)(2); 1926.501(b)(4)(ii).
- M. Unified Facilities Criteria (UFC):
1. UFC 4-010-01, Change October 2013, DoD Minimum Antiterrorism Standards for Buildings.

- N. Underwriters' Laboratories (UL):
1. UL 2108 - Low Voltage Lighting Systems.

1.4 PERFORMANCE REQUIREMENTS

- A. Daylight Reflective Tubes: Spectralight Infinity with INFRAREDuction Technology combines ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance. Patented spectrally-selective optical surface yields an average total- and specular-reflectance for the Visible Light spectrum (400 nm to 700 nm) providing maximized visible light transmission and less than 25 percent reflectance for Infrared (IR) heat wavelengths (750 nm to 2500 nm) for minimized heat transmission, resulting in a spectrally-selective Total Solar Spectrum (250 nm to 2500 nm) reflectance less than 37 percent, as measured using a Perkin Elmer Lambda 1050 spectrophotometer with a Universal Reflectance Accessory. Color: a^* and b^* (defined by CIE $L^*a^*b^*$ color model) shall not exceed plus 2 or be less than minus 2 as determined in accordance with ASTM E308.
- B. SOLAMASTER 750 DS-C (CLOSED CEILING)
1. AAMA/WDMA/CSA 101/IS2/A440, Class CW-PG70, size tested 21 inch (530 mm) diameter, Type TDDOC and Type TDDCC.
 - a. Air Infiltration Test:
 - 1) Air infiltration will not exceed 0.30 cfm/sf aperture with a pressure delta of 1.57 psf across the tube when tested in accordance with ASTM E283.
 - b. Water Resistance Test:
 - 1) Passes water resistance; no uncontrolled water leakage with a pressure differential of 10.7 psf (512 Pa) or 15 percent of the design load (whichever is greater) and a water spray rate of 5 gallons/hour/sf for 24 minutes when tested in accordance with ASTM E547 and ASTM E331.
 - c. Uniform Load Test: All units tested with a safety factor of (3) for positive pressure and (2) for negative pressure, acting normal to plane of roof in accordance with ASTM E330.
 - 1) No breakage, permanent damage to fasteners, hardware parts, or damage to make daylighting system inoperable or cause excessive permanent deflection of any section when tested at a Positive Load of 150 psf (7.18 kPa) or Negative Load of 70 psf (3.35 kPa).
 2. Fire Testing:
 - a. Smoke Density: Rating no greater than 450 per ASTM E84 in way intended for use. Classification C.
 - b. Rate of Burn and/or Extent: Maximum Burning Rate: 2.5 inches/min (62 mm/min) Classification CC-2 per ASTM D635.
 - c. Rate of Burn and/or Extent: Maximum Burn Extent: 1 inch (25 mm) Classification CC-1 per ASTM D635.
 3. Fall Protection Performance:
 - a. Passes fall protection test: No penetration of dome or curb cap when subject to 400 lb (160 Kg)/42 inch (1066 mm) impact drop test when tested in accordance with OSHA 29 CFR 1926.506(c) Safety Net Systems.
 - b. Passes fall protection test: California State OSHA Fall Protection Code

- of Regulations, Title 8, Section 3212 (e)(1) Skylight Screens.
4. Blast Resistance: ASTM F1642, ASTM F2912, GSA-TS01-2003, and UFC 4-010-01:
 - a. Airblast Loading ASTM Hazard Rating: Passes: No Hazard Rating
 - b. Airblast Loading UFC Level of Protection: Passes Medium Level of Protection
 - c. Dynamic Overpressure Loading ASTM Hazard Rating: Passes: No Hazard Rating
 - d. Dynamic Overpressure Loading UFC Level of Protection: Passes Medium Level of Protection

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Data sheets showing roof dome assembly, flashing base, reflective tubes, diffuser assembly, and accessories.
 4. Installation requirements.
- C. Shop Drawings. Submit shop drawings showing layout, profiles, and product components, including rough opening and framing dimensions, anchorage, roof flashings and accessories.
- D. Verification Samples: As requested by Architect.
- E. Test Reports: Independent testing agency or evaluation service reports verifying compliance with specified performance requirements.
- F. 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:

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of twenty years experience in the top lighting industry. Secondary products shall be acceptable to the primary manufacturer.
- B. Installer Qualifications: All products shall be installed by a single installer with a minimum of five years demonstrated experience, with adequate equipment, skilled workers, and practical experience to meet the project schedule. Solatube International 2210 Oak Ridge Way; Vista, CA 92081-8341 Robert Busolo Tel: 760-597-4427; Email: rbusolo@solatube.com; Web: <http://www.solatube.com>
- C. Skylights shall conform with authorities having jurisdiction and be designed to meet

design criteria of the project location and the following:

1. Skylights must be certified by NFRC.
 2. Skylights must be Tested and labeled in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
 3. Skylights must have Factory Mutual (FM) Approval Class Number 4431.
 4. Meet or exceed OSHA 200 pound (90 kg) Drop Tests expressed in 29 CFR 1910.23(e)(8)
 5. Skylights shall provide minimum 69 psf (3.30 kPa) design load.
- D. Pre-Installation Meeting: Contractor shall convene a pre-installation meeting on the project site minimum one week before beginning work of this Section. The meeting shall include the Architect or Owner's Representative and representatives of all related trades to:
1. Coordinate between the at least the following trades.
 - a. Roofing to install the flashing, skylight, and LED Light Kit (when specified). Cut holes in roof deck, and flash curb to deck.
 - b. Ensure clear paths for TDD units and coordinate with mechanical so not to interfere with pathways.
 2. Verify project requirements and site logistics.
 3. Assess integrity of the roofing system and building structure.
 4. Review manufacturer's installation instructions and warranty requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in a cool dry location protected from the weather and in the manufacturer's original unopened containers until ready for installation.
- B. Store products in manufacturer's unopened packaging until ready for installation.

1.8 PROJECT CONDITIONS

- A. Coordinate delivery schedule with the Contractor and project schedule to minimize on site storage.
- B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- C. Store materials in a dry area, protected from freezing, staining, contamination or damage.

1.9 WARRANTY

- A. Daylighting Device: Manufacturer's standard warranty for 10 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Solatube International, Inc., which is located at: Solatube International 2210 Oak Ridge Way; Vista, CA 92081-8341;

Robert Busolo Tel: 760-597-4427; Email: rbusolo@solatube.com;

- B. Requests for substitutions will only be considered provided a lighting layout with photometric data is supplied to demonstrate light levels that meet the original design intent and measurements for each space specified. The following metrics should be compared for minimum acceptance: diffuser height, work plane height, date & time, floor opacity, dirt depreciation, local weather, and site orientation.

2.2 TUBULAR DAYLIGHTING DEVICES

- A. Tubular Daylighting Devices General: Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICC AC-16.
- B. SolaMaster Series: Solatube Model 750 DS, 21 inch (530 mm) Daylighting System:
 - 1. Model:
 - a. Solatube Model 750 DS-C Closed (Penetrating) Ceiling. AAMA Type TDDCC.
 - 2. Capture Zone:
 - a. Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
 - 1) Outer Dome Glazing: Type DA, 0.125 inch (3.2 mm) minimum thickness injection molded acrylic classified as CC2 material; UV inhibiting (100 percent UV C, 100 percent UV B and 98.5 percent UV A), impact modified acrylic blend.
 - a) Raybender 3000: Variable prism optic molded into outer dome to capture low angle sunlight and limit high angle sunlight.
 - b. Tube Ring: 0.090 inch (2.3 mm) nominal thickness injection molded ASA. Prevents thermal bridging between base flashing and tubing and channel condensed moisture. Attached to base of dome ring with butyl glazing rope 0.24 inch (6 mm) diameter; to minimize air infiltration.
 - c. Dome Seal: Adhesive backed weatherstrip, 0.63 inch (16 mm) tall by 0.28 inch (7 mm) wide.
 - 3. Flashings:
 - a. Roof Flashing Base:
 - 1) One Piece: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube. Sheet steel, corrosion resistant conforming to ASTM A653/A653M or ASTM A463/A463M or ASTM A792/A792M, 0.028 inch (0.7 mm) plus or minus .006 inch (.015 mm) thick.
 - a) Base Style: Type FC, Curb cap, with inside dimensions of 27 inches by 27 inches (685 mm by 685 mm) to cover curb as specified in Section 07 62 00.
 - b. Curbs: Metal Insulated Roof Curb: Corrosion resistant 18 Gauge hot-dipped galvanized steel conforming to ASTM A653 G90 with continuous welded seams, integrated base plate for water tightness and extra strength, lined with 1-1/2 inch fiberglass fireproof sound attenuating thermal insulation, factory installed 2 by 2 treated wood nailer secured

- to top ledge of curb. Curb designed for single-ply roofing, lightweight fill, or tapered insulation low slope roof types.
- 1) C20 20 inch (508 mm) high Metal insulated curb
- c. Flashing Options:
- 1) Curb Cap Insulation: Type CCI, Nominal 1 inch thick thermal insulation pad to reduce thermal conduction between curb-cap and tubing and thermal convection between room air and curb-cap. Rated R-6 (OFxft2xh/Btu) Insulation is Polyisocyanurate foam utilizing CFC, HCFC, and HFC free blowing agent. Type-1 Class-1 per ASTM C 1289; Passes UL 1715 (15-minute thermal barrier per IBC 2603.4); Attic ventilation may be required per IBC 1203.2(OFxft2xh/Btu). For use with Flashing Type FC.
4. Transfer Zone:
- a. Extension Tubes: Aluminum sheet, thickness 0.018 inch (0.5 mm) conforming to ASTM B 209.
 - 1) Reflective Tubes:
 - a) Reflective extension tube, Type EXX with total length of run as indicated on the Drawings.
 - b) Interior Finish: Spectralight Infinity with INFRAREDuction Technology combining ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance.
 - 2) Tube Options
 - a) Extension Tube Angle Adapter: Provide manufacturer's standard adapters for applications requiring:
 - b) Top Tube Angle Adapter and Bottom Tube Angle Adapter Kit: Type AK, Reflective 45 degree adjustable top and bottom angle adapters (one each), 16 inches (406 mm) long
 - c) Spectralight Infinity SoftLight Extension Tube: Type ES, 24 inch (610 mm) Super-reflective extension tube with structured surface providing precise light spread for enhanced visual comfort. Replaces one standard 24 inch (610 mm) extension tube in the tube assembly.
 - d) Wire Suspension Kit: Type E, Use the wire suspension kit when additional bracing to the structure is required.
5. Delivery Zone:
- a. Diffuser Assemblies for Tubes Penetrating Ceilings: Solatube Model 750 DS-C. Ceiling mounted box transitioning from round tube to square ceiling assembly, supporting light transmitting surface at bottom termination of tube; 23.8 inches by 23.8 inches (605 mm by 605 mm) square frame to fit standard suspended ceiling grids or hard ceilings.
 - 1) Round Metal Housing: Type TRH, Round metal housing for hard ceilings. Comprised of white powder coated 26 gauge galvanized sheet steel, a Spectralight Infinity sleeve and a white powder coated 24 gauge steel ceiling mounting plate.
 - 2) Lens: Type L5 (Wide), OptiView Micro-replicated lens design to maximize light output and diffusion. Visible Light Transmission shall be greater than 90 percent at 0.022 inch (0.6 mm) thick.

Classified as CC2.

2.3 ACCESSORIES

- A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.
- B. Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions.
- C. If substrate and rough opening preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Coordinate requirements for power supply, conduit, and wiring.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. Installers must wear glasses
- C. Coordinate installation with substrates, air and vapor retarders, roof insulation, roofing membrane, and flashing to ensure that each element of the Work performs properly, and that finished installation is weather tight.
 - 1. Install flashing to produce weatherproof seal with curb and overlap with roofing system termination at top of curb.
 - 2. Provide thermal isolation when components penetrate or disrupt building insulation. Pack fibrous insulation in rough opening to maintain continuity of thermal barriers.
 - 3. Coordinate attachment and seal of perimeter air and vapor barrier material.
- D. Where metal surfaces of tubular unit skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, provide permanent separation as recommended by manufacturer.
- E. Align device free of warp or twist, maintain dimensional tolerances.
- F. Inspect installation to verify secure and proper mounting. Test each fixture to verify

operation, control functions, and performance. Correct deficiencies.

3.4 FIELD QUALITY CONTROL

- A. Provide independent testing and inspection as specified in Section 01 45 23. Inspect installation to verify secure and proper mounting.
 - 1. Test for water leaks in accordance with AAMA 502 after installation and curing of sealants but prior to installation if interior finishes.
 - 2. Perform test for total area of each unit skylight.
 - 3. Notify the Architect and the Contractor of any failed tests.

3.5 CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

3.6 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

**SECTION 08 71 00
DOOR HARDWARE**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
1. Swinging doors.
 2. Sliding doors.
- B. Door hardware includes, but is not necessarily limited to, the following:
1. Mechanical door hardware.
 2. Cylinders specified for doors in other sections.
- C. Related Sections:
1. Division 08 Section "Hollow Metal Doors and Frames".
 2. Division 08 Section "Flush Wood Doors".
 3. Division 08 Section "Stile and Rail Wood Doors".
 4. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 2. ICC/IBC - International Building Code.
 3. NFPA 70 - National Electrical Code.
 4. NFPA 80 - Fire Doors and Windows.
 5. NFPA 101 - Life Safety Code.
 6. NFPA 105 - Installation of Smoke Door Assemblies.
 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
1. ANSI/BHMA Certified Product Standards - A156 Series.
 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.

3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- D. Informational Submittals:
 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
 - 1. Maintenance manual must be provided for tornado/hurricane storm shelter impact protective systems.
- B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.
- C. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) or acceptable integrated file format for updating of Openings Studio™ management software and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
- F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
 2. Plans for existing and future key system expansion.
 3. Requirements for key control storage and software.
 4. Installation of permanent keys, cylinder cores and software.
 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.

- d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 6" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 6" standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.
5. Manufacturers:
 - a. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.3 CONTINUOUS HINGES

- A. Continuous Double-Acting Hinges (Behavioral Health). ANSI/BHMA A156.26 Grade 1-300 Certified continuous hinges.
 1. Provide hinges with functions and features as follows:
 - a. ADA compliance meeting ICC/ANSI A117.1 (2009) for barrier free compliance.
 - b. CMS Compliance eliminating additional ligature points ensuring compliance for reimbursement through Centers for Medicare and Medicaid Services.
 - c. Opens 100° in either direction.
 - e. Built-in stop to prevent finger pinching.
 - f. Spans the entire opening height eliminating hinge side sight lines.
 - g. Provide an emergency release stop to create a complete anti-barricade system with a flush bolt that is used to release the door in emergency situations that allows it to swing in the opposite direction. Stop shall be supplied standard with Torx security screws and hospital tips.
 2. Manufacturers:
 - a. Markar Products; ASSA ABLOY Architectural Door Accessories (MR) - DSH1000.
 - b. Pemko (PE) - DSH1000 Series.
 - c. No Substitution.
- B. Pin and Barrel Continuous Hinges: ANSI/BHMA A156.26 Grade 1-600 pin and barrel continuous hinges with minimum 14 gauge Type 304 stainless steel hinge leaves, concealed

stainless pin, and twin self-lubricated nylon bearings at each knuckle separation. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:

- a. Markar Products; ASSA ABLOY Architectural Door Accessories (MR).
- b. Pemko (PE).

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:
 - a. Rockwood (RO).

B. Coordinators: ANSI/BHMA A156.3 door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.

1. Manufacturers:
 - a. Rockwood (RO).

C. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
6. Manufacturers:
 - a. Rockwood (RO).

2.5 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
 - 1. Threaded mortise cylinders with rings and cams to suit hardware application.
 - 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
 - 4. Tubular deadlocks and other auxiliary locks.
 - 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 - 6. Keyway: Manufacturer's Standard.
- C. Small Format Interchangeable Cores: Provide small format interchangeable cores (SFIC) as specified, core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- D. Keying System: Each type of lock and cylinders to be factory keyed.
 - 1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 - 3. New System: Key locks to a new key system as directed by the Owner.
- E. Key Quantity: Provide the following minimum number of keys:
 - 1. Change Keys per Cylinder: Two (2)
 - 2. Master Keys (per Master Key Level/Group): Five (5).
 - 3. Construction Keys (where required): Ten (10).
- F. Construction Keying: Provide temporary keyed construction cores.
- G. Key Registration List (Bitting List):
 - 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 - 2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 KEY CONTROL

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
 - 1. Manufacturers:
 - a. Lund Equipment (LU).

- b. MMF Industries (MM).
 - c. Telkee (TK).
- P. Electronic Key Management System: Provide an electronic key control system with Stand-alone Plug and Play features including advanced RFID technology. Touchscreen interface with PIN access for keys individually locked in place. Minimum 1,000 system users and 21 iFobs for locking receptors. System shall have a minimum 250,000 audit events screen displayed or ability to be exported via USB port.
 - 1. Manufacturers:
 - a. Medeco (MC).

2.7 MORTISE LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.
 - 1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ML2000 Series.
 - b. Sargent Manufacturing (SA) - 8200 Series.

2.8 CYLINDRICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed cylindrical locksets. Listed manufacturers shall meet all functions and features as specified herein.
 - 1. Provide locksets with functions and features as follows:
 - a. Meets ANSI/BHMA A156.41 for single motion egress.
 - b. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
 - c. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
 - d. Exceeds ANSI/BHMA A156.2 requirements by 2.6 times for 3,100 in-lb. abusive locked lever torque with no entry while maintaining egress.
 - e. Exceeds ANSI/BHMA A156.2 requirements by 8 times for 1,600 lbs. offset lever pull with no entry for protection against attacks.
 - f. Exceeds ANSI/BHMA A156.3 requirements by 2 times for latch retraction with 100 lb. preload while maintaining operation in warped doors.
 - g. Exceeds ANSI/BHMA A156.3 requirements by 20 times for no access with minimum 100 vertical impacts for protection against vandalism attempts.
 - h. Independent return springs allow lock to exceed ANSI/BHMA A156.2 Grade 1 cycle requirements without lever sag.
 - i. Status indicators inside, outside, or on both sides of doors as specified with high visibility red/green or red/white icons to display locked or unlocked state in the rose.
 - j. Ten-year limited warranty for mechanical functions.

2. Manufacturers:

- a. Corbin Russwin Hardware (RU) - CLX3300 Series.
- b. Sargent Manufacturing (SA) - 10X Line.

2.9 RESIDENTIAL LOCKING DEVICES

A. Residential Locking Devices: Provide ANSI A156.2, Series 4000, Grade 2 products (knobs, levers, deadbolts, interconnected, handlesets) as specified.

1. Provide residential locking devices with functions and features as follows:

- a. Locksets, deadbolts, and handle sets designed to fit ANSI standard door preps.
- b. Meets UL and ULC Standard 10C Positive Pressure, Fire Test of Door Assemblies.
- c. Non-handed levers.
- d. Single motion for retraction of latchbolt and deadbolt.
- e. Provide levers of like design and style as specified.

2. Manufacturers:

- a. ASSA ABLOY ACCENTRA - Heritage Series.
- b. Kwikset (KW) - Light Commercial Series.
- c. No Substitution.

B. Residential Pivot Devices: Provide ANSI A156.36, Grade 2 push/pull paddle devices as specified.

1. Provide residential locking devices with functions and features as follows:

- a. ADA compliant.
- b. Two-year limited warranty.

2. Manufacturers:

- a. ASSA ABLOY ACCENTRA - Navis Paddle Series.
- b. No Substitution.

C. Residential Locking Devices: Provide ANSI A156.2, Series 4000, Grade 3 products (knobs, levers, deadbolts, interconnected, handlesets) as specified.

1. Provide residential locking devices with functions and features as follows:

- a. Locksets, deadbolts, and handle sets designed to fit ANSI standard door preps.
- b. Meets UL and ULC Standard 10C Positive Pressure, Fire Test of Door Assemblies.
- c. Non-handed levers.
- d. Single motion for retraction of latchbolt and deadbolt.
- e. Provide levers of like design and style as specified.

2. Manufacturers:

- a. ASSA ABLOY ACCENTRA - Heritage Series.
- b. Kwikset (KW) - Residential Series.
- c. Weiser (WE) - Residential Series.
- d. No Substitution.

2.10 DEADLOCKS AND LATCHES

- A. Mortise Deadlocks, Large Case: ANSI/BHMA A156.13 Grade 1 Certified Products Directory (CPD) listed large case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. One piece stainless steel bolts with a 1" throw. Deadlocks to be products of the same source manufacturer and keyway as other locksets.

1. Manufacturers:

- a. Corbin Russwin Hardware (RU) - ML2000 Series.
- b. Sargent Manufacturing (SA) - 8200 Series.

2.11 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

- 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
- 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
- 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
- 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

- B. Standards: Comply with the following:

- 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
- 2. Strikes for Bored Locks and Latches: BHMA A156.2.
- 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
- 4. Dustproof Strikes: BHMA A156.16.

2.12 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

- 1. Exit devices shall have a five-year warranty.
- 2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
- 3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the

- proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
 5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
 6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.
1. Provide exit devices with functions and features as follows:
 - a. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
 - b. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
 - c. No catch points: addition of applied deflectors or other added components are not allowed.
 - d. No visible plastic.
 - e. Heavy duty end caps with flush and overlapping options made of stainless steel, brass, or bronze with architectural finishes.
 - f. Constructed of all stainless steel.
 - g. Stainless steel pullman type latch with deadlock feature.
 - h. Narrow or wide style exterior trim as specified in the hardware sets.
 - i. Center case adjustability on concealed vertical rod exit devices; single operation with hex key individually adjusts top or bottom latches. No retainer screws or clips required to maintain adjustment.
 - j. Ten-year limited warranty for mechanical features.
 2. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - PED4000 / PED5000 Series.
 - b. Sargent Manufacturing (SA) - PE80 Series.

- C. Multi-Point Exit Devices (Storm Shelter Openings): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices specifically engineered for tornado or hurricane resistant storm shelter openings. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide exit devices with functions and features as follows:

- a. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
- b. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
- c. Meets UL Certification Directory ZHLL.R21744 for products used in windstorm rated assemblies.
- d. Meets FEMA P-361 (2020) and ICC 500 (2020) with respect to impact and pressure testing. Minimum missile impact speeds vary with the design wind speed desired for a particular product.
- e. No catch points: addition of applied deflectors or other added components are not allowed.
- f. No visible plastic.
- g. Concealed hex key dogging with an active or passive dogging indicator where specified that shows visible indication of secured state.
- h. Chassis indicators as specified that show secured state of exterior trim.
- i. Heavy duty end caps with flush and overlapping options made of stainless steel, brass, or bronze with architectural finishes.
- j. Constructed of all stainless steel.
- k. Stainless steel pullman type latch with deadlock feature.
- l. Narrow or wide style exterior trim as specified in the hardware sets.
- m. Center case adjustability on concealed vertical rod exit devices; single operation with hex key individually adjusts top or bottom latches. No retainer screws or clips required to maintain adjustment.
- n. Ten-year limited warranty for mechanical features.

2. Electromechanical exit devices shall have the following functions and features:

- a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
- b. Wire routing for all non-access control electromechanical functions and EcoFlex trim to be contained within the carrier of the device eliminating the need for cavities in doors to be drilled. Include a protective film so that wires don't get damaged if the rail needs to be removed.
- c. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
- d. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
- e. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.

3. Manufacturers:

- a. Corbin Russwin Hardware (RU) - FE PE5400S Series.
- b. Sargent Manufacturing (SA) - FM PE8700 Series.

- c. No Substitution.

2.13 SURFACE DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard..

- 1. Manufacturers:

- a. Corbin Russwin Hardware (RU) - DC6000 Series.
- b. Norton Rixson (NO) - 7500 Series.
- c. Sargent Manufacturing (SA) - 351 Series.

- C. Door Closers, Surface Mounted (Cam Action): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, high efficiency door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be of the cam and roller design, one piece cast aluminum silicon alloy body with adjustable backcheck and independently controlled valves for closing sweep and latch speed.

- 1. Manufacturers:

- a. Corbin Russwin (RU) - DC5000 Series.
- b. Norton Rixson (NO) - 2800ST Series.
- c. Sargent Manufacturing (SA) - 422 Series.

2.14 OVERHEAD CONCEALED DOOR CLOSERS

2.15 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, .050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
 - a. Rockwood (RO).

2.16 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Manufacturers:
 - a. Rockwood (RO).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 1. Manufacturers:
 - a. Norton Rixson (RF).
 - b. Rockwood (RO).

c. Sargent Manufacturing (SA).

2.17 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 - 1. Pemko (PE).

2.18 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.19 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
 - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
 - 1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer's Abbreviations:

1. OT - Other
2. MK - McKinney
3. MR - Markar
4. RO - Rockwood
5. SA - SARGENT
6. RF - Rixson
7. NO - Norton
8. PE - Pemko

Hardware Sets

Set: 1.0

Doors: 101A, 101B, 122A, 127

2 Continuous Hinge	FM300	630	MR
1 Concealed Vert Rod Exit, Nightlatch	16 5CH 72 ADPE8610 P106	US32D	SA
1 Concealed Vert Rod Exit, Exit Only	16 5CH 72 ADPE8610 EO	US32D	SA
3 Small Format Inter Core	7300B	US15	SA
2 Door Pull	RM3311	US32D	RO
2 Surface Closer	2800STH	689	NO
2 Kick Plate	K1050 10" high CSK BEV	US32D	RO
2 Door Stop	466-RKW	Black	RO
2 Astragal	18041CNB		PE
1 Rain Guard	346C x Full Frame Width		PE
1 Gasketing	2891AS		PE
1 Gasketing	290AS		PE
2 Sweep	315CN		PE
1 Threshold	Per Detail		PE

Set: 2.0

Doors: 108B

1 Continuous Hinge	FM300	630	MR
1 Rim Exit Device, Storeroom	72 5CH PE8804 NEMW	US32D	SA

1 Small Format Inter Core	7300B	US15	SA
1 Surface Closer	2800ST	689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Door Stop	466-RKW	Black	RO
1 Rain Guard	346C x Full Frame Width		PE
1 Gasketing	2891AS		PE
1 Gasketing	290AS		PE
1 Sweep	315CN		PE
1 Threshold	Per Detail		PE

Set: 3.0

Doors: 123

1 Continuous Hinge	FM300	630	MR
1 Rim Exit Device, Storeroom	72 5CH PE8804 Less Pull	US32D	SA
1 Small Format Inter Core	7300B	US15	SA
1 Surface Closer	2800STH	689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Door Stop	466-RKW	Black	RO
1 Rain Guard	346C x Full Frame Width		PE
1 Gasketing	2891AS		PE
1 Gasketing	290AS		PE
1 Sweep	315CN		PE
1 Threshold	Per Detail		PE
1 Coat Hook	RM828	US32D	RO

Set: 4.0

Doors: 125, 126

1 Continuous Hinge	FM300	630	MR
1 Classroom Deadlock	72 8203	US32D	SA
1 Door Pull	RM3301	US32D	RO
1 Push Plate	RM1010H	US32D	RO
1 Surface Closer	2800STH	689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Mop Plate	K1050 6" CSK BEV	US32D	RO
1 Door Stop	466-RKW	Black	RO
1 Rain Guard	346C x Full Frame Width		PE
1 Gasketing	2891AS		PE
1 Gasketing	290AS		PE
1 Sweep	315CN		PE
1 Threshold	Per Detail		PE

Set: 5.0

Doors: 103A, 103B, 103C, 103D

6 Hinge, Full Mortise	TA2314 NRP	US32D	MK
1 Flush Bolt	2845	US32D	RO
1 Dust Proof Strike	570	US26D	RO
1 Storeroom/Closet Lock	72 8204 E3MW	US32D	SA
1 Small Format Inter Core	7300B	US15	SA
1 Coordinator	2600 x Required Brackets	Black	RO
2 Surface Closer	2800STH	689	NO
2 Kick Plate	K1050 10" high CSK BEV	US32D	RO
2 Door Stop	466-RKW	Black	RO
1 Astragal	357C		PE
1 Rain Guard	346C x Full Frame Width		PE
1 Gasketing	2891AS		PE
1 Gasketing	290AS		PE
2 Sweep	315CN		PE
1 Threshold	Per Detail		PE

Set: 6.0

Doors: 101C, 118, 122C

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Rim Exit Device, Classroom	72 5CH PE8813 NEMW	US32D	SA
1 Small Format Inter Core	7300B	US15	SA
1 Surface Closer	2800STH	689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Door Stop	RM857	US15	RO
1 Gasketing	S88BL		PE

Set: 6.1

Doors: 119

6 Hinge, Full Mortise	TA2714	US26D	MK
2 Concealed Vert Rod Exit, Classroom	16 5CH 72 MDPE8613 NEMW	US32D	SA
2 Small Format Inter Core	7300B	US15	SA
1 Conc Overhead Stop	2-x36	630	RF
2 Surface Closer	2800STH	689	NO
2 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Wall Stop	RM867	US15	RO
1 Astragal	S771BL		PE
1 Gasketing	S88BL		PE

Set: 6.2

Doors: 108A

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Rim Exit Device, Classroom	72 5CH PE8813 NEMW	US32D	SA
1 Small Format Inter Core	7300B	US15	SA
1 Surface Closer	CLP7500T	689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Gasketing	S88BL		PE

Set: 7.0

Doors: 122D, 122E

6 Hinge, Full Mortise	TA2714	US26D	MK
1 Flush Bolt	557	US26D	RO
1 Storeroom/Closet Lock	72 10XG04 GMW	US26D	SA
1 Small Format Inter Core	7300B	US15	SA
1 Conc Overhead Stop	2-x36	630	RF
1 Wall Stop	RM867	US15	RO
2 Silencer	608-RKW		RO

Set: 8.0

Doors: 102, 104, 105

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Office/Entry Lock	72 8205 E3MW	US32D	SA
1 Small Format Inter Core	7300B	US15	SA
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Wall Stop	RM867	US15	RO
1 Gasketing	S88BL		PE

Set: 10.0

Doors: 107

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Storeroom/Closet Lock	72 10XG04 GMW	US26D	SA
1 Small Format Inter Core	7300B	US15	SA
1 Surface Closer	2800ST	689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Door Stop	RM857	US15	RO
3 Silencer	608-RKW		RO

Set: 11.0

Doors: 109

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Storeroom/Closet Lock	72 10XG04 GMW	US26D	SA
1 Small Format Inter Core	7300B	US15	SA
1 Surface Closer	2800STH	689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Mop Plate	K1050 6" CSK BEV	US32D	RO
1 Wall Stop	RM867	US15	RO
3 Silencer	608-RKW		RO

Set: 12.0

Doors: 122F

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Classroom Lock	72 8237 E3MW	US32D	SA
1 Small Format Inter Core	7300B	US15	SA
1 Surface Closer	2800STH	689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Door Stop	RM857	US15	RO
1 Gasketing	S88BL		PE

Set: 13.0

Doors: 106, 124

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Classroom Lock	72 8237 E3MW	US32D	SA
1 Small Format Inter Core	7300B	US15	SA
1 Surface Closer	2800STH	689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Wall Stop	RM867	US15	RO
1 Gasketing	S88BL		PE

Set: 14.0

Doors: 110, 111, 120, 121

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Dormitory/Exit Lock	V20 72 8245 E3MW	US32D	SA
1 Small Format Inter Core	7300B	US15	SA
1 Surface Closer	2800STH	689	NO
1 Kick Plate	K1050 10" high CSK BEV	US32D	RO
1 Mop Plate	K1050 6" CSK BEV	US32D	RO

1 Wall Stop	RM867	US15	RO
1 Gasketing	S88BL		PE

Set: 15.0

Doors: 122B

1 Patio Folding Door Pedestrian Door	All Hardware by Door Manufacturer		OT
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Set: 16.0

Doors: G4.SG

2 Box Hinge	Weld on by Ameristar		OT
1 Storeroom/Closet Lock	72 8204 E3MW	US32D	SA
1 Small Format Inter Core	7300B	US15	SA
1 Gate Closer	Locinox - Verticlose		OT
1 Door Stop	466-RKW	Black	RO

Set: 17.0

Doors: G1.DBL, G2.DBL, G3.DBL

4 Box Hinge	Weld on by Ameristar		OT
1 Mullion	L980	PC	SA
2 Rim Exit Device, Storeroom	72 5CH PE8804 Less Pull	US32D	SA
3 Small Format Inter Core	7300B	US15	SA
1 Mortise Cylinder	72 41	US32D	SA
2 Door Pull	RM3311	US32D	RO
2 Gate Closer	Locinox - Verticlose		OT
2 Door Stop	466-RKW	Black	RO

END OF SECTION 087100

**SECTION 08 80 00
GLAZING**

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

- B. Principal Work in this Section:

- 1. All glass and glazing for the Project except as noted below.
- 2. Glazing accessories.
- 3. Glazing sealants.

- C. Related Work:

- 1. Section 08 88 13 - Fire-Resistant Glazing

1.03 SUBMITTALS

- A. Procedure: In compliance with Section 01 30 00.
- B. Samples: 12 in. square labeled samples of each type and color of glass, except heat treated, with taped or ground edges.
- C. Certification: Glass manufacturer's certification as specified.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Certification: Submit manufacturer's certification that all materials to be used in the glazing system such as sealants, setting blocks, spacers, backing rods, metal finishes, etc. have been reviewed by the glass manufacturer, and are compatible with the glass supplied to the Project site, and will not cause deterioration, premature aging, and staining of adjacent materials.
- B. Labeling:
 - 1. Submit a certificate stating that the glass furnished for the Project complies with the Specifications.
 - 2. Label each piece of heat-treated glass with a permanent logo etched in one corner to identify the fabricator.

1.05 PERFORMANCE REQUIREMENTS FOR GLASS

- A. Insulating glass shall not experience fogging, wetting or staining within the sealed space, nor spacer corrosion, spacer migration, adhesive or cohesive failure of primary or secondary edge seal. Insulating glass shall not experience decrease in the air space dimension due to chemical reaction of desiccant with entrapped gas. Insulated glass units shall have a classification of Class CBA per ASTM E 774.

- B. Glass shall not experience spontaneous breakage.
- C. Glass center deflection relative to glass edges at 50% of design pressures shall not exceed 1 in. Glass deflection at 150% of design pressures shall be limited to prevent disengagement from frame.
 - 1. For insulating glass edge construction, it shall be assumed that the entire outward design pressure is supported solely by the outdoor glass.
- D. Examine heat-strengthened and tempered glass and discard any lights which exceed the following tolerances:
 - 1/16 in. bow in 2 ft.
 - 1/8 in. bow in 5 ft.
 - 1/4 in. bow in 10 ft.
 - 3/8 in. bow in 15 ft.
 - 1. Where the strengthening process results in essentially parallel ripples or waves, the deviation from flatness at any peak shall not exceed 0.0005 in., and the difference between adjacent peaks shall not exceed 0.003 in.
 - 2. Where bow tolerance and wave tolerance differ, the stricter requirement shall govern.
 - 3. Direction of ripples shall be consistent.
- E. Glazing materials shall be qualified by tests in accordance with UBC Standard 7-2 (for fire doors) or UBC Standard 7-4 (for fire windows) as appropriate for the use, and they shall be labeled for the required fire-protection rating and installed in accordance with their listing. Glazing in fire door assemblies and in fire window assemblies subject to human impact in hazardous locations as indicated in CBC Section 2406.4 shall comply with CBC Section 2406.3.

1.06 HANDLING

- A. Procedure: In accordance with Section 01 60 00.
- B. Precautions: Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, run-off, and other causes.

1.07 PROJECT CONDITIONS

- A. Do not proceed with installation of bulk sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.

1.08 WARRANTY

- A. Warrant insulating glass against fogging, loss of transparency and frost build-up between the glass panes due to defective materials or sealant failure for 5 years after Substantial Completion.
- B. Warrant coating on spandrel glass against cracking, peeling, wrinkling, color fading, blistering, flaking, delaminating, staining and discoloration for 5 years after Substantial Completion.

- C. Glass shall not experience spontaneous breakage.
 - 1. This Specification defines nickel sulfide stones as a glass material defect.
 - 2. Installed tempered glass which breaks due to nickel sulfide stones shall be included in the warranty.
- D. Replace defective materials and workmanship during the warranty period at not cost to the District.

2.00 PRODUCTS

2.01 GLASS

A. General:

- 1. Float glass shall comply with ASTM C 1036; heat-treated glass shall comply with ASTM A 1048.
- 2. All tinted glass shall be made by the same manufacturer.
- 3. Tempered glass shall be tempered horizontally; mark glass as specified above identifying it as tempered glass.
- 4. Unless otherwise indicated or specified, overall thickness of each glass type shall be consistent throughout the Project.

B. Insulating Glass Units:

- 1. Provide insulating glass assemblies CBA rated by IGCC when tested in compliance with ASTM E 774, and permanently labeled with the appropriate certification label of IGCC, ALI or NCTL.
- 2. Sealing System: Dual seal, primary and secondary sealants shall be manufacturer's standard sealants.
- 3. Spacers: Aluminum with clear anodized finish.
- 4. Desiccant: Either molecular sieve or silica gel or blend of both.
- 5. Corner Construction: Manufacturer's standard corner construction.

C. Glass Types:

- 1. Type A: Clear, 1/4 in. thick, tempered, float glass.
- 2. Type B: 1 in. thick insulated assembly consisting of 1/4 in. thick, tempered clear Solarban 60 solar control Low-E glass by PPG, 1/2 in. argon gas space, and Type A glass for the interior lite. Glass shall provide a visible light transmittance of 70 percent and a shading coefficient of .44.

2.02 MISCELLANEOUS GLAZING MATERIALS

- A. Setting Block: Neoprene, silicone, or EPDM, 80 – 90 durometer hardness, compatible with sealants used, 6 in. long minimum.

- B. Spacer: Neoprene, silicone, or EPDM, 50 – 60 durometer hardness, compatible with sealants used.
- C. Sealants:
 - 1. For all conditions, except primary seal of insulating units: General Electric Silglaze, or Dow Corning 795 or 999.
 - 2. For Primary Seal of Insulating Units: Manufacturer's standard sealant.
- D. Glazing Gaskets: Molded resilient continuous neoprene, silicone, or EPDM extrusions, 40 to 60 Shore A durometer hardness, meeting the requirements of ASTM C 509 for cellular (closed-cell) material, and AAMA SG-1 for non-cellular (dense) material.
- E. Compressible Filler Rod:
 - 1. Closed-dell or waterproof jacketed rod stock of synthetic rubber or plastic foam compatible with sealants used, flexible and resilient, with 5 to 10 psi compressive strength at 25% deflection.
 - 2. Do not use vinyl foam stock.
- F. Cleaner, Primer and Sealer: Type recommended by sealant or gasket manufacturer.

2.03 FABRICATION

- A. Cutting:
 - 1. Obtain sizes from shop drawings or by field measurement. Cut glass to fit each opening with at least the minimum edge clearance and bite on glass recommended by glass manufacturer.
 - 2. When glass will be precut to sizes obtained from shop drawings, take field measurements of each opening before glazing to verify adequate bite on glass and minimum edge clearance. Glaze openings which do not fall within tolerances for which precut glass has been sized only with glass specially cut to fit such openings.
 - 3. Do not nip glass edges. Edges may be wheel cut or sawed and seamed at manufacturer's option.
 - 4. For glass to be cut at site, provide glass 2 in. larger than required, in both dimensions, to facilitate cutting of clean-cut edges without seaming or nipping.
 - 5. Do not cut, seam, nip, or abrade tempered glass after tempering.
 - 6. Provide flat ground edges with arrised corners where glass edge is not covered by a metal stop.

3.00 EXECUTION

3.01 INSPECTION

- A. Verify conditions and measurements affecting the work of this Section at site.

- B. Make sure that openings and frames to be glazed are within allowable tolerances, plumb, level and square. Inspect framing joint intersections to insure that the offset in the joinery will not impose undue edge pressure on the glass in compliance with FGMA, Glazing Manual, and Sealant Manual, guidelines.
- C. Verify that other detrimental conditions are corrected before proceeding with installation.

3.02 STANDARDS AND PERFORMANCE

- A. Watertight and airtight installation is required for each piece of glass installed in an exterior wall.
- B. Each installation must withstand normal temperature changes, wind loading, and impact from normal operation for doors, without failure of any kind including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the Work.
 - 1. Installed glass shall be free from rattle.
- C. Protect glass from damage at all times during handling, installation and operation of the building until Substantial Completion.
- D. Comply with combined recommendations of glass manufacturer and manufacturer of sealants and other materials used in glazing, except where more stringent requirements are specified.
- E. Comply with FGMA, Glazing Manual, and Sealant Manual, guidelines, except as recommended otherwise by the manufacturers of the glass and glazing materials.
- F. Inspect each piece of glass immediately before installation, and eliminate those with edge damage or face imperfections.
- G. Unify appearance of each series of lights by setting each piece to match others as nearly as possible. Inspect each piece and set with pattern, draw and bow oriented in the same direction as other pieces.

3.03 PREPARATION FOR GLAZING

- A. Immediately before glazing, clean the glazing channel and other framing members to receive glass.
 - 1. Remove coatings which are not firmly bonded to the substrate.
 - 2. Verify that framing is satisfactory to receive the glass.
- B. Apply primer or sealer to joint surfaces when recommended by sealant manufacturer.

3.04 GLASS INSTALLATION

- A. Install setting blocks of proper size for all glass. Use glass manufacturer's recommended size and spacing. Set blocks in thin course of the heel-bead compound, if used; do not block weep holes.
- B. Provide spacers inside and out unless continuous gaskets are used. Use glass manufacturer recommended size and spacing.

- C. Prevent exudation of sealant or compound by forming voids or installing filler rods in the channel at the heel of jambs and head (do not leave voids in the sill channels, except as needed for drainage and weep holes) depending on light size, thickness and type of glass, and complying with manufacturer's recommendations.
- D. Do not nip glass. Do not install glass with edge damage.
- E. Force sealants into channel to eliminate voids and to assure complete "wetting" or bond of sealant to glass and channel surfaces.
- F. Tool exposed surfaces of sealants to provide a substantial "wash away" from the glass. Install pressurized gaskets to protrude slightly out of the channel, so as to eliminate dirt and moisture pockets.
- G. Clean and trim excess glazing materials from the glass, stops and frames promptly after installation, and eliminate stains and discolorations.
- H. Where wedge-shaped gaskets are driven into one side of the channel to pressurize the sealant or gasket on the opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when subjected to dynamic movement.
 - 1. Anchor gasket to stop with matching ribs, or with adhesive.

3.05 CURING / PROTECTING / CLEANING

- A. Cure glazing sealants and compounds in compliance with their manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.
- B. Protect glass from breakage immediately upon installation. Do not apply markers of any type to glass.
- C. Before Substantial Completion, remove and replace glass which is broken, chipped, cracked, abraded, stained or damaged in other way, including natural causes, accidents and vandalism.
- D. Maintain glass in a clean condition during construction so that it will not be damaged by corrosive action and will not contribute (by wash-off) to the deterioration of glazing materials and other work.
- E. Remove remaining labels and wash and polish glass on both faces not more than 4 days prior to District's acceptance of the work in each area. Comply with glass manufacturer's recommendations.

END OF SECTION

**SECTION 09 65 13
RUBBER BASE**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Topset coved rubber base for installation with surface flooring.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 03 31 00 – Cast-in-Place Concrete.
 - 3. Section 09 65 19 – Luxury Vinyl Tile.
 - 4. Section 09 65 20 – Vinyl Based Tile.
 - 5. Section 09 68 13 – Carpet Tile.

1.02 SUBMITTALS

- A. Procedure: In compliance with Section 01 30 00.
- B. Product Data: Submit manufacturer's published technical data describing materials, construction and recommended installation instructions. Submit technical data and installation instructions for each adhesive material.
- C. Green Building: For adhesives, include printed statement of VOC content and chemical components.
- D. Samples: Submit Samples of top set base in each available color. Following color selections, submit Samples, not less than 12 inches long of each selected color and type. Submit pint cans of each type adhesive.
- E. Maintenance Instructions: Submit manufacturer's recommendations for maintenance, care and cleaning of base.
- F. Maintenance Materials: Before Substantial Completion, deliver at least 50 lineal feet and five outside corner units of each color of rubber base installed. Deliver the materials in unopened factory containers or in sealed cartons with labels identifying the contents, matching installed materials. Include unopened cans of adhesives adequate to install the maintenance materials.

1.03 QUALITY ASSURANCE

- A. Qualifications of Installer: Minimum five (5) years experience in successfully installing the same or similar flooring materials.

- B. Comply with the following as a minimum requirement:
1. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
 2. ASTM F1861: Standard Specification for Resilient Wall Base.
 3. Comply with current Collaborative for High Performance Schools (CHPS) requirements, or California Green Building (CALGreen) Codes, whichever is more stringent.
 4. Chemically based products such as sealers, primers, fillers, adhesives, etc. must be approved by Owner's Office of Environmental Health and Safety (OEHS).
 5. Each selected color and configuration shall be from same dye lot and color.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered to the Project site in original unopened manufacturer's packaging clearly labeled with manufacturer's name. Store materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer's printed instructions, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C), for a minimum of 48 hours before installation.

1.05 PROJECT CONDITIONS

- A. Install products after other finishing operations, including painting, have been completed.
- B. Ventilation and Temperature: Verify areas that are to receive rubber base are ventilated to remove fumes from installation materials, and areas are within temperature range recommended by the various material manufactures for site installation conditions, between 48 hours before and after installation.
- C. Maintain the ambient relative humidity between 40% and 60% during installation.
- D. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).

1.06 WARRANTY

- A. Manufacturer shall provide a five-year material warranty.
- B. Installer shall provide a two-year fabrication and installation warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Tarkett (Johnsonite).
- E. Or Equal.

2.02 MATERIALS

- A. Rubber base:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Tarkett Traditional Thermoplastic Vinyl Wall Base, 4" high x 1/8" thick, cove type, with matching molded inside/outside corners as required. Colors to be determined by architect.
 - b. Performance requirements shall meet ASTM F1861 Standard Specification for Resilient Vinyl Wall Base, Type TV, Group 1
- B. Conform to ASTM F 861; Group 2, solid (homogeneous); Type 1, TS, (thermoset) vulcanized rubber, Style A, 4-inch high unless otherwise indicated, integral colors as selected, non-shrinking, 1/8 inch thick, with matching molded outside corners.
- C. Base Adhesive: Water based, low odor type, as recommended by manufacturer of rubber base.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Coordinate the Work of this section with other sections to provide a level, smooth and clean finish surfaces to receive rubber base.

3.02 EXAMINATION

- A. Field verify dimensions and other conditions affecting the Work of this section before commencing the Work of this section.
- B. Before Work is started, examine surfaces that are to receive rubber base. Deficiencies shall be corrected before starting the Work of this section.

3.03 PREPARATION

- A. Do not start preparation until adjacent concrete floor slabs are at least 90 days old and finish flooring is installed.
- B. Install rubber base when ambient temperature is 70 degrees F or higher, within range recommended by manufacturer, and ambient relative humidity between 40% - 60%.
- C. Vacuum clean substrates to be covered by resilient products immediately before installation.

3.04 INSTALLATION

- A. Install top set base at hard floors, including resilient flooring, concrete and wood, carpet and other soft floors.
- B. Securely fasten cement base to backing in long lengths in accordance with manufacturer's recommendations. Lay out lengths so that not less than 18 inches long filler pieces are provided. Assure that top and toe continuously contact the wall and floor, and that all

joints are tight. Install matching factory formed external corners at all offsets. Inside corners shall be coped; wrapped corners are not acceptable. Base and outside corners shall be rolled with a seam roller before adhesive sets. Do not stretch base during installation.

- C. Use of adhesive gun is prohibited. Apply adhesive directly to substrate using the appropriate notched trowel or spreader according to manufacturer's instructions. Maintain 1/8 inch gap from top of base to prevent adhesive oozing onto adjacent surfaces.

3.05 CLEANING

- A. Maintain surfaces of base clean as installation progresses. Clean rubber base when sufficiently seated and remove foreign substances.
- B. Clean adjacent surfaces of adhesive or other defacement. Replace damaged and/or defective Work to the specified condition.

3.06 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.07 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 09 65 19
LUXURY VINYL TILE

1.00 - GENERAL

1.01 SECTION INCLUDES

- A. Luxury vinyl tile flooring as indicated.

1.02 RELATED SECTIONS

- A. Division 01 - General Requirements.
- B. Section 03 31 00 - Cast-in-Place Concrete.
- C. Section 09 65 13 - Rubber Base.

1.03 DEFINITIONS

- A. Pop-up: A pop-up is defined as any surface deviation or looseness of substrate that is equal to or greater than 1/64 (0.015625) inch above the concrete floor level, regardless of the size.

1.04 REFERENCES

- A. Armstrong Flooring Technical Manuals.
- B. Armstrong Flooring Guaranteed Installation Systems instructions.
- C. ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
- D. ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- E. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- F. ASTM F 1482, Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring.
- G. ASTM F 1700 Standard Specification for Solid Vinyl Tile.
- H. ASTM F 1861 Standard Specification for Resilient Wall Base.
- I. ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- J. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

1.05 PERFORMANCE REQUIREMENTS

- A. Provide flooring which has been manufactured, fabricated, and installed to performance criteria certified by manufacturer without defects, damage, or failure.
- B. Pre-installation Meeting: Conduct an on-site pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.
- C. Pre-installation Testing: Conduct pre-installation testing as follows: [Specify testing (i.e., moisture tests, bond test, pH test, etc.).]
- D. Test Installations/ Mock-ups: Install at the project site a job mock-up using acceptable products and manufacturer approved installation methods, including concrete substrate testing. Obtain Owner's and Consultant's acceptance of finish color, texture and pattern, and workmanship standards.
- E. Sequencing and Scheduling:
 - 1. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring.
 - 2. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond, moisture tests and pH test.

1.06 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Submit the manufacturer's standard samples showing the required colors for flooring and applicable accessories.
- C. Shop Drawings. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation, and maintenance instructions (latest edition of Armstrong Flooring Guaranteed Installation Systems instructions for flooring and accessories.
- D. Submit Safety Data Sheets (SDS) available for adhesives, moisture mitigation systems, primers, patching/leveling compounds, floor finishes (polishes) and cleaning agents and Material Information Sheets for flooring products.
- E. If required, submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.
- F. Closeout Submittals: Submit the following:
 - 1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
 - 2. Warranty: Warranty documents specified herein.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide types of flooring and accessories supplied by one manufacturer, including moisture mitigation systems, primers, leveling and patching compounds, and adhesives.
- B. Installer Qualifications: All products shall be installed by a single installer with a minimum of five (5) years demonstrated experience, with adequate equipment, skilled workers, and practical experience to meet the project schedule.
 - 1. Select an installer who is experienced and competent in the installation of Armstrong resilient solid vinyl tile flooring and the use of Armstrong Flooring subfloor preparation products.
 - a. Engage installers certified as Armstrong Commercial Flooring Certified Installers.
 - b. Confirm installer's certification by requesting their credentials.
- C. Fire Performance Characteristics: Provide resilient tile flooring with the following fire performance characteristics as determined by testing material in accordance with ASTM test methods indicated below by a certified testing laboratory or other testing agency acceptable to authorities having jurisdiction:
 - 1. ASTM E 648 (NFPA 253) Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I
 - 2. ASTM E 662 (NFPA 258) (Smoke Generation) Maximum Specific Optical Density of 450 or less
 - 3. CAN/ULC-S102.2 – Flame Spread Rating and Smoke Developed – Results as tested.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Division 1 Product Requirements Sections.
- B. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- D. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives, and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

1.09 PROJECT CONDITIONS

- A. Coordinate delivery schedule with the Contractor and project schedule to minimize on site storage.
- B. Store materials in a dry area, protected from freezing, staining, contamination or damage.
- C. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65°F (18°C) and a maximum temperature of 85°F (29°C) for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature

of 55°F (13°C) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances. Refer to the Armstrong Flooring Guaranteed Installations Systems instructions for a complete guide on project conditions.

1.10 LIMITED WARRANTY

- A. Resilient Flooring: Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the warranty period.
- B. Limited Warranty Period: 20 years for Exchange™ Luxury Flooring.
- C. The Limited Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.
- D. For the Limited Warranty to be valid, this product is required to be installed using the appropriate Armstrong Flooring Guaranteed Installation System. Product installed not using the specific instructions from the Guaranteed Installation System will void the warranty.

1.11 EXTENDED SYSTEM LIMITED WARRANTY

- A. Resilient Flooring System: Submit a written warranty executed by the manufacturer, agreeing to repair or replace system (subfloor preparation products, adhesive, and floor covering) that fails within the warranty period.
- B. Limited Warranty Period: 10 years on top of the Resilient Flooring Limited Warranty.
- C. [S-463 Level Strong™ cement based self-leveling compound] [S-466 Patch Strong™ flexible patching and smoothing compound] [S-464 Prime Strong™ acrylic primer for porous substrates] [S-465 NP Prime Strong™ acrylic primer for non-porous substrates] [S-462 Seal Strong™ two-part moisture mitigation system].
- D. The installation of an Armstrong Flooring product along with the recommended Armstrong Flooring adhesive, as well as any one of the Strong System subfloor preparation products listed above, provides 10 additional years of limited warranty coverage. The Strong System limited warranty covers the installation integrity for the length of the flooring product warranty plus 10 years. To qualify for the Strong System Warranty, any subfloor preparation product needed for an installation must be an Armstrong Flooring product.
- E. For the System Limited Warranty to be valid, this product is required to be installed using the appropriate Armstrong Flooring Guaranteed Installation System. Product installed not using the specific instructions from the Guaranteed Installation System will void the warranty.
- F. When Armstrong Flooring Strong System subfloor preparation products are used with other manufacturers' floor coverings, adhesives, or other subfloor preparation products, Armstrong Flooring warrants our products to be free from manufacturing defects from the date of purchase through the limited warranty period of 15 years.

1.12 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials from same production run as products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Quantity: Furnish quantity of flooring units equal to 5% of amount installed.
2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage, and protection of extra material.

2.00 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer:
1. Armstrong Flooring, Inc.
 2. Or equal.

2.02 MATERIALS

- A. Exchange™ Luxury Flooring by Armstrong Flooring, Inc.
1. Description: A layered construction consisting of a tough, clear, rigid vinyl wear layer protecting a high-fidelity print layer on a solid vinyl backing. Protected by a diamond-infused UV-cured polyurethane finish, the wear surface is embossed with different textures to enhance each of the printed visuals. Colors are insoluble in water and resistant to cleaning agents and light.
 2. Reference specification - ASTM F 1700, "Standard Specification for Solid Vinyl Tile", Class III, Type B – Embossed Surface. Meets requirements for size, squareness, thickness, thickness of wear layer, residual indentation, resistance to chemicals, resistance to light and resistance to heat.
 3. Pattern and Color: To be selected by architect.
 4. Size: [6 in. x 36 in. (152 mm x 914 mm)].
 5. Wear layer thickness: 0.020 in. (0.5 mm).

2.03 ACCESSORIES

- A. For patching, smoothing, and leveling monolithic subfloors (concrete, terrazzo, quarry tile, ceramic tile, and certain metals), provide Armstrong [S-194 Cement-Based Patch, Underlayment and Embossing Leveler / S-195 Underlayment Additive] [S-463 Level Strong™ cement based self-leveling compound] [S-466 Patch Strong™ flexible patching and smoothing compound].
- B. [For priming porous substrates to aid in adhesive bond strength and reducing subfloor porosity, provide S-464 Prime Strong™ acrylic primer for porous substrates. For non-porous substrates, provide S-465 NP Prime Strong™ acrylic primer for non-porous substrates].
- C. [For creating a moisture barrier, provide S-462 Seal Strong™ two-part moisture mitigation system].
- D. For sealing joints between the top of wall base or integral cove cap and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.
- E. Provide transition/reducing strips tapered to meet abutting materials.
- F. Provide threshold of thickness and width as shown on the drawings.

- G. Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl, or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.
- H. Provide metal edge strips of width shown on the drawings and of required thickness to protect exposed edges of the flooring. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage or overlap-type metal edge strips for exposed anchorage. Unless otherwise shown, provide strips made of extruded aluminum with a mill finish.

3.00 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog, installation instructions, and product carton instructions for installation and maintenance procedures as needed.

3.02 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions (i.e., moisture tests, bond test, pH test, etc.).
- B. Visually inspect flooring materials, adhesives, and accessories prior to installation. Flooring material with visual defects shall not be installed and shall not be considered as a legitimate claim.
- C. Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.
- D. Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
- E. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- F. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

3.03 PREPARATION

- A. [Subfloor Preparation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with Armstrong Flooring [S-184 Fast-Setting Cement-Based Patch and Underlayment][S-194 Cement-Based Patch, Underlayment and Embossing Leveler / S-195 Underlayment Additive] [S-463 Level Strong™ cement based self-leveling compound] [S-466 Patch Strong™ flexible patching and smoothing compound] [S-464 Prime Strong™ acrylic primer for porous substrates] [S-465 NP Prime Strong™ acrylic primer for non-porous substrates] as

recommended by the flooring manufacturer. Refer to Armstrong Flooring Guaranteed Installation Systems instructions and ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.].

- B. [Subfloor Preparation Moisture Mitigation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, mitigate moisture and other defects with Armstrong Flooring [S-194 Cement-Based Patch, Underlayment and Embossing Leveler / S-195 Underlayment Additive] [S-463 Level Strong™ cement based self-leveling compound] [S-466 Patch Strong™ flexible patching and smoothing compound] [S-462 Seal Strong™ two-part moisture mitigation system] [S-464 Prime Strong™ acrylic primer for porous substrates] [S-465 NP Prime Strong™ acrylic primer for non-porous substrates] as recommended by the flooring manufacturer. Refer to Armstrong Flooring Guaranteed Installation Systems instructions and ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.].
- C. Subfloor Cleaning: The surface shall be free of dust, solvents, varnish, paint, wax, oil, grease, sealers, release agents, curing compounds, residual adhesive, adhesive removers, and other foreign materials that might affect the adhesion of resilient flooring to the concrete or cause a discoloration of the flooring from below. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents. Spray paints, permanent markers and other indelible ink markers must not be used to write on the back of the flooring material or used to mark the concrete slab as they could bleed through, telegraphing up to the surface and permanently staining the flooring material. If these contaminants are present on the substrate, they must be mechanically removed prior to the installation of the flooring material. Refer to the Armstrong Flooring Guaranteed Installation Systems instructions and ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.
- D. When using S-995 Adhesive, perform subfloor moisture testing in accordance with ASTM F 2170, "Standard Test Method for Determining Relative Humidity in Concrete Slabs Using *in-situ* Probes" and Bond Tests as described in publication instructions "Armstrong Flooring Guaranteed Installation System," to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. Internal relative humidity of the concrete shall not exceed 99%. On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained.
- E. [When using S-319 Adhesive, perform subfloor moisture testing in accordance with ASTM F 2170, "Standard Test Method for Determining Relative Humidity in Concrete Slabs Using *in-situ* Probes" and Bond Tests as described in "Armstrong Flooring Guaranteed Installation System," instructions to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. Internal relative humidity of the concrete shall not exceed 99%. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained].
- F. [When using S-1000 Adhesive, perform subfloor moisture testing in accordance with [ASTM F 2170, "Standard Test Method for Determining Relative Humidity in Concrete Slabs Using *in-situ* Probes"] [ASTM F 1869, "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride"] and Bond Tests as described in "Armstrong Flooring Guaranteed Installation System" instructions to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. [Internal relative humidity of the concrete shall not exceed 100%.] [MVER shall not exceed 14 lbs./1000 sq. ft./24 hrs.] On installations where both the

Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained].

- G. Concrete pH Testing: Perform pH tests on concrete floors regardless of their age or grade level. All test results shall be documented and retained.
- H. Wood subfloors: Armstrong resilient floors are recommended on suspended wood subfloors with a 1/4" underlayment (see product installation systems for exceptions) and a minimum of 18" of well-ventilated air space below. Armstrong Flooring does not recommend installing resilient flooring on wood subfloors applied directly over concrete or on sleeper-construction subfloors. Loading requirements for subfloors are normally set by various building codes on both local and national levels. Trade associations such as APA–The Engineered Wood Association provide structural guidelines for meeting various code requirements. Subfloor panels are commonly marked with span ratings showing the maximum center-to-center spacing in inches of supports over which the panels should be placed.
 - 1. Refer to the Armstrong Flooring Guaranteed Installation Systems instructions and ASTM F 1482, Standard Guide to Wood Underlayment Products Available for Use under Resilient Flooring for additional information.
- I. Wood subfloors - Surface Cleaning: Make subfloor free from dust, dirt, grease, and all foreign materials.
 - 1. Check panels for sources of discoloration such as contamination from paint, varnish, stain overspray or spills, plumbing sealers, asphalt, heater fuel, markers, or potential staining agents such as wood or bark not visible on the surface, edge sealers, logo markings, printed nail patterns and synthetic patches.
 - 2. Remove old adhesive.
 - 3. Cover adhesive, oil, or wax residue with an appropriate underlayment. If the residue is tacky, place a layer of felt or polyethylene sheeting over it to prevent a cracking sound when walking on the floor.
 - 4. Remove all paint, varnish, oil, and wax from all subfloors. Many buildings constructed before 1978 contain lead-based paint, which can pose a health hazard if not handled properly. State and federal regulations govern activities that disturb lead-based painted surfaces and may also require notice to building occupants. **Do not remove or sand lead-based paint without consulting a qualified lead professional for guidance on lead-based paint testing and safety precautions.** Armstrong Flooring does not recommend the use of solvents to remove paint, varnish, oil, wax, or old adhesive residues because the solvents can remain in the subfloor and negatively affect the new installation. Whenever sanding, be certain the work site is well ventilated and avoid breathing dust. If high dust levels are anticipated, use appropriate National Institute for Occupational Safety and Health (NIOSH) designated dust respirator. All power sanding tools must be equipped with dust collectors. Avoid contact with skin or eyes. Wear gloves, eye protection and long-sleeve, loose fitting clothes
 - 5. For additional information on the installation and preparation of wood and board-type underlayments see the current edition of ASTM F1482, "Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring."
 - 6. Vacuum or broom-clean surfaces to be covered immediately before the application of flooring.

3.04 INSTALLATION

- A. Install flooring in strict accordance with the latest edition of Armstrong Flooring Guaranteed Installation Systems instructions. Failure to comply may result in voiding the manufacturer's warranty listed in Sections 1.10 and 1.11.
- B. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.
- C. If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the subfloor around covers and to covers.
- D. Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.
- E. Roll with a 100-lb. (45.36 kilogram) roller in the field areas. Refer to specific rolling instructions of the flooring manufacturer.
- F. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.
- G. Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrates.
- H. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.
- I. Apply [butt-type] [overlap] metal edge strips where shown on the drawings, [before] [after] flooring installation. Secure units to the substrate, complying with the edge strip manufacturer's recommendations

3.05 CLEANING

- A. Perform initial and on-going maintenance according to the latest edition of the maintenance recommendations for Exchange™. Remove excess sealants, glazing materials, dirt, and other substances.

3.06 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings. (See Finishing the Job in the latest edition of Armstrong Flooring Guaranteed Installation Systems instructions.

END OF SECTION

**SECTION 09 20 00
DRYWALL SUSPENSION SYSTEM**

PART 1 – GENERAL

1.1 SUMMARY

- A. Description of Work: Work of this Section includes, but is not limited to, the following:
 - 1. Metal Suspension Systems framing members for Plaster and Gypsum Board Assemblies
 - 2. Main Tees, Cross Tees, Perimeter Angles, Perimeter Channels, Hanger Wire, and Accessories

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and installation instructions with Project conditions and materials clearly identified or detailed for each required system.
- B. Samples: 12 inch long samples of suspension system components

1.3 SYSTEM REQUIREMENTS

- A. Performance Requirements: Fabricate and install systems as indicated but not less than that required to comply with ASTM C754 under the following conditions:
 - 1. A pre-engineered drywall suspension system consisting of straight main tees (for Wall-to-Wall system) or straight main tees and straight furring cross tees, that join together to support screw attached (interior gypsum panels) (gypsum fiber panels) (gypsum base panels) and independently supported light fixtures, and air diffusers, where applicable. (*Where applicable, installed systems must conform to Underwriter's Laboratories, Inc. (UL) Fire Resistance Design No.*)
 - 2. Maximum deflection of 1/360 of distance between supports.

1.4 QUALITY ASSURANCE

- A. Reference Standards
 - 1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 - 2. ASTM A 645 Standard for Nonstructural Framing Members
 - 3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated, (Galvanized) by the Hot-Dipped Process
 - 4. ASTM C635, Standard Specifications for Metal Suspension Systems
 - 5. ASTM C636, Recommended Practice for Installation of Metal Suspension Systems
 - 6. Cisca Ceiling Systems Installation Handbook
 - 7. ASTM C1186, Standard Specification for Flat Non-Asbestos Fiber-Cement Sheets. [Include if DUROCK panels are used, otherwise delete]
 - 8. ASTM C1278, Standard Specification for Fiber-Reinforced Gypsum Panels [Include if FIBEROCK panels are used, otherwise delete]
 - 9. ASTM C645, Standard Specification for Non-Bearing (Axial) Steel Studs, Runners, (Track), and Rigid Furring Channels for Screw Application of Gypsum Board
 - 10. ASTM C754, Specification for Installation of Steel framing Members to Receive Screw-Attach Gypsum Boards
 - 11. ASTM C840 Specification for Application & Finishing of Gypsum Board

12. (ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials)
13. (Underwriters Laboratories Inc. (UL) Fire Resistance Directory)
14. NOA # 17-09-19.03, TAS 202 and TAS 203

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 1. Deliver material to site promptly without undue exposure to weather.
 2. Deliver in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade.
- B. Inspection:
 1. Promptly inspect delivered materials, file freight claims for damage during shipment, and order replacement materials as required. Any damaged materials shall be promptly removed from the job site.
- C. Storage:
 1. Store above ground in dry, ventilated space.
 2. Protect materials from soiling, rusting, and damage.
 3. Store board to be directly applied to masonry walls at 70°F for 24 hours prior to installation.
- D. Handling:
 1. Handle in such a manner to insure against racking, distortion or physical damage of any kind.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements:
 1. Do not install gypsum board when ambient temperature is below 40°F.
 2. For adhesive attachment of gypsum board, and for finishing of gypsum board, maintain ambient temperature above 55°F from one week prior to attachment or joint treatment, and until joint treatment is complete and dry.

1.7 ALTERNATE CONSTRUCTION WASTE DISPOSAL

- A. Reuse:
 1. Separate clean waste drywall pieces from contaminants for landfilling or recycling. Do not include vinyl faced, mold-resistant or asphalt impregnated gypsum boards. Pulverize and apply to site soil in accordance to landscape specifications. Protect scrapes and pulverized material from moisture and contamination. Alternate to on-site soil amendment, work to supply local farming granular material for their use.
- B. Recycle:
 1. Separate clean waste drywall pieces from contaminants for landfilling or reuse. Working with local waste hauler and local drywall manufacturer, provide proper storage of waste for pickup and return. Protect scrapes material from moisture and contamination.

1.8 COORDINATION WITH OTHER WORK

- A. General:
 1. Coordinate with other work including mechanical and electrical work and partition systems. Installation of conduit and ductwork above suspension system shall be complete before installation of suspension system.

B. Protection:

1. Follow good safety and industrial hygiene practices during handling and installation of all products and systems, with personnel to take necessary precautions and wear appropriate personal protective equipment as needed. Read Material Safety Data Sheets and related literature for important information on products before installation. Contractor to be solely responsible for all personal safety issues during and subsequent to installation; architect, specifier, owner and manufacturer will rely on contractor's performance in such regard.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. All manufactured by USG (United States Gypsum Company, USG Interiors), Chicago, IL, USA, in compliance with applicable ASTM Standards. Contact your local USG Sales Representative for requests.

2.02 MATERIALS - SUSPENSION SYSTEMS

- A. USG Drywall Suspension Systems – Commercial quality, cold-rolled steel, hot dipped galvanized finish.
 1. Main Tees: Fire-Rated Heavy Duty classification 1.617" high x 144" long, integral reversible splice with knurled face. (DGLW-26 1-1/2" Face and 1.617" high)
 - a. Cross Members: Fire-Rated members with knurled face. Cross Tees: DGLW-424 cross tee 1-1/2" high x 48" long with 1-1/2" wide face; DGLW-224 Fire-Rated: 1-1/2" high x 24" long with 1-1/2" face
 2. quick release cross tee ends for positive locking and removability without tools
 3. Accessory Cross Tees: Cross tees must have knurled faces and quick release cross tee ends for positive locking and removability without tools.
 - a. DGW-6026DM: 1.617" high x 5' long with a 1-1/2" face
 - b. DGW-7226DM: 1.617" high x 6' long with a 1-1/2" face
 - c. DGW-8426DM: 1.617" high x 7' long with a 1-1/2" face
 - d. DGW-9626DM: 1.617" high x 8' long with a 1-1/2" face
 4. Wall Moldings: Single web with knurled face
 - a. DGWM-24: 1-1/2" x 1" x 144" long wall molding
 - b. DGCM-27: 144" x 1-5/8" x 1" x 1" channel molding
 - c. DGLC-12: 144" x 1-3/4" x 1" x 1" index channel molding
 5. Accessories
 - a. DGSC-180: Splice Clip
 - b. DGTC-90: Transition Clip
 - c. DGWC: Wall Attachment Clip
 - d. DGSP-180: Splice Plate
 - e. DGHUB: Dome Hub
 - f. CMAC-1: Close Mount Attachment Clip
 6. Wire: Hanger Wire 12 ga., galvanized or as noted on drawings
- B. USG Drywall Wall-to-Wall Suspension Systems – Commercial quality, cold-rolled steel, hot dipped galvanized finish for use in corridors and short span applications.
 1. Main Tees: Fire-Rated Heavy Duty classification 1.617" high x [6'] [8'] [10'] [12'] [14'] [Custom] long, integral reversible splice with 1-1/2" knurled face.
 2. Wall Moldings: Single web with knurled face, 1-1/2" x 1" x 12' long, DGWM24
 3. Wall Channel: Single web with knurled face, 1-5/8" x 1" x 12' long, DGCM27
 4. Locking Wall Channel: Single web with knurled face, 1-3/4" x 1" x 12' long, DGLC-12
- C. Grid Suspension Assemblies: Listed products establish standard of quality and are manufactured by United States Gypsum Company (USG), Chicago, IL

2.03 MATERIALS - BOARDS

A. Gypsum Board:

1. ASTM C36, regular type except where Type X or Type C fire-resistant type is indicated or required to meet UL assembly types.
2. Edges: Tapered
 - a. SHEETROCK Brand Gypsum Panels have long edges tapered on the face side to form a shallow channel for joint reinforcement.
 - b. SHEETROCK brand Gypsum Panels, SW Edge, have an exclusive tapered rounded edge design to help minimize ridging or beading and other joint imperfections and help compensate for extremes of temperature and humidity during construction. The SW system produces a stronger joint than with regular gypsum panels. Setting-type joint compound is recommended with this shape edge. Except for the rounded edge, SW Panels are tapered like, and otherwise identical to, regular tapered-edge gypsum panels.
 - c. Typical thickness for different applications include:
5/8 inch thick for commercial installations
1/2 inch thick for single-layer application in residential construction
1/4 inch thick used as base layer for improving sound control in double layer partitions, for use over old wall and ceiling surfaces and for forming curved surfaces with short radii
 - d. Where curved gypsum board construction is indicated, use 1/4 inch thick flexible facing board.
3. Acceptable products:
 - a. Typical partitions and ceilings: Equivalent to SHEETROCK Brand UltraLight FC 30, SHEETROCK Brand SW, FIRECODE or FIRECODE "C" Gypsum Panels by USG.
 - i. SHEETROCK brand Gypsum Panels, FIRECODE Core meet the definition of a Type X gypsum board for fire-rated assemblies in the Gypsum Association Fire Resistance Design Manual. Edges: SW tapered or tapered.
 - b. OR [depends on edge condition option]: Equivalent to SHEETROCK Brand Regular, FIRECODE or FIRECODE "C" Gypsum Panels by USG.
 - i. SHEETROCK brand Gypsum Panels, FIRECODE C Core provide improved fire protection over standard FIRECODE panels due to additives that enhance the integrity of the core under fire exposure. Comply with Type X requirements.
 - c. Acceptable product for fire-rated walls: Equivalent to Ultracode Core, 3/4 inch thick, by USG.
 - i. SHEETROCK brand Gypsum Panels, ULTRACODE Core, provide 1, 2, 3 and 4 hour fire ratings with fewer layers of gypsum panels than are usually required when used in approved designs.
4. Acceptable product for curved walls: 1/4" Flexible Gypsum Panels
 - a. SHEETROCK brand 1/4 inch Flexible Gypsum Panels bend to fit tight curves without wetting. These 1/4 inch panels are much more flexible than standard SHEETROCK panels of the same thickness.
 - b. SHEETROCK brand Gypsum Panels, are made by laminating special kraft-backed aluminum foil to back surface of regular or SW tapered panels with FIRECODE and FIRECODE C cores as indicated. Effective as a vapor retarder for walls and ceilings when applied with foil surface next to the framing in single-layer application or as the base layer in multi-layer systems. In tests per ASTM E96 (desiccant method), 1/2 inch foil-back panels showed a vapor permeance of 0.06 perm.

- c. Limitations: Not recommended as a base for ceramic or other tile or as base layer for SHEETROCK Vinyl-Faced Gypsum Panels or other highly moisture-resistant wall coverings. Also not to be used in hot, humid climates such as the Southern Atlantic and Gulf Coast areas.
- 5. Ceiling board
 - a. ASTM C36, non-sag type
 - b. Thickness: ½ inch
 - c. Acceptable product: Equivalent to SHEETROCK® Brand UltraLight Panels by USG
 - i. SHEETROCK® Brand UltraLight Panels are re-engineered, lightweight gypsum wallboard panels with a high strength-to-weight ratio composite design. The panels have superior sag resistance that eliminates the need for traditional 1/2" sag-resistant ceiling panels. The noncombustible gypsum core is encased in 100% recycled face and back papers. The natural finish face paper is folded around the long edges to protect the core and the ends are cut square and even. The long edges of the panels are tapered, allowing joints to be reinforced with Sheetrock® Brand joint treatment systems. Thickness: ½, 5/8 inch, unless otherwise indicated.
- 6. Mold-resistant gypsum board
 - a. ASTM C1396, regular except where Type X (FIRECODE) or Type C (FIRECODE C) indicated or required to meet UL assembly types
 - b. Edges: Tapered
 - c. Thickness: 1/2 [5/8](for FIRECODE only), [3/4] inch (ULTRACODE)
 - d. Acceptable product: Equivalent to SHEETROCK brand MOLD TOUGH gypsum panels by USG
 - i. SHEETROCK® brand MOLD TOUGH™ gypsum panels have a noncombustible, moisture- and mold-resistant gypsum core that is encased in moisture- and mold-resistant, 100 percent recycled green face and brown back papers. The panels feature tapered long edges for easy finishing. The 5/8" FIRECODE and 1/2" FIRECODE C Core panels are UL Classified for fire resistance (Type X or Type C).
- B. Cement backer board
 - a. Aggregated portland cement board with woven glass fiber mesh facing complying with ANSI A118.9
 - b. Thickness: 1/2 [5/8] inch
 - c. Acceptable product and manufacturer: Durock Cement Board by USG
 - i. DUROCK Cement Board is vapor permeable and does not deteriorate in the presence of water. It is used as a substrate for tile. If a vapor retarder or waterproof construction is specified, a separate barrier must be applied over or behind the DUROCK Board.
 - ii. For steam rooms and saunas where temperatures exceed 120 degrees F for extended periods, set tile with dry-set or latex-portland cement mortar; do not use organic adhesive.

2.04 MATERIALS - ACCESSORIES

- A. Metal trim for gypsum board
 - 1. Conform to profile and dimensions indicated
 - 2. Material for interior Work: Galvanized steel, 26 gauge minimum
 - 3. Corner beads: Equivalent to Dur-A-Bead No. 103 [104] [800] [900] by USG
 - 4. Casing beads (edge beads): Equivalent to 200A [200B] [401] [402] [P-1] [701-B] [801-A] [801-B] by USG

5. Control joints
 - a. Roll-formed zinc with perforated flanges
 - b. Size: 1-3/4 inch wide, with 1/4 inch wide center channel
 - c. Provide with removable tape strip over channel
 - d. Acceptable product: Equivalent to No. 093 by others
- B. Paper-faced metal trim for gypsum board
 1. Conform to profile and dimensions indicated
 2. Material for interior Work: Comply with ASTM C1047
 3. Outside corners: SHEETROCK Brand Paper Faced Metal Bead and Trim [81W] [B1XWEL] [B1 Super Wide] by USG
 4. Outside Bullnose corners: SHEETROCK Brand Paper Faced Metal Bead and Trim [SLOC] [Danish] [Santa Fe] by USG
 5. Inside corners: SHEETROCK Brand Paper Faced Metal Bead and Trim [B2] [SLIC] by USG
 6. Trims: L shape - B4 SERIES, J shape: B9 SERIES by USG
- C. Special Trim and Reveals: Extruded aluminum alloy 6063-T5, profiles as indicated
- D. Gypsum Board Screws: Self-drilling, self-tapping steel screws
 - a. For steel framing less than 0.03 inch thick: Comply with ASTM C1002
 - b. For steel framing from 0.033 inch thick to 0.112 inch thick: Comply with ASTM C954
 - c. Provide Type S or Type S-12 screws
- E. Backer Board Accessories: Provide accessories and corrosion-resistant-coated steel screws as recommended by backer board manufacturer and required for complete installation.
- F. Acoustical Sealant: Equivalent to Acoustical Sealant by USG
 - SHEETROCK Acoustical Sealant is a highly elastic, water-based caulking for sound-rated partition and ceiling systems and sealing exterior walls to reduce infiltration. Non-bleeding and staining, pumpable and easily applied in beads. Provides excellent adherence to most surfaces, permanent flexibility and lasting seal. Meets ASTM C919 and ASTM C834.
- G. Sound Attenuation Blankets
 - Mineral fiber, conforming to ASTM C665, Type I
 - a. Surface burning characteristics per ASTM E84:
 - i. Flame spread: 15 or less
 - ii. Smoke developed: 0
 - b. Thicknesses: As indicated
 - c. Sound Attenuation Fire Blankets (SAFB) are paperless, semi-rigid mineral fiber mats designed to improve STC ratings when installed in partitions.
 - d. Acceptable product: Sound Attenuation Fire Blankets SAFB by others.[Fire Safety FS-15 Blankets]
- H. Miscellaneous Accessories: Provide as required for complete installations.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates and adjoining construction and conditions under which Work is to be installed. Do not proceed with Work until unsatisfactory conditions are corrected.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Standard reference: Install grid members in accordance with ASTM C636, Cisca installation standards, and other applicable references.
- B. Manufacturer's reference: Install in accordance with manufacturer's current printed recommendations.

- C. Drawing reference: Install in accordance with approved shop drawings and locate ceiling in accordance with main tee dimensions relative to elevations.
- D. Install in accordance with reference standards and manufacturer's instructions [and as required to comply with seismic requirements].

3.03 APPLICATION INSTALLATION REQUIREMENTS

A. Flat Ceiling Applications

1. Hanger Wire Installation: Secure hanger wires to upper structural elements and space hangers so that each hanger wire supports a maximum of 16 sq. ft.
2. Space main tee members a maximum span of 48" on center (or as specified by the UL Fire Resistance Directory)
3. Space cross tees recommended 16" o.c. (5/8" SHEETROCK Brand gypsum Board or 5/8" FIBEROCK Interior panels can span 24" o.c. Check USG AC3095, for maximum allowable spacing based on wind load) (or as specified by the UL Fire Resistance Directory) Install extra cross tees where butt joints occur, 8" from each side of the butt joint.
4. Install compression struts per manufacturer's specifications and spacing, in accordance with wind load if applicable. Adjust main and cross tee spacing as necessary for loading conditions. (See AC3095, USG)
5. Install fiber glass insulation (R____) in plenum, resting on top of main tees and cross members.
6. Do not install insulation within 3" of light fixtures unless fixtures are approved for use with insulation.
7. Limit insulation thickness so that combined weight of supported panels and insulation on grid main tees does not exceed 16 plf
8. Attach (SHEETROCK gypsum Board) (FIBEROCK Interior panels) (DUROCK Cement Board) to the suspension system main runners, cross tees, and cross channels with (1-1/4" bugle head screws – single layer of board) spaced (16" o.c. – SHEETROCK gypsum Board) (8" o.c.- FIBEROCK) (6" o.c. – DUROCK) in the field and at the perimeter of the panels, locate 3/8" in from panel edges. Hold panels in firm contact with framing while driving fasteners. Drive fastener heads flush with, or slightly below surface of (SHEETROCK gypsum board) (FIBEROCK panels). (Drive fasteners so bottoms of heads are flush with surface of DUROCK cement boards.)
9. Install trim, and similar accessories as necessary and as applicable to meet project requirements where indicated on drawings.
10. Install control joints at locations of properly detailed control joints, including additional cross tees as necessary, per direction of architect and/or design professional.
11. Finish boards as described to achieve 'Level of Finish' specified.

B. Corridor (Wall-to-Wall) Applications

1. Hanger Wire Installation: Secure hanger wires to upper structural elements and space hangers so that each hanger wire supports a maximum of 16 sq. ft.
 - a. Note:
 - If using 1/2" single layer of drywall no hangers are required for spans up to 7'-0" (L/240 uniform load, single span design).
 - If using 5/8" single layer of drywall no hangers are required for spans up to 6'-0" (L/240 uniform load, single span design).
 - If using 1/2" single layer of drywall for spans over 7'-0" to 14'-0" one hanger at mid span per each main is required (L/240 uniform load, single span design).
 - If using 5/8" single layer of drywall for spans over 6'-0" to 12'-0" one hanger at mid span per each main is required (L/240 uniform load, single span design).

If using 5/8" single layer of drywall for spans over 12'-0" to 14'-0" two hangers at 1/3 point per each main is required (L/240 uniform load, single span design).

2. Space main tee members as required by span and design load
 - a. Note:

Maximum load (lbs/sf)	Unsupported span	Main tee spacing
18	4'-0"	16" o.c.
12	4'-0"	24" o.c.
9.2	5'-0"	16" o.c.
6.1	5'-0"	24" o.c.
5.3	6'-0"	16" o.c.
3.6	6'-0"	24" o.c.
3.4	7'-0"	16" o.c.

3. Attach (SHEETROCK gypsum board) (FIBEROCK interior panels) (DUROCK cement board) to the suspension system main runners, cross tees, and cross channels with (1-1/4" bugle head screws – single layer of board) spaced (16" o.c. – SHEETROCK gypsum Board) (8" o.c.- FIBEROCK) (6" o.c. – DUROCK) in the field and at the perimeter of the panels, locate 3/8" in from panel edges. Hold panels in firm contact with framing while driving fasteners. (Drive fastener heads flush with, or slightly below surface of (SHEETROCK gypsum board) (FIBEROCK panels). (Drive fasteners so bottoms of heads are flush with surface of DUROCK cement boards.)
 4. Install trim, and similar accessories as necessary and as applicable to meet project requirements where indicated on drawings.
 5. Install control joints at locations of properly detailed control joints, including additional cross tees as necessary, per direction of architect and/or design professional.
 6. Finish boards as described to achieve 'Level of Finish' specified.
- C. Curved, vaults, or dome applications
1. Drawing reference: Install in accordance with approved shop drawings and locate ceiling in accordance with main tee dimensions relative to elevations.
 2. Hanger Wire Installation: Secure hanger wires to upper structural elements and space hangers so that each hanger wire supports a maximum of 12 sq. ft.
 - a. Note: Note: Curved surfaces can be achieved with the attachment of panels, however, in order to achieve the best application, plaster is recommended. Due to the width of the grid flange (greater than 3/4") STRUCTO-BASE gypsum basecoat plaster should be used to reduce cracking. If other gypsum plasters or portland plaster are being used then it is recommended to secure narrow flanged framing members or offset the metal lath to reduce cracking due to reduced mechanical key at framing/lath intersection.
Total weight of ceiling membrane plus overlaid insulation and surface finish material (e.g. ceramic tile) supported by the grid assembly should not exceed 4.0 psf. If the load exceeds 4.0 psf, then spacing of the hanger wires and/or main tees must be reduced (see sample calculation below). For guidance the following are design weights:

1/2" SHEETROCK Exterior Gypsum Ceiling Board 2.0 psf

5/8" SHEETROCK Exterior Gypsum Ceiling Board 2.5 psf

1/2" FIBEROCK Sheathing	2.2 psf
5/8" FIBEROCK Sheathing	3.0 psf
1/2" DUROCK Cement Board	3.0 psf
5/8" DUROCK Cement Board	3.75 psf

- b. If main tee hanger wires are at 4' o.c., the mains' load capacity is: 4 FT * 4 psf = 16 #/LF.
 By reducing the hanger wires to 3' o.c., the mains can carry 32 #/LF.
 By reducing the hanger wires to 2' o.c., the mains can carry 64 #/LF.

3/4" of plaster wet would be about 8.75 #/SF + 5/8" FIBEROCK Sheathing at 3 #/SF for about 12 #/SF.
 Mains are at 4 ft centers with 4' hangers; this load would be 12 #/SF * 4 FT = 48 #/LF.
 If the Mains are at 2 ft centers with 4' hangers; this load would be 12 #/SF * 2 FT = 24 #/LF.

Therefore, there are two options:

- 1.) Space the main tees at 4' o.c. with the 12 ga. hanger wire at 24" o.c. and within 8" from any wall, cross tees at 16" o.c. with hanger wire support at midspan and/or within 8" from any wall.
 - 2.) Space the main tees at 2' o.c. with the 12 ga. hanger wire at 36" o.c. and within 8" from any wall, cross tees at 16" o.c.
3. Space main and cross tee members so the maximum span of metal lath is (16") (12")
 4. Secure self-furring metal lath to tee members with screws spaced 6" o.c. max., applied at lath dimples. Lap metal lath ends and edges and secure with 18 gauge tie wire spaced 6-inches o.c.
 5. Mix STRUCTO-BASE Gypsum Plaster with sand in proportions of 2 cu. ft. of sand per 100 lbs. of plaster for scratch and brown coats. Apply plaster to metal lath to a thickness of 5/8" (min.) Measured from the face of the lath.
 6. Select a plaster mix for the finish coat to provide a smooth trowel or sand float (textured) finish. (Reference SA 920)
 7. Use template(s) to insure uniform and even curvature of the finished surface.

END OF SECTION

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

1.00 GENERAL

1.01 DESCRIPTION

- A Division 1 applies to this section. Provide non-load bearing metal support systems, complete.
- B. Section Includes:
 - 1. Non-load bearing metal framing for gypsum wallboard walls, elevator shaft walls, ceilings and soffits.
 - 2. Metal backing plates for securing materials of other sections.
- C. Related Work Specified Elsewhere:
 - 1. Gypsum wallboard.
 - 2. Cement Backerboard
 - 3. Hanger wires and framing for suspended grid acoustical ceilings.
 - 4. Thermal and sound insulation.
 - 5. Access panels.
 - 6. Metal Decking

1.02 SUBMITTALS

- A. Shop Drawings: Submit showing details for each typical wall, partition and ceiling system. Show all conditions of closures at and connections to, metal roof decking.
- B. Product Data: Submit complete material list for all work of this section. Submit copies of UL test reports and local approvals for fire rated assemblies. Submit manufacturer's product data for all manufactured items.

1.03 QUALITY ASSURANCE

- A. Code: Conform all installations to code. In case of conflict between contract documents and code, the more stringent requirements shall govern. Conform fire resistance rated construction to requirements of DSA and CSFM.
- B. Reference Specification: Except as modified herein or required by code, conform metal support systems for plaster to the CLPCA Plaster/Metal Framing/Lath Manual and to MLSFA Metal Lathing and Furring.
- C. Tolerances: Erect walls and partitions on straight lines, plumb, free of twists or other defects, and contacting a 10-foot straightedge for its entire length at any location within a 1/8" tolerance. Erect horizontal framing level within a tolerance of 1/8" in 12-feet in any direction.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the job site and store in ventilated dry locations. Storage area shall permit easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

2.00 PRODUCTS

2.01 MATERIALS

- A. Wall Framing and Furring for Gypsum Wallboard:
 - 1. Non-Loadbearing: Studs for non-loadbearing walls shall conform to ASTM A446. Studs shall be C-shaped and CH shaped studs at shaft walls, roll-formed steel with minimum uncoated design thickness of 18 gauge, made from G40 hot-dip galvanized coated sheet. Floor and ceiling runner tracks shall conform to ASTM A446. Tracks shall be prefabricated, U-shaped, unpunched web, thickness to match studs, made from G40 hot-dip galvanized coated sheet. ICC-ESR 3064P.
- B. Stud Gauges indicated on drawings or specified above are minimum. Where required stud height exceeds Code approvals or manufacturer's recommendations, provide heavier gauge studs and/or decrease stud spacing as necessary to conform to code approvals, at no additional contract cost.
- C. Suspended Ceiling Systems and Wall Furring: Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of L/240. Carrying channels shall be formed from minimum 0.0548" thick cold-rolled steel, 1-1/2" wide by 7/16" deep. Carrying channels for supports under ducts shall be 2" in size as specified hereafter. Carrying channels shall be made from hot-dip galvanized coated sheet. Furring members shall be formed from cold-rolled steel, 7/8" by 2-9/16". Furring members shall be made from hot-dip galvanized coated sheet.
- D. Framing Accessories: Provide all standard related accessories including floor and ceiling tracks, clips, web stiffeners, anchors, and similar items, of the same manufacture as each type of stud specified, as required for complete installations.
- E. Splay Wires and Compression Struts: Of approved manufacturers, acceptable to manufacturer of ceiling grids, gauges and types as required by building codes for ceiling types and weights specified.
- F. Wires: Soft-annealed galvanized steel wire, 8 gauge for hanger wires and 16 gauge for framing unless otherwise specified.
- G. Fasteners: Wafer head screws, self drilling type for 20 gauge metal and heavier.
- H. Acoustical Foam Tape: Compressible, closed cell polyvinyl chloride foam with pressure sensitive adhesive, in rolles with protective release liner on non-adhesive face, 6 pcf density, 1 " wide by not less than 1/4" thick, Norseal V730, manufactured by Norton Performance Plastics Corporation (800) 724-0883, or equal.
- I. Acoustical Sealant: By USG, Gold Bond, or equal, permanently resilient type.

- J. Zinc-Rich Paint: Conform to Fed Spec DOD-P-21035A, Z.R.C. "Cold Galvanizing Compound", manufactured by ZRC Products Company. Use for touch-up of galvanized surfaces.
- K. Steel Backing Plates: Fabricate of minimum 4" wide by 16 gauge steel, or sections of studs and stud track welded to web of studs, except as otherwise indicated. Apply shop coat of metal primer.

3.00 EXECUTION

3.01 GENERAL

- A. Conform installation of light gauge steel framing and furring to requirements of ASTM C 754 and ASTM C 841 except conform to this section where more stringent requirements are specified. ICC-ESR 3064P.

3.02 INSTALLATION OF STUD TRACKS

- A. Bolt or screw fasten to metal and anchor at least 1-1/4" into concrete with bolts and expansion shields, shotpins, cinch anchors, screws and lead plugs, drilled and bolted steel shells, or other approved device. Concrete nails are not acceptable. Abutting lengths of track shall be securely anchored to a common structural element, butt-welded or spliced. Secure all tracks within 6" of ends and at maximum 24" centers between unless otherwise indicated.

3.03 WALL FRAMING AND FURRING

- A. Provide 18 gauge studs at maximum 16" centers typically, unless otherwise shown, specified, or required under Subparagraph "Stud Height". Cut studs 1/2" short and secure to top track in manner that allows for deflection of structure above. Steel framing and furring members shall be installed in accordance with ASTM C 754 and as specified herein. Members shall be in alignment. Runners shall be aligned accurately at the floor and ceiling and securely anchored.
- B. Wall Openings: The framing system shall provide for the installation and anchorage of the required subframes or finish frames for wall openings at doors, pass-through openings, and access panels. Partitions abutting continuous suspended ceilings shall be strengthened for rigidity at rough openings of more than 30" wide. Studs at openings shall be 14 gauge minimum thickness and spot grouted at jamb anchor inserts. Double studs shall be fastened together with screws and secured to floor and overhead runners. Form heads and sills of openings with track sections screwed or bolted to jamb studs, unless otherwise shown. Steel framing and furring members shall be installed in accordance with ASTM C 754. Members shall be in alignment. Runners shall be aligned accurately at the floor and ceiling and securely anchored.
- C. Control joints for expansion and contraction in the walls shall be constructed with double studs installed 1/2" apart in interior walls or wall furring where indicated on drawings. Control joint spacing shall not exceed 30'. Ceiling-height door frames may be used as vertical control joints. Door frames of less than ceiling height may be used as control joints only if standard control joints extend to ceiling from both corners of top of door frame. Control joints between studs shall be filled with fire-safing insulation in fire rated partitions.

- D. Studs at Wall Mounted Items: Install 14 gauge studs wall-hung casework, fixtures and equipment, and elsewhere as shown.
- E. Studs at Ceramic Tile: Studs for use with ceramic tile shall be not lighter than 16 gauge. Spacing of studs for ceramic tile shall not exceed 16" when tile is thinset over portland cement backer board, and 12" when mortar set over portland cement plaster.

3.04 SOUND INSULATED WALLS AND PARTITIONS

- A. Embed floor runner tracks in two beads of acoustical sealant or two strips of compressed tape seal. Install the top track in same manner for full-height insulated walls. Where wall ends abut concrete, masonry, or steel, set end studs in two beads of acoustical sealant or two tape seals and secure at 4-foot centers vertically. At irregularities in surfaces, provide additional layers of sealant or tape as required to obtain compression.
- B. Embed floor runner tracks in two beads of acoustical sealant or two runs of compressed tape seal. Install the top track in same manner for full-height insulated walls.

3.05 SUSPENDED CEILINGS AND FURRING

- A. Hanger Wires: Secure to structure above according to code and approved submittal. Allow sufficient length for two or more complete turns around runner channels at proper ceiling height.
- B. Suspended Gypsum Wallboard Framing: Suspended ceiling system framing shall be installed in accordance with ASTM C 754, and as follows.
 - 1. Hangers shall be spaced not more than 48" along runner channels and 36" in the other direction or 42" in both directions unless otherwise indicated. Locations of hanger wires shall be coordinated with other work. Hangers at ends of runner channels shall be located not more than 6" from walls. Hanger wire shall be secured to structural elements with suitable fasteners. Sags or twists which develop in the suspended system shall be adjusted. Damaged or faulty parts shall be replaced.
 - 2. Main Runners: Hanger wires shall be double strand saddle-tied to runner channels and the ends of hanger wire shall be twisted three times around itself. Main runners shall be located to within 6" of the parallel wall to support the ends of cross furring. Main runners shall not come in contact with abutting masonry or concrete walls. Where main runners are spliced, ends shall be overlapped 12" with flanges of channels interlocked, and shall be securely tied at each end of splice with wire looped twice around the channels.
 - 3. Furring channels shall be secured to the runner channels and to structural supports at each crossing saddle-tied with one strand of #16 gage or two strands of #18gage tie wire. Furring channels shall be located within 2" of parallel walls and beams, and shall be cut 1/2" short of abutting walls.
 - 4. Ceiling Openings: Support members shall be provided as required at ceiling openings for access panels, recessed light fixtures, and air supply or exhaust. Support members shall be not less than 1-1/2" main runner channels and vertically installed suspension wires or straps shall be located to provide at least the minimum support specified herein for furring and

wallboard attachment. Intermediate structural members not a part of the structural system, shall be provided for attachment or suspension of support members.

5. Light fixtures and air diffusers shall be supported directly from suspended ceiling runners. Wires shall be provided at appropriate locations to carry the weight of recessed or surface mounted light fixtures and air diffusers.
 6. Control Joints: Ceiling control joints for expansion and contraction shall be located where indicated on drawings or on approved submittals. A control joint or intermediate blocking shall be installed where ceiling framing members change direction.
- C. Splay Wires and Compression Struts: Install as detailed and as required to prevent upward and sideward motion under seismic conditions, as required by code.
- D. Suspension Under Ducts: For hangers spaced at 4 to 5-1/2 foot centers, provide 6 gauge hanger wires with minimum 2" runner channels spaced at maximum 48" centers. For greater spans, design system for live load of 10 pounds per square foot of area plus dead load and detail in shop drawings.
- E. Furring: Provide framing for horizontal furring as shown and required. Conform to above requirements as applicable.

3.06 BACKING PLATES AND ANCHORAGE

- A. Install and attach to metal studs or furring for anchoring items indicated or specified in other sections. Comply with approved submittals specified under other sections as applicable to steel backing plates. Backing plates may be omitted where anchorage for wall-hung items is directly into steel studs of 18 gauge or heavier, or items are furnished with equivalent mounting devices. Install plates of lengths to span over at least two supports, equipped with two countersunk machine screws at each support except plates may be welded to supports 18 gauge or heavier. Wall-mounted items requiring backing plates include without limitation the following:

Grab bars
Toilet compartments and urinal screens
Toilet room accessories
Plumbing fixtures
Steel ladders

3.07 CONNECTIONS TO METAL DECKING

- A. Provide premolded neoprene filler strips matching the flute profile for walls and partitions covered on one or both sides up to metal decking. If proprietary fire-rated top tracks are used, the installation shall be in accordance with manufacturer's recommendations.

3.08 TOUCH-UP PAINTING

- A. Spot prime all abraded and damaged areas of zinc coating as specified.

END OF SECTION

**SECTION 09 24 00
PORTLAND CEMENT PLASTER**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Exterior Portland cement plasterwork (stucco) on metal lath.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other work.
- C. Samples: For each type of factory-prepared finish coat indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Where indicated, provide Portland cement plaster assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Mockups: Before plastering, install mockups of at least 100 sq. ft. (9.3 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

1.4 PROJECT CONDITIONS

- A. Comply with ASTM C 926 requirements.
- B. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.1 METAL LATH

- A. Expanded-Metal Lath: ASTM C 847 with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
 - 1. Diamond-Mesh Lath: Self-furring, 2.5 lb/sq. yd. (1.4 kg/sq. m).
- B. Paper Backing: FS UU-B-790, Type I, Grade D, Style 2 vapor-permeable paper.

1. Provide paper-backed lath at exterior locations.

2.2 ACCESSORIES

- A. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
- B. Metal Accessories:
 1. Foundation Weep Screed: Fabricated from hot-dip galvanized-steel sheet, ASTM A 653/A 653M, G60 (Z180) zinc coating.
 2. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
 3. External-Corner Reinforcement: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
 4. Cornerbeads: Fabricated from zinc-coated (galvanized) steel.
 - a. Small-nose style; use unless otherwise indicated.
 5. Casing Beads: Fabricated from zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
 6. Control Joints: Fabricated from zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
 7. Expansion Joints: Fabricated from zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
 8. Two-Piece Expansion Joints: Fabricated from zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch (6.34 to 16 mm) wide; with perforated flanges.
- C. Plastic Accessories: Fabricated from high-impact PVC.
 1. Cornerbeads: With perforated flanges.
 - a. Small-nose style; use unless otherwise indicated.
 2. Casing Beads: With perforated flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated.
 - a. Square-edge style; use unless otherwise indicated.
 3. Control Joints: One-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
 4. Expansion Joints: Two-piece type, formed to produce slip-joint and square-edged 1/2-inch- (13-mm-) wide reveal; with perforated concealed flanges.

2.3 MISCELLANEOUS MATERIALS

- A. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch (13 mm) long, free of contaminants, manufactured for use in portland cement plaster.
- C. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of no fewer than three exposed threads.
- D. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063.
- E. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

2.4 PLASTER MATERIALS

- A. Portland Cement: ASTM C 150, Type I.
- B. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
- C. Sand Aggregate: ASTM C 897.
 - 1. Color for Job-Mixed Finish Coats: as indicated on drawings.
- D. Acrylic-Based Finish Coatings: Factory-mixed acrylic-emulsion coating systems, formulated with colorfast mineral pigments and fine aggregates; for use over portland cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes.
 - 1. Color: As selected by Architect from manufacturer's full range.

2.5 PLASTER MIXES

- A. General: Comply with ASTM C 926 for applications indicated.
 - 1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m) of cementitious materials.
- B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:
 - 1. Portland Cement Mixes:
 - a. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

- b. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
- 2. Masonry Cement Mixes:
 - a. Scratch Coat: 1 part masonry cement and 2-1/2 to 4 parts aggregate.
 - b. Brown Coat: 1 part masonry cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.
- 3. Portland and Masonry Cement Mixes:
 - a. Scratch Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - b. Brown Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
- 4. Plastic Cement Mixes:
 - a. Scratch Coat: 1 part plastic cement and 2-1/2 to 4 parts aggregate.
 - b. Brown Coat: 1 part plastic cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.
- 5. Portland and Plastic Cement Mixes:
 - a. Scratch Coat: For cementitious material, mix 1 part plastic cement and 1 part portland cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - b. Brown Coat: For cementitious material, mix 1 part plastic cement and 1 part portland cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
- C. Factory-Prepared Finish-Coat Mixes: For acrylic-based finish coatings, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- B. Prepare solid substrates for plaster that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

3.2 INSTALLATION, GENERAL

- A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.

- B. Sound Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.

3.3 INSTALLING ACCESSORIES

- A. Install according to ASTM C 1063 and at locations indicated on Drawings.
- B. Reinforcement for External Corners:
 - 1. Install lath-type, external-corner reinforcement at exterior locations.
 - 2. Install cornerbead at exterior locations.
- C. Control Joints: Install control joints at locations indicated on Drawings.
 - 1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
 - a. Vertical Surfaces: 144 sq. ft. (13.4 sq. m).
 - b. Horizontal and other Nonvertical Surfaces: 100 sq. ft. (9.3 sq. m).
 - 2. At distances between control joints of not greater than 18 feet (5.5 m) o.c.
 - 3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
 - 4. Where control joints occur in surface of construction directly behind plaster.
 - 5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.4 PLASTER APPLICATION

- A. General: Comply with ASTM C 926.
- B. Walls; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork, 3/4-inch (19-mm) thickness.
 - 1. Portland cement mixes.
 - 2. Masonry cement mixes.
 - 3. Portland and masonry cement mixes.
 - 4. Plastic cement mixes.
 - 5. Portland and plastic cement mixes.
- C. Ceilings; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork; 1/2 inch (13 mm) thick.
 - 1. Portland cement mixes.
 - 2. Masonry cement mixes.

- 3. Portland and masonry cement mixes.
 - 4. Plastic cement mixes.
 - 5. Portland and plastic cement mixes.
 - D. Plaster Finish Coats: Apply to provide finish to match existing building.
 - E. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.
- 3.5 PLASTER REPAIRS
- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

END OF SECTION

**SECTION 09 25 00
GYPSUM BOARD**

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

A. Principal Work in this Section:

- 1. Gypsum board.
- 2. Metal suspension and furring assemblies.
- 3. Fasteners, joint reinforcing and finishing compound.

B. Related Work:

- 1. Metal Support Systems – Sections 05 40 00 and 09 22 16 (except for framing specified herein).
- 2. Metal Backing Plates and Access Panels in Gypsum Board Surfaces: Reference Sections 08 31 00 and 09 22 16.
- 3. Cement Backerboard: Section 09 25 50.
 - a. Behind all tile areas with thin set or plaster setting bed.

1.03 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

- 1. Comply with fire resistance ratings indicated and required by Code.
- 2. Provide materials, accessories and application procedures listed by UL or tested in compliance with ASTM E 119 for the type of construction shown.

B. Mock-Up:

- 1. Where directed construct a mock-up of a gypsum board wall and ceiling inside the building. Make mock-up full height (minimum 8 ft. high x 8 ft. wide) with a 4 ft. return.
- 2. Tape and finish joints, trim and screw heads as specified for Level 5 herein. Refer to Section 09 90 00 for painting of the mock-up with a semi-gloss paint.
- 3. The Architect will review the mock-up under various light conditions for defects and improperly finished joints, trim and screw heads. Provide a portable light for that purpose when so requested.

4. Make corrections requested by the Architect, or remove and replace mock-up when the corrective work is not acceptable to the Architect.
5. The approved mock-up shall remain in the building until its removal is directed, and will be used as a standard for the gypsum board work for the Project.

1.04 HANDLING

- A. Procedure: In accordance with Section 01 60 00.
- B. Delivery:
 1. Coordinate delivery with installations to minimize storage periods at the site. When stored outdoors, place on skids off the ground, and cover with waterproof tarpaulins. Neatly stack gypsum panels flat to prevent sagging.
 2. Deliver fire-rated materials with UL label and required fire classification numbers clearly visible.
- C. Handling: Handle gypsum board to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal trim.
- D. Storage: Do not overload the floors with localized concentration of gypsum board.

1.05 JOB CONDITIONS

- A. Comply with the gypsum board manufacturer's recommendations for temperature limitations and ventilation before, during and after installation of gypsum board.
- B. Protect installed materials from drafts during hot, dry weather.
- C. Illuminate work areas during installation to provide the same or greater level of illumination, as required to properly perform the work, as will occur in the room or space after the building is in operation.

2.00 PRODUCTS

2.01 MANUFACTURERS

- A. Goldbond Building Products/Div National Gypsum Co., US Gypsum Co., Georgia-Pacific Corp., Domtar Gypsum or Louisiana-Pacific.

2.02 MATERIALS

- A. Gypsum Board: Provide gypsum board in maximum lengths available to minimize end-to-end butt joints. Unless otherwise acceptable to the Architect, no end-to-end joints are permitted on walls or ceilings under 12 ft. in length or width.
 1. Exposed Gypsum Board Surfaces (5/8" Type 'X'): ASTM C 36, with paper face suitable to receive decorated finish, and long edges tapered to receive joint compound. Impact Resistant type typical unless noted otherwise.

B. Suspended and Furring Products:

1. Resilient Channel: 25 gauge 1/2" x 2-1/2". Secure with Type W or S 1-1/4" long drywall screws only.
2. Furring Channel: 25 gauge x 7/8" x 2-3/4" hat section with 1-3/8" face width, with clips.
3. Runner Channels: Cold rolled steel 1-1/2" x .12 pounds per foot – 1/8" thick.
4. Tie Wire: Galvanized, annealed 18 gauge.
5. Reinforcing Channel: Cold rolled steel 3/4" x .300 pounds per foot – 1/8" thick.

C. Fasteners:

1. Screws: ASTM C-1002 or ASTM C-954.
 - a. Type S for light gauge steel framing and furring.
 - b. Type S-12 for heavier gauge steel framing (to 12 gauge max). Buildex S-12 pan head for securing membrane.
 - c. Type G for attaching gypsum board to gypsum board.
 - d. Note: Gypsum sheathing required item 2.03C.2. at all metal connections.
2. Adhesives:
 - a. Gypsum Board to Metal or to Gypsum Board: As recommended by the gypsum board manufacturer.

D. Joint Tape, Compound and Laminating Adhesive: ASTM C 475, the following by Hamilton Materials or one of the gypsum board manufacturers.

1. Taping, and fastener and metal trim concealment: Multi-Purpose Compound V.
2. Topping, Finish and Skim Coats: Topping Joint System.

E. Sealant: As specified in Section 07 90 00.

3.00 EXECUTION

3.01 INSPECTION / PREPARATION

- A. Verify conditions and measurements affecting the work of this Section at site. Make sure that detrimental conditions are corrected before proceeding with installation.
- B. Before enclosing stud walls, thoroughly clean sill of debris.

3.02 GYPSUM BOARD INSTALLATION

- A. General: Comply with the applicable provisions of ASTM C 840, Application and Finishing of Gypsum Board, ASTM E 497, Installing Sound Isolating Lightweight Partitions, GA-216, and the following.
1. Use only full size boards above door and window openings, joints at corners of heads are not acceptable.
 2. Minimize butt joints and avoid butt joints centered on walls, over protruding studs, and above doors and windows. Avoid abutting end joints in the central area of each ceiling.
 3. Provide perimeter relief where board abuts structural decks, ceilings, vertical structural elements, or windows.
 4. Install horizontal board first. Butt joints between boards loosely. Do not force boards into place. Place tapered or wrapped edges next to one another.
 5. Attach boards to all studs and furring members with power-driven screws securely engaging supporting member, and with fastener heads uniformly depressed not over 1/32 in. below surface of board (except for first layer of multiple layer assembly) without breaking face paper. Space fasteners in accordance with Table 25 A-G or 25 A-H of the CBC.
 6. After boards have been installed over screws and backing plates, tap boards with a rubber mallet to depress backside of board over heads to eliminate unacceptable bulges.
 7. Allowable Tolerances:
 - a. Do not exceed 3/16 in. in 8 ft., and 1/8 in. 4 ft. from plumb, level and flat (all directions) in gypsum board surfaces.
 - b. Do not exceed 1/16 in. offset at joints between boards.
 - c. Shim boards as necessary to comply with these tolerances.
- B. Single Layer Application:
1. Horizontal Surfaces:
 - a. Install board with long dimension at right angle to supports, with end joints located over supports.
 - b. Use maximum practical length boards to minimize end joints. Stagger end joints in alternate boards.
 - c. Where water-resistant (WR) boards are used for horizontal surfaces, framing must be spaced at not over 12 in. o.c. maximum.
 2. Vertical Surfaces:
 - a. Unless otherwise acceptable to the Architect, install board vertically. Use floor-to-ceiling length boards (unless height exceeds 12 ft.) with vertical joints located over supports.

- b. Offset joints at least one stud on opposite sides of partition/walls.
- c. Extend gypsum board continuously from finish floor to underside of structure above, except where indicated otherwise on the Drawings.

3.03 ERECTION OF SUSPENDED FRAMING

- A. Space hangers not over 3'-0" o.c. in the direction of the 1-1/2" main runner channels and not over 4'-0" o.c. in the direction at right angles to the main runners and within 6" of main runner ends and of boundary walls, girders or similar interruption of ceiling continuity.
- B. Install main runners not over 4'-0" o.c., properly positioned, level and saddle tie hangers along runners. Main runner shall not come in contact with abutting walls. Space runner channels within 6" of adjacent walls to support ends of the furring channels.
- C. Space drywall furring channels 16" o.c. and securely clip or saddle tie with two strands of tie wire to main runners. Provide end splices by nesting channels no less than 8", and securely wire tie.
- D. All light or other openings that interrupt the main runner or furring channels, reinforce grillage with 3/4" cold rolled channels wire tied atop and parallel to main runner channel.

3.04 FINISHING

- A. Finish gypsum board surface with exposed joints, corners and edges reinforced or trimmed in compliance with the following:
 - Level 0: No taping, finishing or accessories required.
 - Use: First layer of multiple layer construction.
 - Level 1: Joints and interior angles shall have tape embedded in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.
 - Use: In plenum areas above ceilings, in attics, and in areas where the assembly will generally be concealed.
 - Level 2: Not used.
 - Level 3: Not used.
 - Level 4: Joints and interior angles shall have tape embedded in joint compound and 3 separate coats of joint compound applied over joints, angles, fastener heads, and accessories. Joint compound shall be smooth and free of tool marks and ridges.
 - Use: In areas where light textures or backed lightweight wall coverings are to be applied.
 - Level 5: Joints and interior angles shall have tape embedded in joint compound and 3 separate coats of joint compound applied over joints, angles, fastener heads, and accessories. A thin skim coat of joint compound, or a material similar to USG First Coat shall be applied to the entire surface. The surface shall be smooth and free of tool marks and ridges.

Use: All other areas to be painted.

B. General:

1. Fill joints, fastener heads, trim accessory flanges and surface defects with joint compound in compliance with the gypsum board manufacturer's recommendations to obtain a smooth, flush surface.
2. All joints, fastener heads and trim flanges in surfaces which will remain exposed to view in the building, shall be invisible after application of joint tape and compound.

C. Install trim in single unjointed length, unless length exceeds manufacturer's standard. Attach to gypsum board in compliance with manufacturer's printed instructions.

1. Install Type CB trim at external corners.
2. Install Type LC trim where gypsum board edges are exposed in the finish work.
3. Install Type CB or LC trim where gypsum board abuts a different material, and the edges are not covered by a finish material.
4. Install control joints as recommended in paragraph 5.6 of the reference standard. Joint locations are subject to the Architect's approval.

D. Reinforce joints between gypsum boards, and interior corners and angles with tape set in joint compound.

1. Apply skim coat over tape in one application.
2. Where space greater than 1/16 in. occurs between abutting gypsum boards (except at control joints), prefill joints with joint compound and allow to dry before applying joint tape.
3. Reinforce door frame jamb anchors, of openings scheduled to receive wood and metal doors, by spot-grouting with joint compound.

E. Joint Compound:

1. Lap each coat not less than 4 in. over the preceding coat (2 in. on each edge). Width of joint compound on tapered board edges shall be not less than 12 in.; width of joint compound on square board edges not less than 18 in.
2. Allow at least 24 hours drying time between applications of joint compound.
3. Finish joint compound so that little or no sanding is required. When sanding, use sandpaper or mesh cloth with grit as fine as possible; do not scuff face paper. Remove all sanding dust before painting or applying other finishes.

F. Leave gypsum board surfaces smooth, undamaged and ready to receive scheduled finishes.

3.05 MECHANICAL AND ELECTRICAL WORK

- A. Coordinate with Mechanical and Electrical trades in the location and installation of their work. Provide bridging, bracing and support their work installed in or on drywall construction. Do not close both faces of walls until their installations have been inspected and approved. Provide fire assembly enclosures for mechanical and electrical equipment which penetrates fire-rated assemblies.

3.06 ACCESS PANELS

- A. Access panels for access to electrical or mechanical controls and valves which occur in drywall partitions or furring will be furnished to the job by the trade involved for installation under this Section. Locate panels where directed by the Architect and install level and square with adjacent construction.
- B. Refer to the Mechanical and Electrical Drawings and Specifications for additional requirements.

END OF SECTION

SECTION 09 30 50
TILE SETTING MATERIALS AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Edge-protection and transition profiles for floors.
- B. Finishing and edge-protection profiles for walls and countertops.
- C. Movement joint and cove-shaped profiles.

1.2 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and finish.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Warranty document showing duration and scope to be submitted with product submittals.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years' experience.
- B. Source Limitations for Setting Materials and Accessories: Obtain product of a uniform quality for each application condition from a single manufacturer.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.
- D. Preinstallation Conference: Conduct conference at the Project site.
 - 1. Convene one week prior to commencing work of this section.
 - 2. Require attendance of installation material manufacturer, tile supplier, tile installer and installers of related work. Review installation procedures and coordination required with related work.
 - 3. Meeting agenda includes but is not limited to:
 - a. Surface preparation.
 - b. Tile and installation material compatibility.
 - c. Manufacturer and installer warranty duration and scope covered by warranty.

- d. Edge protection, transition, and pre-fabricated movement joint profiles.
 - e. Waterproofing techniques.
 - f. Crack isolation techniques.
- E. Provide sample warranty during submittal process.
- F. Acknowledge warranty duration and scope covered by warranty.
- G. Coordinate Work with other operations and installation of floor finish materials to avoid damage to installed materials.
- H. Obtain products of a uniform quality for each premanufactured tile profile, and mortar and waterproofing and uncoupling membrane from a single manufacturer, to maintain the installation system and provide multi-product warranty from selected manufacturer.

1.4 COORDINATION

- A. Coordinate Work with other operations and installation of floor finish materials to avoid damage to installed materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Schluter Systems L.P., which is located at: 194 Pleasant Ridge Road.; Plattsburgh, NY 12901-5841; Mary Yocum, myocum@schluter.com, 714-329-0355 Web:www.schluter.com/schluter-us/en_US/.

2.2 EDGE-PROTECTION AND TRANSITION PROFILES FOR FLOORS

- A. Schluter-SCHIENE: L-shaped profile with 1/8 inch (3 mm) wide visible surface integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 1. Anchoring Leg: Straight anchoring leg.
 - 2. Profile Height: As required to coordinate with tile selection and setting system.
 - 3. Material and Finish:
 - a. V4A: Stainless Steel Type 316 L equals V4A.

2.3 FINISHING AND EDGE-PROTECTION PROFILES FOR WALLS AND COUNTERTOPS

- A. Schluter-RONDEC: Bullnose-type profile with symmetrically rounded visible surface with 1/4 inch (6 mm) radius, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 1. Corners: Matching inside corners.
 - 2. Corners: Matching outside corners.
 - 3. Corners: Matching internal connectors.
 - 4. Profile Height: As required to coordinate with tile selection and setting system.
 - 5. Material and Finish:
 - a. EV4A: Stainless Steel Type 316 L equals V4A.
- B. Schluter-DESIGNLINE
 - 1. Description: U-shaped profile with 1" (25 mm) wide exposed surface and 1/4" (6mm) tall integrated vertical anchoring legs on each side.
 - 2. Material and Finish
 - a. E – Stainless Steel Type 304 = V2A

2.4 MOVEMENT JOINTS AND COVE-SHAPED PROFILES

- A. Schluter-DILEX-EKE: Profile with integrated rigid, recycled PVC trapezoid-perforated anchoring legs, connected at a 90-degree angle by a 3/16 inch (5 mm) wide soft CPE movement zone that forms the visible surface.
 - 1. Profile Height: As required to coordinate with tile selection and setting system.
 - 2. Movement Zone Color:
 - a. HB: Light Beige. – other color options available to be approved by architect
- B. Schluter-DILEX-EHK: Roll-formed stainless steel profile with integrated trapezoid-perforated anchoring legs, connected at a 90-degree angle by a cove-shaped section with 23/32 inch (18.5 mm) radius that forms the visible surface.
 - 1. Corners: Matching inside corners.
 - 2. Corners: Matching outside corners.
 - 3. Corners: Matching end caps. Color: Gray only.
 - 4. Corners: Matching connectors.
 - 5. Profile Height: As required to coordinate with tile selection and setting system.
 - 6. Material and Finish:
 - a. EV4A: Stainless Steel Type 316 L equals V4A.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

**SECTION 09 31 00
CERAMIC TILE**

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

A. Principal Work in this Section:

1. Shower stall ceramic floor tile and Wall tile, and trim shapes.
2. Locker room ceramic wall tile wainscot.
3. Restroom ceramic wall tile.
4. Setting materials, grouts and sealants.

B. Related Work:

1. Section 07 90 00 – Joint Sealers
2. Section 09 25 00 – Gypsum Board
3. Section 09 30 50 – Tile Setting Materials and Accessories

1.03 SUBMITTALS

- A. Procedure: In accordance with Section 01 30 00.
- B. Samples: 24 in. square samples of each type and color of tile glued to hardboard backing; grout joints. Samples of each type, color and shape of trim and base.
- C. Data: Manufacturer's data for, pre-mixed mortars and grouts, with certification that they meet ANSI standards specified when applicable.
- D. Closeout: One full box of each type, color and size of tile properly packaged and identified, by room or area, for future repair.

1.04 QUALITY ASSURANCE

A. Uniformity:

1. Obtain each color, grade, finish, type, composition, and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
2. Obtain materials of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.

- B. Installer's Qualifications: Experienced firm who has successfully completed tile installations similar in material, design, and extent to that indicated for Project for at least 5 years.
- C. Sample Panels: Before starting tile installation erect sample panels for each form of construction and finish required. Build sample panels complying with the following, using materials indicated for final work.
 - 1. Make sample panels a minimum of 6 ft. square. Locate on site where directed by the Architect.
 - 2. Make modifications requested by the Architect, or remove unsatisfactory sample panels and construct new ones.
 - 3. Obtain Architect's acceptance of sample panels before starting final installation.
 - 4. Retain and maintain sample panels during construction in undisturbed condition as a standard for judging completed tile work.
 - 5. When accepted by the Architect, accepted sample panels in undisturbed condition at time of Substantial Completion may become part of the Work.
- D. Master Grade Certificate: Submit a Master Grade Certificate bearing the Certification Mark of the Tile Council of America, Inc., signed by the tile manufacturer, stating the type and quality of each type of tile delivered to the job site.
- E. Reference Standards: The applicable provisions of the following govern the work of this Section, except as otherwise specified.
 - 1. TCA, Handbook for Ceramic Tile Installation.
 - 2. ANSI A 108.1, Glazed Wall Tile, Ceramic Mosaic Tile, Quarry Tile and Paver Tile installed with Portland Cement Mortar.
 - 3. ANSI A108.4, Latex-Portland Cement Mortar.
 - 4. ANSI A108.5, Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
 - 5. ANSI A108.10, Installation of Grout In Tilework.
 - 6. ANSI A118.3, Chemical Resistant, Water-Cleanable, Tile-Setting and Grouting Epoxy and Water-Cleanable Tile-Setting Epoxy Adhesive.
 - 7. ANSI A118.6, Ceramic Tile Grouts.
 - 8. ANSI A118.8, Modified Epoxy Emulsion Mortar/Grout.
 - 9. ANSI A137.1, Standard Specifications for Ceramic Tile.

1.05 HANDLING

- A. Procedure: In accordance with Section 01 60 00. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.

- B. Delivery: Deliver tile cartons with grade seals unbroken.

1.06 JOB CONDITIONS

- A. Set and grout this work when ambient temperature is at least 50 deg. F or higher. Do not install materials on surfaces (or when ambient temperature) is less than 40 deg. F.
- B. Illuminate interior work areas during installation to provide the same or greater level of illumination, as required to properly perform this work, as will occur in the room or space after the building is in operation.
- C. For exterior tile work, shade the work areas from direct sunlight during installation, as needed to prevent rapid evaporation caused by excessive heat or wind.

2.00 PRODUCTS

2.01 MATERIALS

- A. Colors, Textures, and Patterns: Where manufacturer's standard products are scheduled or specified for tile, grout and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements.
 - 1. Where no color is scheduled or specified, provide selections made by Architect from manufacturer's full range of standard colors, textures, and patterns for products of type indicated.
- B. Factory Blending: For tile exhibiting color variations within the ranges selected during sample submittals, factory-blend tiles and package accordingly to those tiles taken from one package show the same color range as those taken from other packages, and match approved samples.
- C. Coefficient of Friction: Shall be not less than 0.6 for level surfaces when tested in compliance with ASTM C 1028 (field test) or ASTM D 2047 (laboratory test).
- D. Tile:
 - 1. Showers and Restrooms and Locker Room Areas Floor Tile:
 - a. Glazed Ceramic Floor Tile: 2" x 2" size. Color to be selected by Architect from Dal Tile KEYSTONES Group 1 Matte Finish.
 - 2. Showers, Restrooms and Locker Room Areas Wall Tile:
 - a. Glazed Ceramic Field Tile: 6" x 18" x 3/8" thick, with squared edges, semi-gloss glazed. Color to be selected by Architect from Dal Tile LINEAR colors in price group 1.
 - b. Glazed Ceramic Accent Tile: Three (3) colors. Color to be selected by Architect from Dal Tile CLASSIC colors in price group 3.

3. Restrooms - Single Occupant (Community Room and Detached Restroom Building Area) Floor Tile:
 - a. Glazed Ceramic Floor Tile: 2" x 2" size. Color to be selected by Architect from Dal Tile KEYSTONES Group 1 Matte Finish.
4. Restrooms – Single occupant (Community Room and Detached Restroom Building Area) Wall Tile:
 - a. Glazed Ceramic Wall Tile: 12" x 24" size. Color to be selected by Architect from Dal Tile KEYSTONES Group 1 Matte Finish.
5. Main Reception Area Restrooms & Shower Floor Tile:
 - a. Glazed Ceramic Floor Tile: 2" x 2" size. Color to be selected by Architect from Dal Tile KEYSTONES Group 1 Matte Finish.
6. Main Reception Area Restrooms & Shower Wall Tile:
 - a. Field Tile: 12" x 24" size. Color to be selected by Architect from Dal Tile KEYSTONES Matte Finish.
- E. Trim: Provide matching base, caps, stops, returns, trimmers required to complete the installation.
- F. Setting Materials:
 1. Latex Dry-Set Mortar: Pre-sanded, latex-modified complying with ANSI A1418.4, specifically formulated for the substrates to which tile is applied.
 2. Portland Cement: ASTM C 150, Type 1.
 3. Sand: ASTM C 144.
 4. Water: Potable, fresh.
 5. Setting Bed Reinforcing Mesh: 2 in. x 2 in. x 16/16, 3 in. x 3 in. x 13/13 or 1-1/2 in. x 2 in. x 16/13 wire complying with ASTM A 82 or A 185.
- G. Grout: Color(s) selected by the Architect.
 1. ANSI A 118.6, latex Portland cement grout, as applicable to the joint width and recommended by the grout manufacturer.
 - a. Unsanded Portland Cement Grout: Keracolor Wall mixed with Plastijoints by Mapei or Laticrete Dry-Set Grout mixed with Laticrete 1776 by Laticrete International.
 - b. Sanded Portland Cement Grout: Keracolor Floor mixed with Plastijoints by Mapei or Laticrete Floor Grout mixed with Laticrete 1776 by Laticrete International.
- H. Sealant and Back-Up for Control Joints in Tiles: As specified in Section 07 90 00.

- I. Cleavage Membrane: 10-mil thick polyethylene complying with ASTM D 2103, Type 13300, or 15 lbs. asphalt-saturated felt complying with ASTM D 226.

3.00 EXECUTION

3.01 INSPECTION / PREPARATION

- A. Verify conditions and measurements affecting the work of this Section at site.
- B. Remove glaze and contaminants, including remaining curing compounds, from floors by wire-brushing or sandblasting.
- C. Make sure that surfaces to be tiled are firm, dry, clean, and free from oil or waxy films and curing compounds, and within the following tolerances:
 - 1. Dry-Set Tiles: 1/8 in. in 10 ft. for floors and 1/8 in. in 8 ft. for walls.
 - 2. Mortar Set Tiles: 1/4 in. in 10 ft. for floors and 1/4 in. in 8 ft. for walls.
 - 3. Walls shall have been engineered and installed for a maximum deflection of L/360 under loads prescribed by Code.
- D. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical work, and similar items located in or behind tile has been completed before installing tile.
- E. Make sure that other detrimental conditions are corrected before proceeding with installation.

3.02 INSTALLATION

- A. General: Install proprietary materials in compliance with their manufacturer's printed instructions. Press or beat the tiles to obtain 100% coverage of mortar on back of tile; back butter tile if necessary.
 - 1. Maintain minimum temperature limits and installation practices recommended by mortar and grout materials manufacturers in areas where this work is performed.
 - 2. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignment. Saw-cut and drill tiles to obtain tight fitting, clean, sharp, undamaged cut edges.
 - a. Rub cuts smooth with fine abrasive stone.
 - b. Cut and drill so that electrical outlet, plumbing fixtures, pipes, fixtures and fittings standard plates, escutcheon and collars will overlap the tile.
 - 3. Install tile in patterns indicated with uniform joints and perimeter units not less than one-half unit wide.
 - 4. Where tiles selected by the Architect are installed in the same plane, but are of a different thickness, it is the Contractor responsibility to adjust the setting bed or mortar thickness so that all tiles are flush.
 - 5. Maximum deviation from true lines and levels shall not exceed 1/8 in. in 10 ft. for floors, and 1/8 in. in 8 ft. for walls.

6. Calk penetrations in tile with sealant and backing rod specified in Section 07 90 00. Provide expansion joints where indicated or as recommended by CTA Method EJ171.

B. Tile Blending:

1. For tile exhibiting color variations within the ranges selected during sample submittals, verify that tiles have been factory-blended and packaged accordingly so that tiles taken from one package show the same color range as those taken from other packages, and match approved samples.
2. If not factory-blended, either return to manufacturer or blend tiles at Project site before installing.

C. Interior Tile Installations:

1. Wall Tile: Install over cement backer board in compliance with ANSI A108.5 and TCA installation method W244.
2. Floor Tile: Install over mortar bed in compliance with ANSI A108.5 and TCA installation method F114.

3.03 GROUTING / CLEANING / CURING

- A. Grouting: Comply with ANSI A108.10. Finish joints of square edge tiles flush with tile surfaces; finish joints of cushion edge tiles to depth of cushion. Grout shall be free of voids and pits.
- B. Fill joints grouted with epoxy flush with tile edges. The epoxy cures to a slight depression.
- C. Cleaning:
 1. Clean tile and repair faulty grouting. Sponge and clean surfaces with clean water and soft brushes.
 2. Polish glazed tile after cleaning with clean, dry cloths.

3.04 PROTECTION

- A. Protect completed installations until acceptance by the District. Protect floor tiles with reinforced kraft paper or other heavy covering securely taped in place during the construction period to prevent damage and stains. Remove protection when no longer needed.
- B. When recommended by tile manufacturer, apply a coat of neutral protective cleaner to completed tilework.
- C. Prohibit food and wheel traffic from tiled floors for at least 7 days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

- E. Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective tiles. Replace tiles damaged before acceptance at no additional cost to the District.

END OF SECTION

SECTION 09 90 00 PAINTING

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

Provide painting work as specified and as shown, complete. The work includes cleaning and preparation of all surfaces to be painted or finished, and the painting and finishing of all surfaces unless hereinafter excluded.

- A. Paint all exposed surfaces except where material is obviously intended and specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas. If system, color or finish is not designated, the Architect will select these from colors available for the materials systems as specified. The standard for all color selections will be from standard colors of Dunn -Edwards's coatings.
- B. In existing buildings, unless specifically noted otherwise, paint only walls where existing surfaces have been worked on; such as, items removed, "demoed", modified in any way, added to, patched, etc. Paint entire surfaces from ceiling to base/floor and from one termination of wall surface to another. Terminating painting at door or openings in the walls will not be acceptable unless openings extend from floor to the ceiling or door head or transom panel about the ceiling.
- C. "Paint" as used herein, means all coating systems materials including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate, or finish coats.
- D. Work Not To Be Painted: In general, the following items will not require finishing unless specifically specified, scheduled or indicated.
 - 1. Do not include painting when factory-finishing or installer-finishing is specified for such items as, but not limited to, metal toilet enclosures; acoustic materials; modular laminate plastic casework; finished mechanical and electrical equipment including light fixtures, switch gear and distribution cabinets; elevator frames, doors and equipment.
 - 2. Anodized aluminum, stainless steel, chromium plate, brass, bronze and similar finished materials.
 - 3. Do not paint moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts.
 - 4. Do not paint over code-required labels, such as: Underwriters' Laboratories and Factory Mutual, or equipment identification, performance rating, name, or nomenclature plates.
 - 5. Concealed Surfaces: Painting is not required on wall or ceiling surfaces in concealed areas and inaccessible areas such as furred areas, pipe spaces, duct shafts and

elevator shafts, as applicable to this project. Paint all exposed piping, equipment, and other such items as required.

6. Finish hardware, except prime-coated items.
 7. Walking surfaces.
- E. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, miscellaneous metal, hollow metal work, and similar items. Also, for shop-fabricated or factory-built mechanical and electrical equipment or accessories.

1.03 SUBMITTALS

Comply with pertinent provisions of Section 01 30 00.

- A. Product Data: Submit manufacturer's technical information including manufacturers name, product number, paint label analysis and application instructions for each material proposed for use.
- B. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC's).
- C. Samples: Submit samples for Architect's review of color and texture only. Provide a listing of material and application for each coat of each finish samples.
 1. Provide three 8-1/2" X 11" painted samples of each color and material with texture to simulate actual conditions. Resubmit samples as requested by Architect until acceptable sheen, color, and texture is achieved.
 2. On actual wood surfaces, provide two 4" X 8" samples of natural and stained wood finish. Label and identify each as to location and application.
 3. Do not proceed with painting work until color samples have been accepted.

1.04 QUALITY ASSURANCE

- A. Codes and Standards: Conform work and materials to regulations of State Fire Marshal, Safety Color Coding in conformance with OSHA, and all local State Ordinances, having jurisdiction. Conform to the most stringent requirements and authorities having jurisdiction.
 1. Conform to the requirements of the California Air Resources Board (CARB) and all materials shall conform to APCD requirements.
- B. Quality Standards: Materials or products specified herein by trade name shall be provided as specified. References to brand names shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Brand names where used in specifications, shall be presumed to be followed by words "or products of equal or superior quality". Submittal approval will be granted only as set forth in the contract documents and with certification that materials submitted are equal or superior to brand named in specifications in construction, efficiency and utility. All painted surfaces shall be free from any bubbling or peeling for a minimum of three years or shall be re-painted where defective at no cost to owner.
 1. Submittals for approval as equal shall include manufacturer's product data sheet for each product indicating composition and percent by weight.

1.05 DELIVERY AND STORAGE

- A. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:
 - 1. Name of title of material.
 - 2. Fed. Spec. number, if applicable.
 - 3. Manufacturer's stock number and date of manufacturer.
 - 4. Manufacturer's name.
 - 5. Contents by volume, for major pigment and vehicle constituents.
 - 6. Thinning instructions.
 - 7. Application instructions.
 - 8. Color name and number.
- B. Storage: Store paint materials in a single suitable place in compliance with health and fire regulations. Material shall be stacked no more than 3 high in 5 gallon cans, and put in a designated area. Keep such storage place neat and clean. All damage to storage area or to its surroundings shall be cleaned, repaired and refinished and otherwise made good to satisfaction of District. Remove oily rags, waste and the like from building each night and take every precaution to avoid danger of fire.

1.06 JOB CONDITIONS

- A. Apply water-base paints and solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are within the range permitted by paint manufacturer's printed instructions.
- B. Do not apply paint in rain, fog or mist; or when relative humidity exceeds 85%; or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.
- C. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.
- D. Painting Work by Other Trades: Examine drawings and specifications, including requirements specified in other sections for painting work by other trades. Notify Architect in writing of any conflict between work of this section and that of other trades and sections, and any errors, omissions or impractical requirements. All surfaces that are left unfinished by the requirements of their specification shall be painted or finished as specified as work of this section.

2.00 PRODUCTS

2.01 MATERIAL QUALITY

- A. Provide best quality grade of various types of coating as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as standard, best-grade product will not be acceptable.

- B. Unless otherwise specified or approved, use paint products of one manufacturer. Oils, thinners, dryers, primers and catalysts shall be approved for use by manufacturer of paint.
- C. Provide paints of durable and washable quality. Do not use paint materials which will not withstand normal washing as required to remove pencil marks, ink, etc., without showing discoloration, loss of gloss, staining, or other damage.

2.02 MANUFACTURERS

- A. Manufacturers' catalog names and numbers are used to aid in establishing kind and quality of material required and are not used as an indication of color desired.
- B. Opaque Paint Finish Materials: Systems specified herein, are products of the Dunn Edwards Corporation. Equivalent opaque finish products by the following will be acceptable, as approved per equivalency chart prepared by Dunn Edwards Corporation. All other manufacturers must submit paint specifications and must be approved by the Architect a minimum of 21 days prior to the bid due date.

Pratt & Lambert
Benjamin Moore

2.03 COLORS AND FINISHES

- A. Surface treatments and finishes are shown on drawings and indicated in "schedules" on drawings. Paint colors shall match existing wherever adjoining existing painted surfaces and as approved by the Architect.
- B. In locations where new paint is required, the Architect will furnish sample color chips for surfaces to be painted. Match colors of sample chips and submit samples, as specified herein, before proceeding with work. Colors shall normally be from the standard color chart of Evr-gard coatings. Paint shall be custom mixed as necessary, paint which does not match these standard colors exactly will not be accepted.
- C. Paint Coordination: Provide finish coats which are compatible with the prime paints used or with existing paint. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of the total coating system for the various substrates. Upon requests from other subcontractors, furnish information on characteristics of specified finish materials, to ensure that compatible prime coats are used. Provide barrier coats over incompatible primers or existing paints or remove and reprime as required. Notify Architect in writing of anticipated problems using specified coating systems with substrates primed by others.

3.00 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected.
- B. Starting of painting will be construed as acceptance of surfaces and conditions within a particular area.

3.02 SURFACE PREPARATION

- A. Perform preparation and cleaning procedures following paint manufacturer's instructions and as specified, for each particular substrate condition.
- B. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so contaminants from cleaning process will not fall onto wet, newly painted surface.
- C. Remove hardware, hardware accessories, switch and receptacle plates, surface-mounted lighting fixtures, finish frames of recessed lighting fixture, escutcheons and plats, surface-mounted equipment, free-standing equipment blocking access to painted surfaces, grilles and louvers at ducts opening into finished specs, and other items as required prior to surface preparation and painting operations. Following completion of painting of each space or area, re-install removed items.
- D. Wood: All surfaces shall be clean and dry. Sandpaper wood, (except saw-textured wood, if any), smooth to provide an even surface and then dust off and wipe clean. Touch up all knots and pitch pockets with shellac on interior wood and with outside sealer on exterior work. After priming coat has been applied, thoroughly fill all nail holes, irregularities and cracks; use plastic wood filler for stained or natural finish and putty for painted work.
- E. Plaster Surfaces: Fill all holes, cracks and abrasions with plaster patching compound, properly prepared, applied and smoothed off to match adjoining surfaces. Plaster surfaces that are to receive enamel finishes shall be allowed to cure for a least three weeks. Do not apply enamel systems to plaster when moisture content exceeds 8 % to 10% as determined by the moisture register meter manufactured by The Moisture Register Co., Alhambra, California.
- F. Uncoated Steel and Iron: Acid wash all surfaces with to remove any dirt or grease before applying paint. Where rust ore scale is present, it shall be wire brushed and sandpapered clean. Clean field welds and braided portions of field welded and erected ferrous metal components.
- G. Shop Coated Metal Work: Thoroughly clean off all oil, grease, dirt and foreign matter. Spot prime field connections, welds, soldered joints, and burned and braided portions. Factory finished surfaces indicated to be repainted shall be sanded or etched to increase adherence of finish coats.
- H. Concrete and Masonry: Properly prepare surfaces where efflorescence exists with approved acid base wash. Fill minor surface defects and cracks with a mixture of acrylic paint and spackling compound.
- I. Existing Building Surface Preparation:
 - 1. Metal Surfaces: If existing finish is sound and shows only normal chalking, sand lightly and dust. Wherever existing finish is badly checked, cracked, alligatored, peeling or in general poor condition, completely remove existing finish by liquid remover, water blasting, grinding, sanding or light sandblasting to a sound substrate.
 - 2. Concrete: Sound but chalky; use approved surface conditioner. Light chalky; scrub with stiff fiber brush. Heavy chalked, blistered, alligatored, cracked, loose, or scaling; high pressure water blast or sandblast clean. Fill all minor cracks. Loose or defective concrete shall be replaced with L.M. Scofield Co., "Speed Crete," or approved equal.

3. Plaster: Clean by power washing with mild alkali and rinse thoroughly. Remove all loose, blistered or otherwise defective paint, smooth and feather edges by sanding. Plaster on which existing paint is loose, peeling, shows poor adhesion, checking, or is otherwise unsuitable for painting is to be stripped to bare plaster. Cut out and fill all plaster cracks with elastomeric plaster patching compound. Spot prime all plaster patches.
4. Wood: Remove all loose, peeling, or scaly paint, dirt, and other surface contaminants from wood. Feather all edges, and spot prime with multi-purpose exterior wood primer as necessary.
5. Concrete Block: All surfaces must be power washed removing all dirt, loose paint and foreign matter leaving only tightly adhering coatings with tapered edges. Patch all cracks or damaged areas and prime. Prime all bare block.
6. Drywall: Clean surface to remove all dirt, loose paint and foreign matter leaving only tightly adhering coatings with tapered edges. Patch all cracks or damaged areas.

3.03 MATERIAL PREPARATION

- A. Mix and prepare painting materials following manufacturer's directions.
- B. Store materials not in actual use in tightly covered containers.
- C. Stir materials before application to produce a mixture of uniform density, stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
- D. Use only thinners approved by paint manufacturer, and only within recommended limits.

3.04 APPLICATION

- A. Apply paint following manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, and conditions otherwise detrimental to formation of a durable paint file.
- C. Apply paint to clean, dry, prepared surfaces only. Apply all paint material evenly, smoothly flowed on without runs or sags.
- D. Provide finish coats compatible with primers used.
- E. Minimum Coating Thickness: Apply each material at not less than manufacturer's recommended spreading rate, to provide a total dry film thickness of not less than 5.0 mils for the entire coating system of prime and finish coats for 3-coat work. Provide a total dry film thickness of not less than 3.5 mils for the entire coating system of prime and finish coat for 2-coat work.
- F. The number of coats and film thickness required is the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface following manufacturer's directions.
- G. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to

ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.

- H. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.
- I. Included Work: Finish tops, bottoms, and edges of doors, same as balance of door, after door has been fitted by Carpenter. Where doors open into rooms or spaces having different finishes, communicating doors shall have edges finished as directed. Where walls are specified to be painted, include all columns, arises, reveals, soffits, returns, and the like.
- J. Priming: Where shop coats and touch-up painting are specified under other sections of the work, omit prime coat. Prime all ungalvanized ferrous metals. Prime all doors requiring paint, as soon as possible after delivery to job. Prime all edges created by louver and glazing cut-outs.
- K. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.05 SPECIAL INSPECTION

- A. In addition to any inspection and corrections made by District representatives, for all applications over 5000 square feet, a representative of the paint manufacturer shall inspect all surfaces after they have been prepared for painting and again after surfaces have been primed. They shall certify in writing that the substrate is suitably prepared and primed for the paint being applied. A representative shall also inspect the final application and shall again certify in writing that it has been applied in accordance with the manufacturer's recommendations. Painting contractor shall perform all additional work required to obtain certification of the manufacturer including additional preparation work and/or re-painting of defective workmanship.

3.06 CLEANING AND PROTECTION

- A. Cleanup: At the end of each workday, remove empty can, rags, rubbish, and other discarded paint materials from the site.
- B. Protection: Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing and repainting as acceptable to Architect.
- C. Provide "Wet Paint" signs and barricades to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.
- D. At completion of work of other trades, touch-up and restore damaged and defaced painted surfaces.
- E. Provide owner with a minimum of 10 gallons of each exact color and type of paint in unopened containers. Owner will not allow opened containers to be left on site, dispose of all opened paint containers off site legally.

3.07 PAINT SYSTEM SCHEDULE

- A. Provide following paint systems for substrates indicated.

B. Exterior Surfaces:

1. FERROUS METAL, Structural Steel, (Shop Prime Only)

1ST COAT: CARBOLINE Carbozinc Zinc Epoxy Primer (859)

2. FERROUS METAL, Structural Steel, (Field Application over factory primer)
Concealed Areas

SPOT PRIME: CARBOLINE Carbozinc Zinc Epoxy Primer (859 VOC)
(Weld and bolted areas)

1ST COAT: CARBOLINE Carboguard Epoxy Primer (890 VOC)

3. FERROUS METAL, Structural Steel, (Field Application over factory primer)
All exposed to view areas

SPOT PRIME: CARBOLINE Carbozinc Zinc Epoxy Primer (859 VOC)
(Weld and bolted areas)

1ST COAT: CARBOLINE Carboguard Epoxy Primer (890 VOC)

2ND COAT: CARBOLINE Carbothane Acrylic Polyurethane Semi Gloss 133MC

3RD COAT: CARBOLINE Carbothane Acrylic Polyurethane Semi Gloss 133MC

4. FERROUS METAL, Metal Stairs, (Field Application over factory primer)

SPOT PRIME: CARBOLINE Carbozinc Zinc Epoxy Primer (859 VOC)
(Weld and bolted areas)

1ST COAT: CARBOLINE Carboguard Epoxy Primer (890 VOC)

2ND COAT: EVERSIELD, Exterior Semi-Gloss Paint (EVSH50)

3RD COAT: EVERSIELD, Exterior Semi-Gloss Paint (EVSH50)

5. FERROUS METAL, Metal Louvers,

1ST COAT: GALV-ALUM Epoxy Metal Primer (GAPR00)

2ND COAT: EVERSIELD, Exterior Semi Gloss Paint (EVSH50)

3RD COAT: EVERSIELD, Exterior Semi Gloss Paint (EVSH50)

6. FERROUS METAL, Hollow Metal Doors and Frames,

1ST COAT: GALV-ALUM Epoxy Metal Primer (GAPR00)

2ND COAT: EVERSIELD, Exterior Semi-Gloss Paint (EVSH50)

3RD COAT: EVERSIELD, Exterior Semi-Gloss Paint (EVSH50)

7. GALVANIZED METAL, Sheet Metal Flashing,

PRETREATMENT: SUPREME CHIEMICAL Metal Etch and Cleaner SC ME-01

1ST COAT: GALV-ALUM Epoxy Metal Primer (GAPR00)

2ND COAT: EVERSIELD, Exterior Semi-Gloss Paint (EVSH50)

3rd COAT: EVERSIELD, Exterior Semi-Gloss Paint (EVSH50)

8. STUCCO,

1ST COAT: EFF-STOP, Masonry Primer (ESPR00)

2RD COAT: EVERSIELD, Exterior Semi-Gloss Paint (EVSH50)

3RD COAT: EVERSIELD, Exterior Semi-Gloss Paint (EVSH50)

C. INTERIOR SYSTEMS:

1 CMU, Eggshell,

- 1ST COAT: EFF-STOP Masonry Sealer (ESPR00)
- 2nd COAT: Suprema Interior Eggshell Paint (SPMA30)
- 3rd COAT: Suprema Interior Eggshell Paint (SPMA30)

2. GALVANIZED METAL, Ceiling Deck, Electrical Conduit, Etc.

- 1ST COAT: AQUAFALL Latex Dryfall Eggshell
- 2ND COAT: AQUAFALL Latex Dryfall Eggshell

3. DRYWALL: Shower Stall Ceilings,

- 1ST COAT: RUSTOLEUM Sierra Grip Tec Primer S-30
- 2ND COAT: RUSTOLEUM Sierra W/B Epoxy Gloss S-60
- 3rd COAT: RUSTOLEUM Sierra W/B Epoxy Gloss S-60

4. DRYWALL: Eggshell

- 1ST COAT: VINYLASTIC Interior Wall Sealer (VNPR00)
- 2ND COAT: SUPREMA Interior Eggshell Paint (SPMA30)
- 3RD COAT: SUPREMA Interior Eggshell Paint (SPMA30)

5. WOOD: Semi Transparent Stain

- 1st COAT: ZENITH W/B Semi Transparent Stain
- 2nd COAT: DEFT W/B Polyurethane Satin
- 3rd COAT: DEFT W/B Polyurethane Satin
- 4th COAT: DEFT W/B Polyurethane Satin

END OF SECTION

SECTION 09 96 23
ANTI-GRAFFITI COATING - CLEAR

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Anti-graffiti coating as indicated on the drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. 09 90 00 - Painting
- B. Masonry Waterproofing.

1.3 SUBMITTALS

- A. Samples and materials list in conformance with Section 01 34 00.

1.4 QUALITY ASSURANCE

- A. The Contractor shall be a trained and certified applicator, and shall be approved in writing by the manufacturer.

PART 2 - MATERIALS

2.1 COATING

- A. Two part, non-sacrificial, clear coating system, consisting of a barrier/sealer and flat top coat.
- B. Remover shall be supplied to the District, in sealed containers, sufficient to clean 200 square feet of surface.
- C. Manufacturer: American Polymer, Inc. "GSS Barrier, GSS-10 Topcoat and GSS Erosol Remover."

PART 3 - EXECUTION

3.1 PREPARATION

- A. The Contractor, in company with the Architect, shall examine the surfaces required to receive work of this Section.
- B. The Contractor shall determine the porosity of the material surfaces to which his materials are to be supplied.
- C. Coating shall be formulated to provide a uniformly clear ant-graffiti coating on each surface as indicated.
- D. The Contractor shall test all surfaces for moisture content. Coating shall not be applied until optimum moisture content is obtained.
- E. Surfaces shall be clean and shall conform to the manufacturer's written instructions for preparation.

F. Adjacent surfaces shall carefully masked and protected.

3.2 APPLICATION

- A. Coating shall be applied in strict conformance with the manufacturer's written instructions.
- B. Equipment used shall be clean, capable of providing precise control and shall provide uniform coverage, gloss and finish.

3.3 APPROVAL

- A. The Contractor shall demonstrate the anti-graffiti performance of the coating, using spray paint in an inconspicuous location.

END OF SECTION

IDENTIFYING DEVICES
SECTION 10 14 00

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Plastic signs.
 - a. ISA sign
 - b. Room Number and Name Sign
 - c. Occupancy Sign
 - d. Exit Sign
 - e. Accessible Restroom Signage
- B. Related Work:
 - 1. Lighted Exit Signs: Division 26.

1.03 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies and Codes:
 - 1. State Fire Marshal, Title 19.
 - 2. California Building Code (CBC) and Standards.
 - 3. Federal Americans with Disabilities Act (ADA) and to State "Accessibility" Regulations.
- B. Text, Numbering and Message: The District will provide exact numbering and wording for signs.

1.04 SUBMITTALS

- A. Procedure: In accordance with Division 01.
- B. Samples:
 - 1. Two (2) for Each Type, Including the following:
 - a. Manufacturer's standard color range.
 - b. One (1) of each typical sign specified.

- C. Product Data: Manufacturer's standard brochures describing all items and materials; specific items for this work shall be indicated / highlighted.

- D. Shop Drawings: Signs, 4 copies, all work, including fastening devices and backing plates.

PART 2 - PRODUCTS

2.01 MANUFACTURERS/MATERIALS

- A. All other Plastic and Metal Signs:
- B. Acceptable Manufacturers / Products: Mohawk Sign Systems (518) 370-3433) Series No. 200-A, or equal.
- C. Description of System: Text, letters, symbols and Braille must be integral.
- D. List of Signs: Note that all signs specified below may not be required for the Project. Refer to the Drawings and provide all required signage for the Project.
- E. Unframed Plastic Signs:
 - 1. Plastic – ES Plastic: Two-color sandwich with face color contrasting with core color suitable for interior and exterior use.
 - 2. Text / Letters / Symbols / Braille:
 - a. Raised in accordance with ADA and CBC requirements.
 - b. Color contrasting with their background color. 70% minimum contrast and have a non-glare finish.
 - c. Created by sandblasting away the face color to expose the surrounding background (core) color.
 - d. Contracted Grade 2 Braille shall be used whenever Braille symbols are specifically required. Dots shall be spaced 1/10 inch (2.54 mm) on center within each cell with 2/10 inch (5.08 mm) space between cells. Domed Dot shall be raised 1/40 inch (0.635 mm) above background. Refer to CBC Sections 11B-703.3 and 11B703.4. All signage shall conform to CBC Sections 11B-703
 - e. Gluing components of signs together is not acceptable.
 - 3. Type Style: "Helvetica Medium" all upper case, 3/4 in. high (72-point). Characters on signs shall be raised 1/32" (0.794 mm) minimum and shall be sans serif uppercase characters accompanied by Grade 2 Braille.
 - 4. Arrangement: Standard spacing between letters, words, numbers and lines; centered typically; 1/2 in. minimum margins.
 - 5. Edges and Corners: Finish edges smooth; 1/2 in. rounded corners. Provide screw mounting hole at each corner.
 - 6. Colors: As selected by the Architect. Contrast between character, symbols and their background must be 70% minimum and have a non-glare finish, per 11B-

703.5.1.

7. Sign Face Colors, and Core Colors: One face/core color combination for each site will be selected by Architect from manufacturer's standard color ranges (12 colors minimum).
8. Code Required Colors: Where colors are mandated by Codes or regulations, conform to those requirements. Accessibility signage shall be blue color equal to #15090 per Federal Standard 595B. All other colors will be selected by Architect.
9. Color Type: Integral to sign material; painting is not acceptable.
10. Mounting: Non-corrosive vandal-resistant screws and double-face, pressure-sensitive foam tape, full length and width of sign.
11. Letters and numbers on signs: Proportion for raised characters on signs shall be selected from fonts where the width of the uppercase letter "O" is 60% minimum and 100% maximum height of the uppercase letter "I". Stroke thickness of the uppercase letter "I" shall be 15% maximum of the height of the character.

F. Room Number Signs:

1. Size: 8 in. high by 9 in. long, with 3 numbers.
2. Wording: Varies from sign to sign, but signs will average 12 letters.
3. Arrange words in a single line of text where possible within the limitations imposed for number of characters for each line. Use additional lines where necessary to accommodate longer tests. Do not hyphenate words.

G. Typical Sizes: Signs shall be modular. Use combinations of the following height and width dimensions as necessary to suit the wording for each particular type.

1. Heights:

- a. For 1 line of text: 6 in.
- b. For 2 lines of text: 6 in.
- c. For 3 lines of text: 6 in.

NOTE: With corresponding Braille.

2. Length - Characters for Each Line of Text:

- a. 10 characters or less: 9 in.
- b. 16 characters maximum: 13 in.

H. Building Entrance Signs:

1. Size: 6 in. by 6 in., typically.

2. International accessible/Wheelchair symbol (ISA sign).
 3. Refer to the Drawings.
- I. Exit / Exit Route signs
1. 6 in. x 6 in., typical
 2. Refer to drawings
- J. Plastic Accessible Symbol Signs:
1. Figure / Symbol Style: Recognized standard "International Symbols of Accessibility" such as those developed by the American Institute of Graphics for the US Dept. of Transportation.
 2. Types:
 - a. Toilet Room Door Signs: Appropriate Man/Boy or Woman/Girl silhouette figures, superimposed over geometric symbols.
 - 1) Color: White figure on blue geometric symbol.
 - 2) Geometric Symbols:
 - a) For Men: Equilateral triangle, 12 in/ on a side by 1/4 in. thick.
 - b) For Women: 12 in. diameter circle by 1/4 in. thick.
- K. Occupancy Capacity Signage:
1. Sign Size: Typically 6 in. high by 10 in. long, except as indicated.
 2. See 1/8 in. scale "Floor Plan" sheets / Drawings for sign location.
 3. Wording for Typical Signs. "CAPACITY OF THIS ROOM LIMITED TO _____ PERSONS"
- Note: See "Building Code Analysis" plan sheets for the (Number) of persons to be inserted for each sign.

3.00 EXECUTION

3.01 PREPARATION

- A. Layout: Accurately lay out work to maintain proper lines, levels and spacing.

3.02 INSTALLATION - PLASTIC SIGNS

- A. General: Press tape firmly to mounting surface, and secure each sign with 4 vandal-resistant screws, one screw at each corner, equidistant from the edges.
- B. Mounting Location:
 - 1. General:
 - a. At heights and locations prescribed by Code.
 - b. As indicated on Drawings.
 - c. Multiple Signs: Where more than one sign occurs in one area, group signs vertically, one above the other with 1/4 in. space between signs; field verify with Architect before installation.
 - 2. Mount the Following Signs on Walls:
 - a. Typical Signs: Room name signs and room number signs at 60 in. above finished floor and as directed by Architect.
 - b. Building Entrance: Accessible (ISA) figure symbol building entrance sign(s) as indicated on Drawings.
 - c. Room Capacity Signs: Mount on wall in visible location as directed.
 - d. Exit Signs.

END OF SECTION

**SECTION 10 16 05
SOLID POLYMER TOILET COMPARTMENTS**

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 DESCRIPTION

- A. Solid polymer resin HDPE panels and aluminum hardware as indicated on the drawings and specified herein.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Toilet Room accessories.
- B. Supporting construction.

1.04 QUALITY CONTROL

- A. Panel Test Requirements:

<u>PROPERTY</u>	<u>VALUE</u>	<u>UNITS</u>	<u>ASTM TEST METHOD</u>
Density	0.96+	g/cc	D-1505
Tensile Yield	4400	psi	D 638
Elongation	600%	%	D 638
Izod Impact	7.0	ft-lb/in of notch	D 256
Tensile Impact Brittleness	120	ft-lb/in ²	D1822
Temperature -	76	°C	D 746
Hardness	68	Shore D	D2240
Flexural Modulus	220.000	psi	D 256
Smoke Density	75		D2843
Self Ignition	700		D1929-77
Rate of Burn	1.29	CM/MIN	D-635-81

1.05 DESIGN

- A. Floor mounted, overhead braced, except as noted.
- B. Height, dimension to meet manufacturers' standard.
- C. Where required, stall door openings shall conform to The California Building Code – (CBC). Except where noted otherwise on drawings, doors to be 3'-0" wide, have slide bolt door latch or "U" shaped wire pulls both sides of door mounted at 30" to 44" above finished floor and coat hooks at 48" above first floor.

- D. U shape handle both sides immediately beneath latch.
- E. Door hardware shall be mounted at 30" to 44" above finished floor.
- F. Doors shall have self-closing continuous hinges.
- G. Doors at front entrance stalls shall have 32" minimum clear width when door is opened 90 degrees.
- H. Doors at side entry stalls shall have 34" minimum clear width when door is opened 90 degrees.
- I. Provide coat hook at each stall at back of door.
- J. Provide continuous wall-mounting brackets for all partitions.

1.06 SUBMITTALS

- A. Submit the following, in conformance with Division 01.
 - 1. Laboratory results for flammability.
 - 2. Laboratory results for chemical resistance, including sugar solutions.
 - 3. Shop drawings, including precise locations of connections to supporting structure.
 - 4. Color samples for Architects' color selection.
 - 5. Warranty: Ten years.

2.00 MATERIALS

2.01 PANEL

- A. Single component solid polymer or high density polyethylene resin casting with integral color extending from surface to surface, including shoes.
- B. Manufacturer: Santana Products Inc. There shall be no substitutions.
- C. Machined edges - 1/4" minimum radius.

2.02 HARDWARE

- A. Partition assembly, bracing, leveling and operating hardware shall be manufacturers heavy duty vandal-proof design.
- B. Stainless steel - 304 only. Zmak chrome-plated steel. Aluminum - hard coat anodize-clear.
- C. Hardware warranty shall match panels.

3.00 EXECUTION

3.01 INSTALLATION

- A. Install work of this Section in conformance with reviewed shop drawings. Finish colors shall conform to selections by the Architect.
- B. Panels shall completely fill the space indicated. Panels shall be square, level, and plumb. Joints shall be uniform.
- C. Fasteners shall be installed normal to bearing surfaces, in precisely drilled holes.

3.02 APPROVAL

- A. Hardware shall be secured to solid blocking.
- B. Operating hardware shall control doors in all positions and shall be adjusted for smooth operation.
- C. Work of this section shall have complete finishes, free from blemish or discoloration.

END OF SECTION

SECTION 10 20 00
EXTERIOR WALL LOUVERS

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 DESCRIPTION

- A. Principal work in this Section:
 - 1. Exterior steel wall louvers with bird screens.
 - 2. Supplementary parts and components such as inserts, clips, fasteners, anchors, and other miscellaneous supports and accessories required for a complete installation.
- B. Related work:
 - 1. Finish painting louvers: Section 09 90 00.
 - 2. Interior louvers connected to ductwork – see mechanical drawings.

1.03 SUBMITTALS

- A. Submit copies of manufacturer's data supplemented by shop drawings showing fabrication and installation details not shown by the manufacturer's data sheets.
- B. Include details of sections and connections. Show anchorage and accessories.

1.04 QUALITY ASSURANCE

- A. Engineer, design, fabricate and install louver assemblies to resist, without failure and a maximum deflection of 1/240 of the span, a live load of 20 psf.

2.00 PRODUCTS

2.01 MANUFACTURE

- A. Description of louvers given hereafter and indicated on the Drawings, to establish a standard of quality, function and design, is for model No. FCB-666 by Airolite Co. Other acceptable manufacturers, whose products may be used only with the Architect's approval in each case, include Construction Specialties, Inc., Air Louvers, and Industrial Louvers Inc.
- B. An acceptable alternate to the above is Airolite Co. CB-666 aluminum with a factory applied "Kynar 500" finish. Color to be selected by Architect to match adjacent surface.

2.02 MATERIALS

- A. Galvanized sheet steel: ASTM A526 and A527, with ASTM A525, G90 zinc coating, mill phosphatized.

- B. Steel reinforcement (where required to meet design criteria): ASTM A36 galvanized to provide a zinc coating equivalent to the sheet steel specified above.
- C. Solder: ASTM B32, alloy grade 50A for ferrous metals. Provide proper flux to suit base metal.
- D. Fasteners, anchors and inserts: Use non-ferrous metal or hot dip galvanized steel.
- E. Metal treat: Vinyl wash primer complying with SSPC-PT 3.
- F. Primer: Manufacturer standard rust-inhibitive paint compatible with galvanizing.
- G. Bird screen: 1/2" mesh, 0.063" diameter galvanized wire, crimped screen material. See mechanical drawings and specifications.
- H. Insect Screen: 18 x 16 size aluminum mesh, set in aluminum frame. See mechanical drawings and specifications.
- I. Sealant and back-up: As specified in Section 07 90 00.

2.03 FABRICATION

- A. Louvers and frames:
 - 1. Fabricate from minimum 16 gauge galvanized sheet steel.
 - 2. Provide concealed vertical stiffener assemblies of plates, angles, tees or shapes as required for rigidity, welded or fastened to the inside face of each blade. Form ends of blades flat against jamb for fastening.
 - 3. Frame each louver with mitered or coped and continuously welded or riveted and soldered joints. Weld or rivet and solder blades to frames at each end, so that all joints will be watertight. Reinforce frames and blades as required for stiffness.
 - 4. Form blades and frames to the profiles, sizes and spacing shown. Overlap blades and "hook" both edges to prevent blow-through of water. Form frame to provide tolerances for installation, with sealants in joints between louvers and adjoining work.
- B. Screens:
 - 1. Provide removable (bird)(insect) screens where indicated. Secure screen in formed galvanized steel frame with a driven spline or insert for securing screen mesh.
 - 2. Locate screen on inside face of louver. Attach to louver frames with machine screws, spaced at each corner and at 12" o.c. between.
- C. Provide sill extensions and loose sills made of same material as louvers, where indicated or required for drainage to exterior and to prevent water penetration.
- D. Finishing: Clean, treat and paint louvers in the shop. Apply primer to a minimum dry film thickness of 2 mils on all surfaces of the fabricated units, whether exposed or concealed when installed.

3.00 EXECUTION

3.01 INSPECTION

- A. Inspect adjacent construction and supports. Make sure that openings are within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface, and that other conditions detrimental to the proper or timely completion of this work are corrected before proceeding with installation.

3.02 INSTALLATION

- A. Coordinate setting drawings, diagrams, templates, instructions and directions for the installation of anchors to be embedded in concrete or masonry. Coordinate the delivery of these items to the Project site.
- B. Locate and place louvers plumb, level and in proper alignment with adjacent work.
- C. Use concealed anchors wherever possible.
- D. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers, as shown.
- E. Install removable bird screens in louver frames.
- F. Repair primer damaged by cutting, welding, soldering and grinding operations required for fitting and jointing. Use same paint as for shop primer.

END OF SECTION

**SECTION 10 44 00
FIRE EXTINGUISHERS AND CABINETS**

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

- A. Section includes fire extinguishers; fire extinguisher cabinets; and brackets for wall mounting.
- B. Related Sections:
 - 1. Section 07 90 00 – Sealants and Caulking.
 - 2. Section 09 90 00 - Painting: Field applied paint finish.

1.03 REFERENCES

- A. ADA - Title III of the American with Disabilities Act, for the Handicapped.
- B. CAR - The California Accessibility Regulations, Part 2, Title 24 of the California Building Code, 1998 California Building Code with State Amendments.
- C. NFPA 10 - Standard for Portable Fire Extinguishers.
- D. UL - Fire Protection Equipment Directory.

1.04 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 01 34 00 – Shop Drawings and Samples.
- B. Shop Drawings: Indicate physical dimensions of cabinet and adjacent plate, rough-in details, measurements for mounting, attachment methods, and hardware. Show relationship to existing wall opening.
- C. Product Data: Provide extinguisher operational features,color, finish and anchorage.

1.05 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Contract Closeout: Closeout procedures.
- B. Operation and Maintenance Data: Submit test, refill or recharge schedules and re-certification requirements.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Handling: Environmental conditions affecting products on site.
- B. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

1.07 REGULATORY REQUIREMENTS

- A. Conform to the more restrictive provisions of Title III of the American with Disabilities Act or the California Accessibility Regulation, Part 2, Title 24 of the 1998 California Building Code with State Amendments.
- B. Conform to Title 19, CCR Chapter 3.
- C. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

2.00 PRODUCTS

2.01 FIRE EXTINGUISHERS

- A. Manufacturers:
 - 1. J. L Industries
 - 2. Kidde Fire Extinguisher CO.
 - 3. Larsen's Manufacturing Co.
 - 4. Substitutions: Under provisions of Section 01 63 00 Substitutions.
- B. Fire Extinguishers: Multipurpose dry chemical type, 5 lbs. Nominal capacity, UL-rated 2A:10-BC, in cast steel container in classrooms, offices, and multipurpose rooms. Model shall be cosmic by J.L. Industries or accepted substitution.
- C. Extinguisher Finish: Stainless steel tank.

2.02 FIRE EXTINGUISHER CABINETS

- A. Cabinet shall be Academy 2025 by J.L. Industries or accepted substitution.
- B. Metal: #180 aluminum, clear anodized.
- C. Configuration: recessed type, sized to accommodate accessories.
- D. Trim Type: Flat trim.
- E. Door: 18 gauge thick, reinforced for flatness and rigidity; lock with break glass access.
- F. Door Glazing: 1/4 inch thick plate.
- G. Must comply with CBC Sections 1117B.6 and 1118B.

3.00 EXECUTION

3.01 EXAMINATION

- A. Verification of existing conditions before starting work.
- B. Verify size and condition of opening in CMU walls.

3.02 INSTALLATION

- A. Fabricate and coordinate the assembly of cabinet and adjacent plate so that installation into wall opening is provided.
- B. Provide one (1) hour fire rated wall assembly at back side of existing wall opening.
- C. Install in accordance with manufacturer's instructions.
- D. Install brackets plumb and level on wall, height from finished floor as indicated on drawings conforming to California Building Code.
- E. Secure rigidly in place.
- F. Place extinguishers and accessories in cabinets.

END OF SECTION

SECTION 10 51 26
PLASTIC LOCKERS AND BENCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Solid plastic lockers and locker room benches.

1.2 RELATED SECTIONS

- A. Division 06 Section "Rough Carpentry"

1.3 REFERENCES

- A. ASTM International (ASTM):

- 1. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

- B. US Federal Government:

- 1. U.S. Architectural & Transportation Barriers Compliance Board. Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG).

- C. UL GREENGUARD Certification (GREENGUARD):

- 1. GREENGUARD certified low emitting products.

1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer's data sheets for each type of product indicated include fabrication details, description of materials and finishes.

- 1. Product Test Reports: When requested by Architect, provide documentation indicating compliance of products with requirements, from a qualified independent testing agency.

- B. Shop Drawings: Include overall locker dimensions, floor plan, elevations, sections, details, and attachments to other work. Include choice of options with details.

- C. Samples for Selection: Furnish samples of manufacturer's full range of colors for initial selection.

- D. Color Samples for Approval: Furnish a sample chip in the selected color.

1. Size: 2 by 3 inch (50 by 76 mm) in type of finish specified.

E. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content. Include breakout costs for each product with recycled content.

1.5 INFORMATIONAL SUBMITTALS

- A. Installation instructions.
- B. Warranty: Sample of special warranty.

1.6 MAINTENANCE SUBMITTALS

- A. Operation and Maintenance Data.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Approved manufacturer listed in this section, with minimum [5] years experience in the manufacture of plastic lockers. Manufacturers seeking approval must submit the following in accordance with Instructions to Bidders and Division 01 requirements:
 1. Product data, including test data from qualified independent testing agency indicating compliance with requirements.
 2. Samples of each component of product specified.
 3. List of successful installations of similar products available for evaluation by Architect.
 4. Submit substitution request not less than 15 days prior to bid date.
- B. Installers Qualifications: An experienced Installer regularly engaged in the installation of lockers for a minimum of 3 years.
- C. Source Limitations: Obtain plastic lockers and trim accessories from single manufacturer.
- D. Accessibility Requirements: Comply with requirements of ADA/ABA and with requirements of authorities having jurisdiction.
- E. Indoor Environmental Quality Certification: Provide certificate indicated that products have been certified under the following programs, or a comparable certification acceptable to Owner:
 1. GREENGUARD Indoor Air Quality Certified.
 2. GREENGUARD Certified for Children and Schools.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver plastic lockers to the site until the building is enclosed and HVAC systems are in operation. Deliver plastic lockers in manufacturer's original packaging. Store in an upright condition. Protect plastic lockers from exposure to direct sunlight.
- B. Ship plastic lockers fully assembled.
- C. Lift and handle plastic lockers from the base not the sides.

1.9 WARRANTY

- A. Special Manufacturer's Warranty: 20 year against rust, delamination or breakage of plastic parts under normal use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products of Bradley Corporation, Menomonee Falls, WI 53051, (800)272-3539, fax (262)251-5817; Email info@BradleyCorp.com; Website www.bradleycorp.com.

- 1. Provide basis of design products or comparable products of one of the following approved manufacturers:

- a. Submit requests for substitution in accordance with Instructions to Bidders and Division 01 General Requirements.

B. MATERIALS

- 1. High Density Polyethylene (HDPE): 30 percent pre-consumer recycled content polyethylene thermoplastic formed under high pressure into solid plastic components.
- 2. High Density Polyethylene (HDPE): 100 percent pre-consumer or post-consumer recycled content polyethylene thermoplastic formed under high pressure into solid plastic components.
- 3. Stainless-Steel Sheet: ASTM A 666, Type 304.
- 4. Fasteners: Tamper-Resistant Fasteners: Stainless steel torx-head screws.

- a. Locker Connectors: No. 10-24 sex bolts.

- b. Anchors: Type and size required for secure anchorage.
- c. Drilled-in-place Masonry Anchors: Minimum 1/4 by 1-3/4 inch (6 by 44 mm) screws.

2.2 STANDARD PLASTIC LOCKERS

- A. Basis-of-Design Product: **Bradley LENOXLOCKER.**
- B. Locker Configuration: Three tier
- C. Locker Dimensions
 - 1. Height, Nominal: 72 inch.
 - 2. Width: 12 inch
 - 3. Depth: 12 inch.
- D. Material: HDPE plastic, [30 percent] [100 percent] recycled material.
- E. Sides, Tops, Bottoms, Dividers, and Shelves: 3/8 inch (10 mm) thick HDPE plastic with smooth finish.
- F. Locker Shelves: 3/8 inch (10 mm) HDPE plastic, mortised into sides and back.
- G. Locker Tops: Slope top
- H. Doors: Fabricate from a single piece 1/2 inch (13 mm) HDPE plastic.
 - 1. Doors and Frame: 1/2 inch (13 mm) thick HDPE plastic with matte texture finish with ventilation slots
 - 2. Logo on Door: Indicate accessible lockers for those shown in plans.
 - 3. Handle: ADA/ABA Compliant handle fabricated from injection molded plastic.
 - 4. Locks: Standard hasp
 - 5. Hinges: Continuous piano hinges, .05 inch/18 gauge (1.27 mm) thick type 304 stainless steel fabricated to wrap around edges of door and frame and attached with stainless steel tamper-resistant screws.
 - a. Finish: Powder coated to match color of locker.
 - 6. Latch Bar: Full-height latch bar constructed of 1/2 inch (13 mm) Black HDPE plastic secured to locker with stainless steel tamper-resistant screws.
- I. Color: As selected by Architect from manufacturer's full range.
- J. Accessories:

1. Coat Hooks: Black polycarbonate double hook.
2. End Panels: 1/2 inch thick, with color and finish matching locker body.
3. Filler Panels: 1/2 inch (13 mm) HDPE filler panel, with color and finish matching locker body, attached with 3/8 inch (10 mm) thick HDPE solid plastic angle bracket.
4. Wall Hooks: Black powder coated, cast zinc hook one per locker.
5. Number Plate: White acrylic with black film coating, laser etched with number specified. Provide one per locker.
6. Locker Base: 1 inch (26 mm) solid HDPE plastic, with black or finish matching locker body, 4 inch high.
7. stainless steel tamper-resistant screws.

2.3 PEDESTAL BENCH

- A. Basis-of-Design Product: **Bradley LENOXPEDESTAL.**
- B. Pedestal Bench Dimensions
 1. Length: 60 inch.
 2. Width: 9.5 inch.
 3. Height: 18-1/2 inch.
- C. Materials:
 1. Bench Top: 1-1/2 inch (39 mm) thick HDPE plastic, 30 percent recycled material, with matte texture finish.
 2. Pedestal: Black anodized aluminum with welded aluminum flanges top and bottom.
- D. Color: As selected by Architect from manufacturer's full range.

2.4 LOCKER FABRICATION

- A. Fabricate locker box from a single sheet of HDPE solid plastic with corners fused together. Weld frames and shelves to box assembly. Provide all welded construction of locker parts without dovetail slots or metal fasteners. Add welded gussets in single tier full height lockers.
- B. Hardware Attachment: All hinges, handles, hasps, hooks, latch bars, and locks attached with tamper-resistant screws.
- C. Provide ventilated panels where indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lockers in climate-controlled environment, shielded from direct sunlight.
- B. General: Install on floor or other firm support. Install level, plumb, and true.
 - 1. Position locker base per approved shop drawing. Using fasteners provided by manufacturer, anchor base sections to the floor.
 - 2. Attach filler pieces to lockers with male-female sex bolts.
 - 3. Position first locker according to submittal layout. Square and plumb the locker using concealed shims. Secure the locker to the wall at the top and bottom of the locker. Position second locker next to first, square and plumb to align the tops and bottoms; and temporarily clamp lockers together. Drill four holes through the sides of the lockers and connect lockers using sex bolts provided by manufacturer.
- C. Accessories: Fit exposed connections of trim, fillers, and closures together to form tight, hairline joints, with concealed fasteners and splice plates furnished by locker manufacturer. Install as indicated on approved shop drawings.
- D. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, spaced as indicated. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

3.2 FINAL CLEANING

- A. Clean locker interior and exterior surfaces.
- B. Remove packaging and construction debris and legally dispose of off-site.

END OF SECTION

**SECTION 10 80 00
TOILET ACCESSORIES**

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 DESCRIPTION

- B. Toilet accessories as indicated on the drawings and as specified herein.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Concealed backing.

1.04 SUBMITTALS

- A. Material list, catalog cuts, finish samples in conformance with Section 01 34 00.

1.05 MANUFACTURERS

- A. Manufacturers' "Bradley Corp" model numbers indicate the description for design and material. Proposed equals shall demonstrate equality in every feature of design and material, exposed or concealed. The minimum standard for stainless steel shall be Type 304.

2.00 MATERIALS

2.01 PRODUCTS

- A. Soap Dispenser: ASI #0356 at lavatory units toilet rooms.
- B. Surface-Mounted Towel Dispenser: ASI #20210.
- C. Recessed Multi-Roll Toilet Tissue Dispenser: ASI #9031. As indicated on the drawings. Installed at accessible stall. Complying with CBC 115B.8.4. Dispenser shall be continuous flow type.
- D. ASI #0032 Dual access partition mounted double roll toilet paper dispenser.
- E. Toilet Seat Cover Dispenser (surface-mounted): ASI #20477-SMI as indicated on the drawings. One at each toilet stall.
- F. Grab Bars: ASI
 - 1. 1 1/4" x 36" – 3700 Series. One per accessible toilet or stall.
 - 2. 1 1/4" x 42" – 3700 Series. One per accessible toilet or stall.

- 3. The grab bar cannot project more than 3" into the 48" minimum clear space in front of the water closet. 1115B.7.1.3. Toilet paper and feminine napkin dispensers located on the grab bar side of an accessible toilet room or stall should not project more than the grab bar. The accessory shall not be located closer than 1 ½" clear of the tangent point of the grab bar. Accessories surfaces mounted above grab bar will restrict usability.
- G. Feminine napkin disposal unit ASI #20852 as shown on drawings shall not project more than 3" from the finished wall surface nor be located closer than 1-1/2" clear of the tangent point of the grab bar. (4 total, rooms 102, 105, 107, and 113C)
- H. Framed Mirrors: ASI #0620 Channel Frame Mirror (surface mounted); size as indicated on the drawings. At single occupancy coach toilet room only. (2 total)
- I. Lavatory Pipe Insulation: Wheelchair accessible toilet hot water and waste piping under lavatories shall be wrapped with Brocar Products, Inc., 'Trap Wrap', with all required accessory materials per manufacturer's recommendations. Alternate Manufacturer: Truebro, Inc.
- J. Surface-Mounted Toilet Paper Holder ASI #9030.
- K. Single Robe Hook ASI Model #7340. Mount on interior side of each toilet stall partition door. Mounted 48" max. above the finish floor.
- L. Heavy-Duty Recessed Soap Dish: ASI #0399.
- M. Extra Heavy-Duty Shower Curtain Rod ASI #1204, Curtain ASI #1200-V, and Curtain Hook ASI #1200-SHU.
- N. "L-Shaped" Phenolic Fold-Up Shower Stall Seat ASI #8206.

3.00 EXECUTION

3.01 COORDINATION

- A. Concealed backing, specified elsewhere, shall be located by the installer of work in this Section.

3.02 INSTALLATION

- A. Install all items where indicated, in conformance with accessibility requirements of the State of California. Fasteners shall be installed into solid blocking, square with adjacent edges and surfaces.
- B. All operating devices shall function smoothly.
- C. Access keys (two minimum) shall operate smoothly.
- D. Fasteners except as otherwise indicated, shall be vandal proof.
- E. Toilet accessories required to be accessible shall be mounted at heights according to CBC Section 1115B.8.

3.03 APPROVAL

- A. All units shall match catalog cuts in design and function.
- B. Surfaces shall be whole, uniform in finish and free from blemish.
- C. Containers shall be tightly jointed, free of distortion.

END OF SECTION

SECTION 11 52 10
ASSISTIVE LISTENING SYSTEM

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

- A. Work in this Section Includes:
 - 1. Radio Frequency Hearing Assistance System to comply with the provisions of CBC Section 11B-216.10, 11B-219.
 - 2. Permanently installed assistive listening system – one (1) system for Gymnasium and one (1) system for Theater.
- B. Related work in other Sections include:
 - 1. See Electrical Drawings

1.03 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Section 01 30 00.
- B. Submit outline drawing of system showing relative positions of all major components.
- C. Submit a certificate of completion of installation and service training from the system manufacturer.

1.04 GENERAL REQUIREMENTS

- A. The system shall be supplied by the manufacturer's authorized representative. Certification shall be submitted verifying that the contractor is the manufacturer's authorized representative. Included shall be certificates of attendance in manufacturer's installation/maintenance training by the contractors directly employed personnel. The communications contracting company shall have been in business for a minimum of 5 years, continuously furnishing the specified manufacturer's product lines and systems.
- B. The system assemblies shall be completely factory built and tested by manufacturers of established reputation, who have and can refer to similar systems which are currently installed and functioning properly.
- C. The system shall be guaranteed for a period of two years from the date of acceptance or first beneficial use, whichever is first, against defects in materials, workmanship, design and improper adjustment. Any defects in the system shall be corrected at no

expense to the Owner, provided the system does not show signs of abuse. During the guarantee period any work found not to be in conformance with the plans, specifications and addenda shall be brought into conformity with same at no additional cost to the District.

- D. The contractor shall instruct personnel designated by the District in the proper use, basic care and maintenance of the equipment. Such training shall be provided as an integral component of the system.

1.05 OPERATIONS AND MAINTENANCE MANUALS

- A. Provide 4 complete bound O & M manuals describing maintenance and operation of the system. Include descriptions and service data on all component parts. Manual shall also include the following:
 - 1. Warranty statement indicating effective dates.
 - 2. Complete engineering data on all systems furnished, including schematics of all equipment, shop drawings on all specially fabricated items, wiring diagrams of the system in its "as built" condition.
 - 3. Instructions on operational procedures, including master and substation operation, standard and special codes and alarm or maintenance indications and procedures.

2.00 PRODUCTS

2.01 EQUIPMENT (Two [2] complete systems required)

- A. Hearing Assistance System: Radio Frequency Hearing Assistance System shall be as manufactured by Genter Assistive Listening Systems, (219) 929-4127, or approved equal, and shall consist of the following components:
 - 1. Model No. TX-37A Transmitter. The Transmitter shall operate on 37 FCC-approved frequencies for RF assistive listening, and transmit to an area of at least 700 sq. ft. Transmitter shall have universal input to accept mic level, balanced and unbalanced line levels, and speaker level. Signal strength shall be adjustable to quarter power, half power, or full power.
 - 2. Model No. Digital-1 Receiver. Receiver shall be capable of digital tuning to lock on to desired frequency, and be field tunable to all FM assistive listening channels. Total number of receivers supplied for the project shall be as indicated on the drawings.
 - 3. Model No. BC-10B Battery Charger. Unit shall be capable of storing or trickle charging up to 10 receivers at one time (using NiCad or NiMH batteries). The charger must be capable of charging without removing the batteries from the receiver. The charger shall have LED status indicators showing charging status of each slot. A total of one (1) battery charger shall be provided for the project.

4. Single Rack Mount Kit. Manufacturer's standard rack mount kit to fit one transmitter into a standard 19-inch equipment rack, consisting of two metal components that fit on each side of the transmitter.

3.00 EXECUTION

3.01 INSTALLATION

- A. All installation work under this section shall be performed by persons having specific familiarity with telephone, data and sound system installation. Upon request the contractor shall submit resumes, references or other corroborating documentation, to the engineer to confirm the contractor's capabilities and experience.

3.02 TESTING AND TRAINING

- A. Upon completion of the installation the contractor shall test each room device for proper operation. Any malfunction shall be corrected prior to final acceptance.
- B. Operational guidelines shall be given in written form in sufficient numbers so that all key personnel have operational instructions of programming, station use and special features.

END OF SECTION

SECTION 13 11 00
SWIMMING POOL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

- A. The scope of the work included under this Section of the Specifications shall include swimming pool(s) as illustrated on the Drawings and specified herein. The General and Supplementary Conditions of the Specifications shall form a part and be included under this Section of the Specifications. The Swimming Pool Subcontractor shall provide all supervision, labor, material, equipment, machinery, plant and any and all other items necessary to complete the work. ALL OF THE WORK IN SECTIONS 13 1100 – 13 1108 IS TO BE THE RESPONSIBILITY OF ONE EXPERIENCED SWIMMING POOL SUBCONTRACTOR PRIMARILY ENGAGED IN THE CONSTRUCTION OF COMMERCIAL PUBLIC-USE SWIMMING POOLS. A SWIMMING POOL SUBCONTRACTOR SHALL BE CONSIDERED PRIMARILY ENGAGED AS REQUIRED HEREIN IF THE SUBCONTRACTOR DERIVED 50 PERCENT OF ITS ANNUAL REVENUE FROM PUBLIC-USE SWIMMING POOL CONSTRUCTION FOR EACH OF THE LAST FIVE YEARS. THE SUBCONTRACTOR MUST HAVE ALSO, IN THE LAST FIVE YEARS CONSTRUCTED AT LEAST 5 COMMERCIALLY DESIGNED MUNICIPAL AND PUBLIC-USE SWIMMING POOLS, EACH OF WHICH SHALL HAVE INCORPORATED A MINIMUM SIZE OF 6,000 SQUARE FEET OF WATER SURFACE AREA WITH A CONCRETE AND CERAMIC TILE PERIMETER OVERFLOW GUTTER AND SELF-MODULATING BALANCE TANK. The Swimming Pool Subcontractor shall furnish and install the swimming pool structures, finishes, cantilever forming, swimming pool mechanical and electrical systems, and all accessories necessary for a complete, functional swimming pool system, as herein described. Work shall include start-up, instruction of City's personnel, as-built drawings and warranties as required.

1.2 CODES, RULES, PERMITS, FEES

- A. The swimming pools shall be constructed in strict accordance with the applicable provisions set forth by authorities having jurisdiction over swimming pool construction and operation in the State of California.
- B. The Swimming Pool Subcontractor shall give all necessary notices, obtain all permits, and pay all government sales taxes, fees, and other costs in connection with their work; file all necessary plans, prepare all documents and obtain all necessary approvals of governmental departments having jurisdiction; obtain all required certificates of inspection for their work and deliver same to the City's Representative before request for acceptance and final payment for the work.
- C. The Swimming Pool Subcontractor shall include in the work any labor, materials, services, apparatus, or drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on Drawings and/or specified.
- D. The Contractor shall submit all required documents and materials to all Governmental Departments having jurisdiction for any deferred approval items or substituted materials or products to obtain final approval to installation.

1.3 DESCRIPTION OF WORK

- A. Furnish and perform supervision, coordination, all layout, formwork, excavation, hand trim, disposing off-site of all unused material or debris to complete the swimming pool excavation to the dimensions shown on the plans.
- B. Furnish and install complete swimming pool structures, including reinforcing steel and cast-in-place or pneumatically placed concrete walls and floors.
- C. Furnish and install swimming pool finishes, including ceramic tile and marble plaster or other waterproof finishes.
- D. Furnish and install complete swimming pool mechanical system(s), including, but not limited to, circulation systems, filtration systems, pool water heating systems, water chemistry control systems, domestic water fill line systems, booster pump and special effects systems, and all pumps, piping, valves, and connections between system(s) and swimming pool(s).
- E. Furnish and install complete swimming pool electrical system(s) from P.O.C. in Mechanical Room, including, but not limited to, underwater lighting systems, water level control systems, timing systems, scoreboards, special effects systems, control circuitry, motor starters, time clocks, bonding, and all conduits, conductors, contactors, and switches between the system(s) and swimming pool(s).
- F. Furnish and install all swimming pool cantilever forming, deck equipment and required anchors and inserts for the specified equipment as required by code, shown on the Drawings and specified herein.
- G. After the initial filling of the swimming pool system(s), should any repairs, continuing work, or other Subcontractor responsibility require drainage or partial drainage of the swimming pool systems, the Swimming Pool Subcontractor shall be responsible for any subsequent refilling and shall complete the project with the swimming pool system(s) full of water, water in chemical balance, complete in every way, and in full operation.

1.4 ASSIGNED RESPONSIBILITIES AND RELATED WORK

- A. It is the intent of this section of the Specifications to clarify Work responsibilities of the trades directly and indirectly involved in construction of the pool systems. All labor, equipment, materials and supplies furnished by the Swimming Pool Subcontractor and other Subcontractors per the contractual agreement with the General Contractor and Owner and shall be as directed by the City through their Designated Representative.
- B. THE SWIMMING POOL SUBCONTRACTOR SHALL NOT SUBCONTRACT ANY PORTION OF THE SWIMMING POOL CONSTRUCTION OR SWIMMING POOL EQUIPMENT INSTALLATION TO ANYONE OTHER THAN A SUBCONTRACTOR THAT SATISFIES THE REQUIREMENTS OF SECTION 13 11 00
- C. References to "swimming pool systems" shall include the swimming pools, equipment, and accessories.
- D. The City will provide one complete water filling of the swimming pool(s), but will not assume any responsibility for the swimming pool system(s) until they have been proved fully operational, complete in every way and accepted by the City's Representative.

1.5 RESPONSIBILITIES OF THE CONTRACTOR

- A. The Contractor shall grade the swimming pool site(s), establish benchmarks, cut and fill as necessary to provide as level an area as possible at swimming pool deck elevation before swimming pool layout.
- B. The Contractor shall be responsible for horizontal dimensions and grade elevations accurately from established lines and benchmarks (as indicated on the Drawings) and be responsible for those grades.
- C. The Contractor shall provide adequate temporary light, electric power, heat and ventilation per Federal and State OSHA requirements to construct the swimming pool system(s).
- D. The Contractor shall not permit any heavy equipment activity over any area or within 5 feet of any area under which swimming pool piping is buried. There shall be no exceptions to this requirement.
- E. The Contractor shall keep the swimming pool excavation(s) and swimming pool structure(s) free of construction residue and waste materials of their workmen or Subcontractors, removing said material from the swimming pools as required.
- F. The Contractor shall protect the swimming pool(s) from damage caused by their construction equipment and /or workmen and Subcontractors.
- G. The Contractor shall provide a representative at time of swimming pool start-up to coordinate all trades related to swimming pool system(s).

1.6 RESPONSIBILITIES OF THE MECHANICAL SUBCONTRACTOR

- A. The Mechanical Subcontractor shall be licensed in the State of California and provide written notifications to Swimming Pool Subcontractor and contractor when necessary to excavate and backfill within the swimming pool construction site.
- B. The Mechanical Subcontractor shall not utilize any swimming pool piping trench for installation of any sanitary sewer, storm sewer, domestic water, hot water, chilled water or natural gas line.
- C. The Mechanical Subcontractor shall furnish and install all sanitary sewer piping, including vent stacks (if necessary), for backwash pits, floor drains and floor sinks as required by code, shown on Drawings, and herein specified.
- D. The Mechanical Subcontractor shall furnish and install all storm sewer piping and site drainage systems as required by code, shown on the Drawings, and herein specified.
- E. The Mechanical Subcontractor shall provide a minimum 75 psi water supply for swimming pool construction work within 50 feet of the swimming pool construction site(s).
- F. The Mechanical Subcontractor shall furnish and install reduced pressure backflow protected domestic water lines to P.O.C. within swimming pool Mechanical Room as required by code, shown on the Drawings, and herein specified.
- G. The Mechanical Subcontractor shall furnish and install natural gas piping, pressure regulation and valving to P.O.C. within swimming pool Mechanical Room as required by code, shown on the drawings, and herein specified.

- H. The Mechanical Subcontractor shall furnish and install all ductwork, louvers, and all HVAC equipment within swimming pool Mechanical Room as required by code, shown on the Drawings, and herein specified.
- I. The Mechanical Subcontractor shall provide a representative at time of swimming pool start-up to coordinate work related to swimming pool system(s).

1.7 RESPONSIBILITIES OF THE ELECTRICAL SUBCONTRACTOR

- A. The Electrical Subcontractor shall be licensed in the State of California and shall furnish and install electrical service to swimming pool Mechanical Room sized to accommodate all necessary swimming pool equipment as shown on the Drawings and herein specified.
- B. The Electrical Subcontractor shall furnish any temporary power needed by the Swimming Pool Subcontractor within 50 feet of the swimming pool construction site(s).
- C. The Electrical Subcontractor shall furnish and install all conduits, conductors, starters/disconnects, panels, circuits, switches and equipment as required for lighting, ventilation and HVAC equipment within swimming pool Mechanical Room as required by code, shown on the Drawings, and herein specified.
- D. The Electrical Subcontractor shall furnish and install all conduits, conductors, panels, circuits, switches and equipment for area lighting as required by code, shown on the Drawings, and herein specified.
- E. All equipment, material and installation shall be as required under Division 16 of the Specifications and shall conform to NEC Article 680 (latest revision), State and Local Codes, and as may be required by all authorities having jurisdiction over swimming pool construction within the State of California.
- F. The Electrical Subcontractor shall provide a representative at time of swimming pool start-up to coordinate work related to swimming pool system(s).

1.8 INTENT

- A. It is the intention of these specifications and Drawings to call for finished work, tested and ready for operation. Wherever the work "provide" is used, it shall mean "furnish and install complete and ready for use."
- B. Minor details not usually shown or specified, but necessary for proper installation and operation, shall be included in the work, the same as if herein specified or shown.

1.9 SCHEDULE OF VALUES

- A. Provide a Schedule of Values for all work specified in each of the technical specifications listed in the table below, regardless of whether the work is performed by the swimming pool contractor or others. Values listed shall be fully burdened, with contractor general conditions, overhead, profit and bonds included. Payments for swimming pool work completed shall not be approved until Schedule of Values has been submitted to and approved by City Representative.

SWIMMING POOL SCHEDULE OF VALUES			
No.	Section #	Description	Value

1.	13 1101	Swimming Pool Excavation	
2.	13 1102	Swimming Pool Concrete	
3.	13 1103	Swimming Pool Shotcrete	
4.	13 1104	Swimming Pool Ceramic Tile	
5.	13 1105	Swimming Pool Plaster	
6.	13 1106	Swimming Pool Equipment	
7.	13 1107	Swimming Pool Mechanical	
8.	13 1108	Swimming Pool Electrical	
Total			

1.10 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by City Representative for Subcontractor's use in preparing submittals.
- B. Coordination: Coordinate preparation and processing submittals with performance construction activities.
 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. City Representative reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for schedules performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for re-submittals as follows. Time for review shall commence on City Representative's receipt of submittal.
 1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. City Representative will advise Contract when a submittal being processed must be delayed for coordination.
 2. Concurrent Review: Where concurrent review of submittals by City Representative's consultants, City, or other parties is required, allow 21 days for initial review of each submittal.
 3. Direct Transmittal to Consultant: Where the Contract Documents indicate that submittals may be transmitted directly to City Representative's consultants, provide duplicate copy of transmittal to City Representative. Submittal will be returned to City Representative before being returned to Subcontractor.
 4. If intermediate submittal is necessary, process it in same manner as initial submittal.
 5. Allow 15 days for processing each submittal.
 6. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.

E. Identification: Place a title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on title block.
2. Provide a space on title block to record Subcontractor's review and approval markings and action taken by City Representative.
 - a. Include the following information on title block for processing and recording action taken:
(See Attached Sample)
 - b. Project name.
 - c. Date.
 - d. Name and address of Subcontractor.
 - e. Name of Subcontractor.
 - f. Name of Supplier.
 - g. Name of Manufacturer.
 - h. Unique identifier, including revision number.
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Other necessary identification.

SUBMITTAL FOR:

SUBMITTAL TO:

SUBCONTRACTOR:

Item Number: _____

Section Number: _____

Section Description: _____

Subcontractor: _____

Supplier: _____

Manufacturer: _____

Product Code: _____

Quantity: _____

Subcontractor Certification:

Contractor's Submittal Stamp:

It is hereby certified that the equipment or material designated in this submittal is proposed to be incorporated in the above-named project and is in compliance with the contract drawings and / or specifications and is submitted for approval.

Certified by: _____

Date: _____

Job Superintendent: _____

Revisions: _____

Architect's Review Stamp and Comments

- F. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract documents on submittal.
- G. On all catalogue or cut sheets identify which model or type is being submitted.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Product data and shop drawings shall be packaged within a three-ring binder and colored samples shall be packaged on a heavy cardboard. Transmit each submittal using a transmittal form.
 - 1. On an attached separate sheet, prepared on Subcontractor's letterhead, record relevant information, request for data, revisions other than those requested by City Representative on previous submittals and deviations from requirements of the Contract documents, including minor variations and limitations. Include the same label information as the related submittal.
 - 2. Include Subcontractor's certification stating that information submitted complies with requires of the Contract Documents.
 - 3. Transmittal Form: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of Subcontractor, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Remarks.
- I. Distribution: Furnish copies of final submittals to manufacturers, Subcontractors, suppliers, fabricators, installers, authorities having jurisdiction and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Use only final submittals with mark indicating action taken by City Representative in connection with construction.

1.11 SUBSTITUTIONS

- A. To obtain approval to use unspecified products, bidders shall submit requests for substitution at least 10 days prior to bid date. Requests shall only be considered if they clearly describe the product for which approval is asked, including all data necessary to demonstrate acceptability. All unspecified products and equipment will be considered on an "or equal" basis at the discretion of the City's Representative. Requests for substitution received after the specified deadline will not be considered. Where a conflict exists between the requirements of the General Conditions / Special Conditions / Division 1 concerning substitutions and the requirements of this Article, this Article (Section 13 11 00, Article 1.10) shall govern.
- B. Where the Swimming Pool Subcontractor proposes to use an item of equipment other than that specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring, or any other part of the architectural, mechanical, or electrical layout, all such redesign and all new drawings (stamped by California Licensed Engineer) and detailing required shall be prepared by the Swimming Pool Subcontractor, at their own expense, submitted for review and approval by the City's Representative prior to bid.

- C. Where such approved deviation requires a different quantity and arrangement of piping, supports and anchors, wiring, conduit, and equipment from that specified or indicated on the Drawings, the Swimming Pool Subcontractor shall furnish and install any such piping, structural supports, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the City.

1.12 SURVEYS AND MEASUREMENTS

- A. The Swimming Pool Subcontractor shall base all measurements, both horizontal and vertical, from benchmarks established by the Contractor. All work shall agree with these established lines and levels. The mechanical Drawings do not give exact details as to elevations of piping, exact locations, etc. and do not show all offsets, control lines, pilot lines and other installation details. Verify all measurements at site and check the correctness of same as related to the work.

1.13 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of the systems and work included in the Subcontractor. Drawings are not to be scaled. The architectural drawings and details shall be examined for exact dimensions. Where they are not definitely shown, this information shall be obtained from the City's Representative.

1.14 SWIMMING POOL SUBSUBCONTRACTOR

- A. The swimming pool construction work as herein described and specified in Division 13 of the Project Manual shall be the complete responsibility of a qualified and specifically licensed (C-53 license classification within the State of California) Swimming Pool Subcontractor with extensive experience in commercial public use swimming pool installations.
- B. The Contractor shall require the Swimming Pool Subcontractor to furnish to the Contractor performance and payment bonds in the amount of 100% of the Swimming Pool Subcontractor's bid written by a surety Company properly registered in the State of California and listed by the U.S. Treasury. The expense of the bond(s) is to be borne by the Subcontractor. The Contractor shall clearly specify the amount and requirements of the bond(s) in the Contractor's written or published request for subbids. The Contractor's written or published request for subbids shall also specify that the bond(s) expense is to be borne by the Subcontractor.
 - 1. Subcontractor certifies that it meets the qualifications and experience requirements established in Swimming Pool General Requirements, Section 13 1100, as follows:
 - 2. Subcontractor has derived 50 percent of its annual revenue from public-use swimming pool construction for each of the last 5 years.
 - 3. Subcontractor has, in the last 5 years, constructed at least 5 commercially designed municipal and public-use swimming pools, each of which have incorporated a minimum size of 6,000 square feet of water surface area with a concrete and ceramic tile perimeter overflow gutter and self-modulating balance tank.
 - 4. The following list of projects meet the requirements of section (b) above and the contact as reference by the Contractor, the Awarding Authority of their agent or designee.

a. City: _____

Scope of Project: _____
Contact Person: _____
Phone Number: _____
City Representative for
Project: _____

b. City: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____
City Representative for
Project: _____

c. City: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____
City Representative for
Project: _____

d. City: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____
City Representative for
Project: _____

e. City: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____
City Representative for
Project: _____

C. Swimming Pool Deck Subcontractor other than the swimming pool Subcontractor certifies that it meets the qualifications and experience requirements established in Swimming Pool General Requirements, Section 13 1100, as follows:

1. Subcontract has, in the last 5 years, constructed at least 5 commercially designed cantilevered pool decks over perimeter gutters, each of which have incorporated a minimum size of 6,000 square feet of water surface area of the swimming pool.
2. The following list of projects meet the requirements of section (b) above and the contact as reference by the Contractor, the Awarding Authority of their agent or designee.

SWIMMING POOL DECK SUBCONTRACTOR

a. City: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____

	City Representative for Project:	_____

b.	City:	_____
	Scope of Project:	_____
	Contact Person:	_____
	Phone Number:	_____
	City Representative for Project:	_____

c.	City:	_____
	Scope of Project:	_____
	Contact Person:	_____
	Phone Number:	_____
	City Representative for Project:	_____

d.	City:	_____
	Scope of Project:	_____
	Contact Person:	_____
	Phone Number:	_____
	City Representative for Project:	_____

e.	City:	_____
	Scope of Project:	_____
	Contact Person:	_____
	Phone Number:	_____
	City Representative for Project:	_____

1.15 OPERATING INSTRUCTIONS

- A. The Swimming Pool Subcontractor shall determine from actual samples of pool water supplied by the City, the proper water management program necessary for maximum operating efficiency and comfort. The Swimming Pool Subcontractor shall provide the services of experienced personnel familiar with this type of pool system operation, in conformance with Section 13 11 05 of the Specifications.

1.16 MAINTENANCE MANUALS

- A. The Swimming Pool Subcontractor shall provide 6 bound sets for delivery to the City's Representative of instructions for operating and maintaining all systems and equipment included in this Contract. Manufacturer's advertising literature or catalog pictures will not be acceptable for operating and maintenance instructions.
- B. Bound in ring binders shall be all parts lists, periodic maintenance instructions and troubleshooting guidelines for all pool equipment, including but not limited to filters, pumps, controllers, water chemistry control equipment, etc.

1.17 SECURE FROM THE CITY

- A. A complete City-furnished filling of the swimming pools.
- B. The City's assistance, as specified herein, from the time of start-up until final written acceptance of the swimming pool system(s).
- C. Chemicals as required for swimming pool operation after Swimming Pool Subcontractor completes initial water chemistry balance and water treatment during the maintenance period described in Section 13 11 05 of the Specifications.

1.18 WARRANTY

- A. The Swimming Pool Subcontractor shall warrant all swimming pool structures, finishes and systems against defects in material and workmanship for a period of one year after the date of acceptance by the City. Any repair or replacement required due to defective material or workmanship will be promptly corrected by the Swimming Pool Subcontractor.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 13 11 01

SWIMMING POOL EXCAVATION

PART 1 GENERAL

1.01 DESCRIPTION

- A. Finish and fine grading to bring the surface of the ground to the required grades and elevations as indicated on the Drawings.
- B. Subgrade improvements and placing of compacted fills.
- C. Excavation and backfill for all swimming pool, pool deck, surge chamber and backwash retention tank structural requirements, including footings, foundations, slabs and walls.

1.02 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: Conform with requirements of the General Conditions, and more specifically the following:
 - 1. Comply with California Building Code, 2022 edition.
 - 2. Comply with applicable construction safety orders, latest edition, Federal and State OSHA.
 - 3. Comply with applicable trench safety provisions, latest edition, Federal and State OSHA.
- B. Qualifications of Workers:
 - 1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
 - 2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
 - 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- C. Project/Site Conditions:
 - 1. Be familiar with site and subsurface conditions.
 - 2. Excavation is unclassified and includes excavation to sub-grade elevations indicated or necessary, regardless of character of materials and obstructions encountered.
 - 3. Provisions for mitigation of wet soils due to seepage or rain shall be made during excavation and throughout construction. If wet soils are encountered within the swimming pool excavations, de-watering shall be provided and the Geotechnical Engineer shall make recommendations for moist soil mitigation.
 - 4. Where slope instability is encountered, all excavations within those areas shall be 1:1 or flatter. Forming of vertical walls may be necessary, and all soil conditions shall be field verified by the Geotechnical Engineer.
 - 5. Contractor shall review the Geotechnical Investigation Report as furnished by the Owner to determine the suitability of the soils.
 - 6. Refer to General Conditions, Articles 3.17 and 3.18.
- D. Adverse Weather Conditions:
 - 1. During the periods when site soil moisture content is substantially in excess of moisture content required for optimum compaction, do not perform fill compaction.
 - 2. When unfavorable weather conditions necessitate interrupting filling and grading operations,

prepare areas by compaction of surface and grading to avoid collection of water. Provide adequate temporary drainage to prevent erosion.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with requirements of Section 01 33 00. Requests for substitution shall conform to requirements of Article 1.10.A of Section 13 11 00.
- B. Required submittals include:
 - 1. Offsite fill material, if applicable.
- C. Submit proof of qualifications as specified in Article 1.02.B of this Section.

1.04 EXCAVATING & TRENCHING, GENERAL REQUIREMENTS

- A. Refer to Section 01 50 00, Temporary Facilities and Controls.
- B. All trenches, holes, etc. are to be completely protected using solid barricades, steel plates, and plywood both during construction and during off hours, including night time.
- C. Flashing warning light barricades are required on sidewalks, roads, and any other critical areas that require night time protection.
- D. Roads, paths and sidewalks shall not be blocked at any time or in any way. Trenching across roads, paths or sidewalks involves special instructions and review of the construction procedure by the Owner at least three (3) days prior to the Work actually being started.
- E. Construction equipment, including all trucks, cars, etc. shall not be parked or driven on roads, paths or sidewalks. Items not allowed on roads, paths or sidewalks include hoses, power cords, ropes, construction materials, dirt and debris, etc.
- F. All roads, paths and sidewalks must remain clear and the Contractor shall maintain temporary safe and effective pedestrian access at all times.
- G. Drawings show existing major underground utilities using the best information available. The Contractor shall also fully check public works reference drawings prior to excavation. Call local Dig Alert to locate utilities to ensure safety.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fill Material, General: All material shall be subject to the review of the Geotechnical Engineer to determine acceptability.
- B. Imported Fill Material: Materials of equal or better quality than on-site material could be reviewed by the Geotechnical Engineer on a case-by-case basis. No soil materials shall be imported onto the project site without prior approval by the Geotechnical Engineer. Any deviation from the specifications given below shall be approved by the Geotechnical Engineer prior to import operations.

MAXIMUM PERCENT PASSING #200 SIEVE	40
MAXIMUM PERCENT RETAINED 3" SIEVE	0
MAXIMUM PERCENT RETAINED 1½" SIEVE FOR BUILDING AREAS.	15
MAXIMUM PERCENT RETAINED ¾" SIEVE FOR LANDSCAPE AREAS	5
MAXIMUM LIQUID LIMIT	40

MAXIMUM PLASTICITY INDEX	14
MINIMUM R-VALUE FOR PAVEMENT AREAS.....	50
MAXIMUM EXPANSION INDEX	20

- C Furthermore, the soils proposed for import shall be generally homogenous and shall not contain cemented or clayey and/or silty lumps larger than one inch. When such lumps are present, they shall not represent more than ten percent (10%) of the material by dry weight.

Where a proposed import source contains obviously variable soils, such as clay and/or silt layers, the soils which do not meet the above requirements shall be segregated and not used for this project or the various layers shall be thoroughly mixed prior to acceptance testing by the Geotechnical Engineer. The contractor shall provide sufficient advance notice, prior to import operations, to allow testing and evaluation of the proposed import materials. Because of the time needed to perform the above tests, the contractor shall provide a means by which the Geotechnical Engineer or others can verify that the soil(s) which was sampled and tested is the same soil(s) which is being imported to the project.

- D. Engineered Fill: weeds, cobbles less than 2 inches and other deleterious debris are first removed. On-site, non-expansive soils with expansion index of less than 20 must be used.

Engineered fill materials shall be placed in thin layers (less than ten inches uncompacted thickness), brought to near the optimum moisture content or to a moisture content commensurate with effective compaction and soil stability, and compacted to a minimum of 90 percent of the maximum density obtainable by ASTM Test Method D1557.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify drawing dimensions and elevations with actual field conditions. Inspect related Work and adjacent surfaces and report discrepancies and conditions which prevent proper execution of the Work to the Owner's Representative.

3.02 SUBGRADE IMPROVEMENTS

- A. Clearing: Strip site area (as defined within the Drawings) of any topsoil containing vegetation, trees and roots, organic matter, and other debris, and dispose of as specified.
- B. Placement of Fills: Place fill, consisting of approved soils, clean and free of all vegetation, debris, and rocks larger than three (3) inches, in uniform six (6) inch lifts. Fill to be compacted at optimum moisture to ninety-five percent (95%) maximum density with approved mechanical compaction equipment.

3.03 EXCAVATION

- A. Checking Layout: Contractor shall, before commencing the excavation work, check all lines, stakes and levels for dimensions, angles, elevations and grades with the survey.
- B. Over-Excavation:
- Any overexcavation that may be required shall be per Geotechnical Engineering Report and subject to Geotechnical observation for any onsite conditions. Prior to placing fill, the subgrade exposed by the overexcavation should be scarified to a depth of at least eight (8) inches, moisture-conditioned to at least three percent (3%) above optimum moisture content, and compacted to at least ninety percent (90%) relative compaction.
 - Excavate for footings, foundations, grade beams and slabs to depths indicated on Drawings. Elevations and depths of excavations shown on the Drawings shall govern and will be basis for bidding and execution of work except as otherwise may be directed by the Owner's

Representative. Greater or lesser quantities of excavation and backfill required by authorized instructions shall be adjusted in accordance with the General Conditions.

3. In areas where proposed swimming pool decking is anticipated, the site should be excavated to a depth of one (1) foot below existing grade and backfilled with compacted engineered fill. The intent of this recommendation is to remove soils susceptible to compressibility.
 4. Except where extra excavation is directed by the Owner's Representative or Geotechnical Engineer, excavations made to a greater depth or size than indicated or required shall be filled with concrete or shotcrete as specified in Sections 13 11 02 / 13 11 03.
- C. Dimensions: Excavate to proper dimensions as shown, cut square and smooth with firm level bottoms. Prepared excavations shall be approved by Geotechnical Engineer. Excavations shall be free of loose or disturbed materials.
 - D. Excess Water Control: Keep all excavations free from standing water by pumping, draining or providing proper protection against water intrusion. If soil becomes soft, soggy or saturated, perform additional excavation to firm soil not affected by water.
 - E. Form Removal: Make all excavations of sufficient size to permit installation and removal of forms and all other required work.
 - F. Alternate Forming: Sides of structures may be formed by neat excavations where banks will stand without caving. If banks cave, provide forming as required and widen excavation to permit forming, bracing and inspection. Provide forming in conformance with Section 13 11 02 and all recognized safety standards. Form all grade beams.

3.04 BACKFILLING

- A. Method: After concrete has been placed, forms removed and concrete work approved, backfill the excavations with earth to indicated or required grades. Carry on backfilling simultaneously on each side of walls or grade beams. Remove all rubbish and wood from the excavations before placing backfill.
- B. Concrete Protection: Prior to placing any backfill, adequately cure all concrete and provide any bracing required to ensure the stability of the structure. Protect waterproofing and dampproofing against damage in a manner acceptable to the Owner's Representative. Remove bracing as backfill operations progress.
- C. Material: Use the material from the excavations for backfilling, subject to approval by Soils Testing Agency. The earth shall be free from debris, large clods or stones.
- D. Lifts: Place backfill in six (6) inch loose layers, bring to optimum moisture content and compact to ninety percent (90%) of maximum density, sloping down and away from the structures being backfilled.
- E. Moisture: Rigidly control the amount of water used to insure optimum moisture conditions for the type of fill material used. Excessive amounts of water causing saturation of earth will not be permitted. Compaction by flooding or jetting is prohibited.

3.05 GRADING

- A. Slopes: Grade to finish grades indicated on Drawings, with uniform slopes between all points.
- B. Subgrades: Blade to required grade and roll or tamp subgrades for exterior slabs, decks and paving.

3.06 CLEAN-UP

- A. Disposal: Haul away rubbish, debris, and rocks from site promptly and dispose of legally. Burning rubbish on site is prohibited.

- B. Dust and Noise Abatement: During entire period of construction keep area and material being loaded sprinkled to reduce dust in air and annoyance to premises and surrounding property.

END OF SECTION

SECTION 13 11 02
SWIMMING POOL CONCRETE

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Forming for cast-in-place concrete and shotcrete associated with swimming pools.
- B. Reinforcement for cast-in-place concrete and shotcrete associated with swimming pools.
- C. Cast-in-place concrete for swimming pool structures. Do not use waterproofing admixture of any kind.
- D. Cast-in-place concrete for swimming pool decks with Xypex C-500 crystalline waterproofing admixture. Waterproofing admixture for swimming pool decks only.
- E. Provide labor, materials and equipment as required to install sealant for all pool deck expansion joints, or any other caulking, as indicated on the aquatic Drawings and herein specified.

1.2 QUALITY ASSURANCE

A. Qualifications of Workers:

- 1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least 5 years immediately prior to commencement of the Work.
- 2. For actual construction operations, use only trained and experienced workers with a minimum of 3 years' experience with the materials and methods specified.
- 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of 5 years' experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.

B. Standards:

- 1. In addition to complying with the California Building Code (2022 edition), 1908 comply with all pertinent recommendations contained in "Guide to Formwork for Concrete" Publication ACI 347R-14 of the American Concrete Institute.
- 2. In addition to complying with California Building Code (2022 edition), comply with all pertinent recommendations contained in "Guide to Presenting Reinforcing Steel Design Details," Publication ACI 315R-18 of the American Concrete Institute. In addition to complying with all local codes and regulations, comply with all pertinent recommendations contained in American Society for Testing and materials (ASTM); ASTM C 920 "Standard Specification for Elastometric Joint Sealants."

1.3 TOLERANCES

- A. Construct all swimming pool concrete straight, true, plumb and square within a tolerance horizontally and vertically of 1/8" in total distance.

1.4 SUBMITTAL AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 01 33 00.
- B. Samples and Certificates, Concrete Reinforcement:
 - 1. Provide all data and access required for testing as described in Section 01 45 00 of the Specifications.
 - 2. All material shall bear mill tags with heat number identification. Mill analysis and report shall be made available upon request.
 - 3. Material not so labeled and identifiable may be required by the City to be tested by the testing laboratory selected by the City and at no additional cost to the City, in which case random samples will be taken for one series of tests from each 2 ½ tons or fraction thereof of each size and kind of reinforcing steel.
 - 4. Design mix from batch plant demonstrating previous use history and associated strengths at 28 days.
 - 5. The Contractor shall submit a mix design stamped and signed by a licensed engineer for approval by City's Representative prior to any placement of concrete.
 - 6. The Contractor shall submit a separate mix design stamped and signed by a licensed engineer for the swimming pool decks which contains the specified Xypex C-50 crystalline waterproofing admixture for approval by the City's Representative prior to any placement of concrete.
- C. Submit proof of qualifications as specified in Article 1.2.A of this Section.
- D. Submit reinforcing shop drawings for pool walls, gutters, floors, dike walls and balance tanks, etc. as shown on the construction drawings.

1.5 PRODUCT HANDLING

- A. Delivery: Deliver materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.
- B. Storage: Store materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project Site.
- C. Protection: Use all means necessary to protect the swimming pool concrete before, during, and after installation and to protect the installed Work specified in other Sections.
- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the City.

PART 2 - PRODUCTS

2.1 CONCRETE FORMWORK

A. Form Materials:

1. Form Lumber: All form lumber in contact with exposed concrete shall be new except as allowed for reuse of forms in Part 3 of this Section, and all form lumber shall be one of the following, a combination thereof, or an equal approved in advance by the City's Representative.
 - a. "Plyform," Class I or II, bearing the label of the Douglas Fir Plywood Association; "Inner-Seal" Form as manufactured by Louisiana-Pacific, or approved equal.
 - b. Douglas Fir-Larch, number two grade, seasoned, surfaced four sides.
2. Form Release Agent: Colorless, non-staining, free from oils; chemically reactive agent that shall not impair bonding of paint or other coatings intended for use.

B. Ties and Spreaders:

1. Type: All form ties shall be a type which do not leave an open hole through the concrete and which permits neat and solid patching at every hole.
2. Design: When forms are removed, all metal reinforcement shall be not less than two (2) inches from the finished concrete surface.
3. Wire Ties and Wood Spreaders: Do not use wire ties or wood spreaders.

C. Alternate Forming Systems: Alternate forming systems may be used subject to the advance approval of the City's Representative.

2.2 CONCRETE REINFORCEMENT

- A. Bars: Bars for reinforcement shall conform to "Specifications for Deformed Carbon-Steel Bars for Concrete Reinforcement," ASTM A-615, Grade 60.
- B. Wire Fabric: Wire fabric shall conform to "Specifications for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete," ASTM A-1064.
- C. Tie Wire: Tie wire for reinforcement shall conform to "Specifications for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete," ASTM A-1064 black annealed 16-gauge tie wire.

2.3 CAST-IN-PLACE CONCRETE

A. Concrete:

1. All concrete, unless otherwise specifically permitted by the City's Representative, shall be transit-mixed in accordance with ASTM C94. Concrete for water retaining structures that do not receive a waterproofing finish such as ceramic tile or swimming pool plaster shall receive a topical waterproofing finish.

2. The control of concrete production shall be under the supervision of a recognized testing agency, selected by the City in accordance with Section 01 25 00 of the Specifications.
3. Quality: All concrete shall have the following minimum compressive strengths at twenty-eight (28) days and shall be proportioned within the following limits:
 - a. 4,000 psi minimum compressive strength for cast-in-place concrete for swimming pool structures.
 - b. 4,000 psi minimum compressive strength for cast-in-place concrete for swimming pool decks with Xypex C-500 waterproofing admixture.
 - c. 1-inch maximum size aggregate.
 - d. 6.0 minimum sacks of cement per cubic yard. *
 - e. Maximum water to cement ratio of 0.40 minimum-0.45 maximum
 - f. 4-inch maximum slump.
 - g. Xypex Admix C-500 2%-2.5% by weight of cement content. Contact Xypex Technical Services to confirm dosage. (To be used for swimming pool decks only)

* For estimate only: to be determined by mix design.
4. Cement: All cement shall be Portland Cement conforming to ASTM C-150, Type V, and shall be the product of one manufacturer.
5. Aggregates:
 - a. Shall conform to "Standard Specifications for Concrete Aggregates," ASTM C33, except as modified herein.
 - b. Coarse Aggregate: Clean sound washed gravel or crushed rock. Crushing may constitute not more than 30 percent of the total coarse aggregate volume. Not more than 5 percent flat, thin, elongated or laminated material nor more than 1 percent deleterious material shall be present. 1-inch aggregate graded from ¼ inch to 1 inch, fineness modulus 6.90 to 7.40. 1-1/2 inch graded from ½ inch to 1-1/2-inch fineness modulus 7.80 to 8.20.
 - c. Fine Aggregate: Washed natural sand of hard, strong particles and shall contain no more than 1 percent of deleterious material, fineness modulus 2.65 to 3.05.
 - d. Aggregate must be certified, non-expansive from a "known" good source.
6. Water: ASTM C1602; Clean, fresh, free from acid, alkali, organic matter or other impurities liable to be detrimental to the concrete (potable).
7. Admixtures: Admixtures shall be used upon approval of the City's Representative.
 - a. Air-entraining admixture: Conform to ASTM C260.
 - b. Water-reducing admixture: Conform to ASTM C494.
 - c. Waterproofing admixture for swimming pool decks only: Xypex Admix C-500, no substitutions permitted. Conform to ASTM C494.
8. Xypex Admix C-500 Dosage: To be used for swimming pool decks only.
 - a. General: Xypex Admix must be added to concrete mix at time of batching. It is important to obtain a homogeneous mixture of Xypex Admix with the concrete. Do not add dry Admix powder directly to wet mixed concrete as this could cause clumping and thorough dispersion may not occur.
 - b. Dosage Rate: Under normal conditions, the crystalline waterproofing powder shall be added to the concrete mix at the following rates:
 - 1) Xypex Admix C-500 2% – 2.5% by weight of cement content
 - c. Weather Conditions: For mixing, transporting and placing concrete under conditions of high temperature or low temperature, follow concrete practices such

as those referred to in ACI 305R (Hot Weather Concreting) and ACI 306R (Cold Weather Concreting) or other applicable standards.

- d. Concrete Batching & Mixing Procedures: Procedures for the addition of Xypex admixture will vary according to type of batch plant operation and equipment. Prior to the placement of any concrete, the concrete batch plant and the contractor shall be responsible to consult with the local Xypex representative concerning additional procedures for the addition, mixing and to confirm dosage.
Note: For enhanced chemical protection or for meeting specific project requirements or where the concrete mix design contains higher than 25% type F fly ash content or includes a Portland cement/slag cement/type C fly ash blend, consult with manufacturer or its authorized representative to determine appropriate dosage rates

- B. Construction Joints: Use keyform for slab pour joints. Either preformed galvanized or PVC construction joint forms of a standard manufacturer may be used. Install per manufacturer's recommendations and tool edges of slabs.
- C. Waterstops: PVC bulb-type for use between concrete pours / lifts, conforming with ASTM D 570, D 624, and D 638. Provide in configuration(s) as recommended by manufacturer for specific application. Greenstreak, W.R. Meadows, or equal.
- D. Curing Materials:
 - 1. Liquid Membrane (covered slab): Chlorinated rubber membrane forming, curing-sealing compound conforming to ASTM C309.
 - 2. Liquid Membrane (exposed slab): Clear methyl and butyl methacrylate non-staining, membrane forming, curing-sealing compound conforming to ASTM C309.
- E. Cement Grout and Drypack:
 - 1. Cement Grout: Mix 1 part by volume of Portland Cement, 1/2 part by volume of water and fine aggregate enough to make mixture flow under its' own weight.
 - 2. Drypack: Mix 1 part by volume of Portland Cement, 1/2 part by volume of water and fine aggregate enough to make a stiff mix that will mold into a ball. Mix no more than can be used in 30 minutes.

2.4 JOINT SEALANT MATERIALS

- A. Caulking: Multipart, non-sag gun grade polyurethane based sealant meeting the requirements of ASTM C920-02, Type S or M, Mamemco International, Pecora, Sika Corp., Sonneborn Building Products, Tremco or equal. Self-leveling caulking materials are not allowed.
- B. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- C. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- D. Sealant Backer Rod: Provide compressible polyethylene or polyurethane backer rod as recommended by the sealant manufacturer.

- E. Bond Breaker Tape: Provide polyethylene tape or other plastic tape as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant.
- F. Sand: Cover the surface of the caulking with #30 silica sand.

2.5 OTHER MATERIALS

- A. All other materials, not specifically described but required for proper completion of the work of this Section, shall be as selected by the Contractor subject to the advance review by the City's Representative.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Inspection:
 - 1. Prior to all Work of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.
 - 2. Verify that all Work may be constructed in accordance with all applicable codes and regulations, the referenced standards, the original design, and in accordance with site specific Geotechnical Report.
- B. Discrepancies:
 - 1. In the event of discrepancy, immediately notify the City's Representative.
 - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
 - 3. Failure to notify the City's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive work.

3.2 CONCRETE FORMWORK

- A. Construction of Forms:
 - 1. General: Construct all required forms to be substantial, sufficiently tight to prevent leakage of concrete paste, and able to withstand excessive deflection when filled with wet concrete.
 - 2. Layout:
 - a. Form for all required cast-in-place concrete to the shapes, sizes, lines and dimensions indicated on the Drawings.
 - b. Exercise particular care in the layout of forms to avoid necessity for cutting concrete after placement.

- c. Make proper provisions for all openings, offsets, recesses, anchorages, blocking and other features of the Work as shown or required.
 - d. Perform all forming required for Work of other trades and do all cutting and repairing of forms required to permit such installation.
 - e. Carefully examine the Drawings and Specifications and consult with other trades as required relative to providing for pipe and conduit penetrations, reglets, chases and other items in the forms.
 - 3. Imbedded Items: Set all required steel frames, angles, bolts, inserts and other such items required to be anchored in the concrete prior to concrete being placed.
 - 4. Bracings:
 - a. Properly brace and tie the forms together so as to maintain position and shape and to ensure safety to workmen.
 - b. Construct all bracing, supporting members and centering of ample size and strength to safely carry, without excessive deflection, all dead and live loads to which they may be subjected.
 - c. Properly space the forms apart and securely tie them together, using metal spreader ties that give positive tying and accurate spreading.
 - 5. Wetting: Keep forms sufficiently wetted to prevent joints from opening up before concrete is placed.
- B. Plywood Forms:
- 1. Design: Nail the plywood panels directly to studs and apply in a manner to minimize the number of joints.
 - 2. Joints: Make all panel joints tight butt joints with all edges true and square.
- C. Footing Forms:
- 1. Wood Forms: All footing forms shall be wood unless otherwise specifically approved by the City's Representative, or as specified in paragraph 3.2(C)(2).
 - 2. Earth Forms:
 - a. Side walls for footings may be of earth provided the soil will stand without caving and the sides of the bank are made with a neat cut to the minimum dimensions indicated on the Drawings.
 - b. For excavation and backfill of earth forms, conform with applicable provisions of Section 13 11 01.
- D. Reuse of Forms:
- 1. Reuse of forms shall be subject to advance approval of the City's Representative.
 - 2. Except as specifically approved in advance by the City's Representative, reuse of forms shall in no way delay or change the schedule for placement of concrete from the schedule obtainable if all forms were new.

3. Except as specifically approved in advance by the City's Representative, reuse of forms shall in no way impart less structural stability to the forms nor less acceptable appearance to finished concrete.

E. Removal of Forms:

1. General:

- a. In general, side forms of footings may be removed 7 days after placement of concrete, but time may be extended if deemed necessary by the City's Representative.
- b. Forms for footings, foundations, grade beams, slabs, walls, and other formed concrete may be removed 14 days after placement of concrete.

2. Removal:

- a. Use all means necessary to protect workers, passersby, the installed Work of other trades and the complete safety of the structure.
- b. Cut nails and tie wires or form ties off flush, and leave all surfaces smooth and clean.
- c. Remove metal spreader ties on exposed concrete by removing or snapping off inside the wall surface and pointing up and rubbing the resulting pockets to match the surrounding areas.
- d. Flush all holes resulting from the use of spreader ties and sleeve nuts using water, and then solidly pack throughout the wall thickness with cement grout applied under pressure by means of a grouting gun; grout shall be one part Portland Cement to 2-1/2 parts sand; apply grout immediately after removing forms.

3.3 CONCRETE REINFORCEMENT

A. Bending:

1. General:

- a. Fabricate all reinforcement in strict accordance with the Drawings.
- b. Do not use bars with kinks or bends not shown on the Drawings.
- c. Do not bend or straighten steel in a manner that will injure the material. (When opposite end is already encased in concrete.)

2. Design:

- a. Bend all bars cold.
- b. Make bends for stirrups and ties around a pin having a diameter of not less than 4 times the minimum thickness of the bar (#3-#5) per ACI.
- c. Make bends for other bars, including hooks, around a pin having a diameter of not less than 6 times the minimum thickness of the bar.

B. Placing:

1. General: Before the start of concrete placement, accurately place all concrete reinforcement, positively securing and supporting by concrete blocks, metal chairs or spacers, or by metal hangers.
2. Clearance:

- a. Preserve clear space between bars of not less than one and one-half times the nominal diameter of the round bars.
 - b. In no case let the clear space be less than one and one-half inches nor less than one and one-third times the maximum size of the aggregate.
 - c. Provide the following minimum concrete covering of reinforcement:
 - 1) Concrete deposited against earth: 3 inches minimum.
 - 2) Concrete below grade deposited against forms: 2 inches minimum.
 - 3) Concrete elsewhere: As indicated on Drawings or otherwise approved by the City's Representative.
3. Splicing:
- a. Horizontal Bars:
 - 1) Place bars in horizontal members with minimum lap at splices sufficient to develop the strength of the bars.
 - 2) Bars may be wired together at laps except at points of support of the member, at which points preserve clear space described above.
 - 3) Whenever possible, stagger the splices of adjacent bars.
 - 4) Splice 40 bar diameters minimum.
 - 5) Provide non-contact lap slices for shotcrete.
 - b. Wire Fabric: Make all splices in wire fabric at least one and one-half meshes wide.
 - c. Other Splices: Make only those other splices that are indicated on the Drawings or specifically approved by the City's Representative.
4. Dowels: Place all required steel dowels and securely anchor them into position before concrete is placed.
5. Obstructions: In the event conduits, piping, inserts, sleeves and other items interfere with placing reinforcement as indicated on the Drawings or otherwise required, immediately consult with the City's Representative and obtain approval of a new procedure prior to placing concrete.
- C. Cleaning Reinforcement: Steel reinforcement, at the time concrete is placed around it, shall be free from rust scale, loose mill scale, oil, paint and all other coatings which will destroy or reduce the bond between steel and concrete. Bend down all tie wire away from the top of the pool deck. Maintain a 2" clear from top of concrete to the tie wire.

3.4 SHOTCRETE REINFORCEMENT

- A. Shotcrete reinforcement shall be in accordance with the requirements of CBC 1908A and ACI 318-19, along with the provisions of ACI 506R and ACI 506.2. For parallel nonprestressed reinforcement in shotcrete members, the clear spacing between bars shall be at least the greater of 6 bar diameters and 2-1/2 in. Where two curtains of reinforcement are provided, the clear spacing between bars in the curtain nearer the nozzle shall be at least 12 bar diameters; the clear spacing between bars in the remaining curtain shall be at least the greater of 6 bar diameters and 2-1/2 in. Adequate encasement of bars larger than No. 5 shall be demonstrated by a preconstruction test shotcrete mockup panel.
- B. Subject to the approval of the building official, it shall be permitted to use a clear spacing that does not meet the clear spacing provisions listed above provided that shotcrete mockup panels are used to demonstrate the proper reinforcement encasement in accordance with the following:
 - 1. The shotcrete mockup panels shall be representative of the most complex reinforcement configurations to be encountered.

2. The licensed design professional shall specify the shotcrete mockup panel quantity, frequency of shooting per nozzle man and member type, and panel thickness to verify reinforcement encasement.

C. Non-contact lap splices for reinforcement in shotcrete shall have clear spacing in accordance with the following

1. For No. 6 and smaller bars, the clear spacing between bars shall be at least greater of 6 bar diameters and 2-1/2" in.
2. For No. 7 and larger bars, the clear spacing shall be established using a shotcrete mockup panel to demonstrate that the reinforcement is properly encased.
3. Subject to the approval of the building official, contact lap splices for reinforcement in shotcrete shall be oriented with the plane of the spliced bars perpendicular to the surface of the shotcrete and approved by the licensed design professional based on a shotcrete mockup panel to demonstrate that the reinforcement is properly encased.

3.5 CAST-IN-PLACE CONCRETE

A. Conveying and Placing Concrete:

1. Before placing concrete, mixing and conveying equipment shall be well cleaned, and the forms and space to be occupied by concrete shall be thoroughly cleaned and wetted. Ground water shall be removed until the completion of the work.
2. No concrete shall be placed in any unit of work until all formwork has been completely constructed, all reinforcement has been secured in place, all items to be built into concrete are in place, and form ties at construction joints tightened.
3. Concrete shall be conveyed from mixer to place of final deposit in such a way to prevent the separation or loss of ingredients. It shall be placed as nearly as practicable in its' final position to avoid rehandling or flowing. Concrete shall not be dropped freely where reinforcing bars will cause segregation, nor shall it be dropped freely more than 6 feet. Use tremies, spouts and dump boxes in deep sections. Vibrators are not acceptable for facilitating concrete transport.
4. Concrete shall be tamped and spaded to insure proper compaction into all parts of forms and around reinforcement. A mechanical vibrator shall be used to thoroughly compact the concrete. Vibration must be by direct action in the concrete and not against forms or reinforcement.
5. Mixing and transport time as indicated in ASTM C94 is required. If air temperatures are between 85° and 90° F the delivery time is to be reduced to 75 minutes. When air temperatures are in excess of 90° F the delivery time should be reduced to 60 minutes.
6. Truck mixes without batch certificates will be rejected.

B. Construction Joints / Expansion Joints: Construction joints and expansion joints shall be provided at locations and in the manner shown on the Drawings. With exception of existing concrete / new shotcrete joints, use PVC bulb-type waterstops appropriate for design condition between all concrete pours / lifts to avoid cold joints. Waterstops shall be placed in such a way

to protect reinforcing steel from rust and oxidation. All expansion joints must be the full depth of the concrete section in which they are located.

- C. Slab Finishes: Concrete slabs shall be compacted and screeded uniformly to grades shown. Push large aggregates below the surface with a screen tamper, screed and bull float. As soon as the surface becomes workable, it shall be wood floated, then finished as indicated on the Drawings to a uniform smooth, true surface in a neat and workmanlike manner. Carefully coordinate slab finish requirements with other trades (ceramic tile, pool plaster) to ensure concrete finish is appropriate substrate for final finish material.

1. Contractor shall provide three mock-up deck samples, minimum 3' x 3', with a wedge anchor installed in one sample. These 3 samples shall be constructed; one with a light broom finish, one with a medium broom finish and one with a heavy broom finish for determination and selection of an appropriate deck finish. Each sample shall be edged on all four sides to demonstrate a $\frac{3}{4}$ inch radius edge. Anchor installation shall demonstrate acceptable interface between anchor and the top of deck. Deck samples shall remain on job site through final inspection for reference.
2. Pool Floor Slab: Heavy Wire Broom Finish.

- D. Protection and Curing:

1. Concrete shall be protected from injurious action of the elements and defacement of any nature during construction.
2. All forms must be kept wet to prevent drying out of the concrete.
3. All concrete surfaces including footings must be kept wet for at least 7 days after concrete is placed.
4. Apply the appropriate curing materials, as specified in 2.3 of this Section, immediately after finishing slabs. Application shall be as specified by the manufacturer.

- E. Form Removal:

1. Take care in removing forms so that surfaces are not marred or gouged and that corners are true, sharp and unbroken.
2. No steel spreaders, ties or other metal shall project from or be visible on any concrete surfaces.

- F. Defective Work:

1. Should the strength of any concrete for any portion of the work indicated by tests of molded cylinders and core tests fall below minimum 28 days' strength specified or indicated, concrete will be deemed defective work and shall be replaced.
2. Concrete work that is not formed as indicated, is not true to intended alignment, not plumb or level where so intended, not true to intended grades or elevations, not true to specified or selected finish, contains sawdust shavings, wood, or embedded debris, which exhibits cracks or contains fine or coarse sulfide particles, or expansive aggregates detrimental to performance or appearance of the concrete shall be deemed defective.

3. Promptly perform work required to replace and properly clean (by sandblasting if necessary) any defective concrete panels (control joint or expansion joint to control joint or expansion joint), at Contractor's expense, including all expense of additional inspection, tests, or supervision made necessary as a result of defective concrete.

3.6 EXPANSION JOINTS

- A. Temperatures: Do not install sealants when air temperature is less than 40 degrees Fahrenheit.
- B. Tooling: Tool exposed joints to a slightly concave surface using slicking materials recommended by the manufacturer. The tooling procedure shall press sealant against the sides of the joint. No materials shall be left "feathered" out or smeared on the abutting materials. Completed joints shall have a uniform professional appearance.
- C. Joint Construction: Sealant joint width, thickness and cross-sectional profile to be constructed in strict accordance with the sealant manufacturer's recommendations.
- D. Sand: at the appropriate time cover the sealant with sand to provide a sanded finish.

3.7 CLEAN-UP

- A. Upon completion of the Work of this Section, immediately remove all swimming pool concrete materials, debris and rubbish occasioned by this Work to the approval of the City's Representative.

END OF SECTION

**SECTION 13 11 03
SWIMMING POOL SHOTCRETE**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide labor, materials and equipment as required to install structural wet mix shotcrete for swimming pool structures as indicated on the Drawings and herein specified.

1.2 QUALITY ASSURANCE

A. Qualifications of Workers:

1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.

- B. Standards: Except as otherwise indicated, provide shotcrete per American Concrete Institute Standard ACI 506R, ACI 506.2, ACI 318-19 and the California Building Code (2022 edition).

- C. Mix Design: The Contractor shall submit a mix design stamped and signed by a licensed engineer for approval by the Owner's Representative prior to any placement of shotcrete. Mix design shall indicate source of aggregate and brands of cement and admixtures used. All mix designs shall take character of locally available aggregate into consideration and make adjustments as necessary to conform with specified design criteria.

- D. **Testing and Inspection:** A test panel shall be shot, cured, cored or sawn, examined and tested (representing the most congested and difficult project scenario) prior to commencement of the project in accordance with ASTM C1140. All project conditions and personnel shall be represented in the test panel. Additionally, one test panel shall be provided for each 50 yards (or portion thereof) of shotcrete placed for each day or each nozzleman, whichever is greater. The size of the strength test panel shall be per the direction of the Special Shotcrete Inspector. At least three (3) cores shall be taken from each test panel. (At least three (3) cores shall be taken from the completed work for each day of shotcrete operation.) Testing shall be performed by the Owner's designated Testing Lab and comply with Section ACI 318-19 and CBC 2022 1705A.3.9. Continuous inspection of the shotcrete operation by a deputy inspector provided by the Owner shall be required.

- E. Tolerances: Construct all swimming pool shotcrete straight, true, plumb and square within a tolerance horizontally of one in 200 and a tolerance vertically of one in 2000.

1.3 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 01 33 00 and ACI 506.2. Requests for substitution shall conform with requirements of Article 1.10.A of Section 13 11 00.
- B. Materials List: Within thirty (30) days after issuance of Notice to Proceed, and before shotcrete materials are delivered to the project site, submit to the Owner a complete list of materials proposed to be used in this portion of the Work, showing manufacturer's name and catalog number of all items such as admixtures and curing membranes, and the name and address of the supplier of cement and aggregate to be used.
- C. Submit proof of qualifications as specified in Article 1.2.A of this Section.

1.4 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect shotcrete materials before, during and after installation and to protect the installed Work specified in other Sections.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cement: Cement shall be Type 1 Portland Cement conforming to ASTM C150. Cement type shall be the same for all shotcrete work.
- B. Aggregate: ASTM C33, washed hard dense durable clean sharp sand from approved pit, free of organic matter and opaline, feldspar, or silicious magnesium substances and containing not more than 3% by weight of deleterious substances. Maximum size aggregate for shotcrete is $\frac{3}{4}$ " per ACI 318-19. When tested for organic impurities by ASTM C40 method, fine aggregate color not darker than reference standard color. When tested for soundness by ASTM C88 method, grading No. 2 of ASTM C1436, loss after 5 cycles not over 10% of fine aggregate.
- C. Water: Potable, clean, fresh, free from acid, alkali, organic matter or other impurities liable to be detrimental to the shotcrete.
- D. Admixtures: Admixtures shall conform to ASTM C1141 and only be used upon approval of the Owner's Representative.

PART 3 - EXECUTION

3.1 EXECUTION

- A. Inspection:
 - 1. Prior to all Work of this Section carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.

2. Verify that items to be imbedded in shotcrete are in place and that shotcrete may be placed to the lines and elevations shown on the Drawings, with all required clearance from reinforcement.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Owner's Representative.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
3. Failure to notify the Owner's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive the Work.

3.2 PREPARATION

A. General:

1. Thoroughly clean all areas where shotcrete is to be placed to insure proper bonding of shotcrete.
2. Where shotcrete is to be placed against smooth surfaces (i.e., cast-in-place concrete), sandblast surfaces to receive shotcrete to provide clean aggregate surface, thereby insuring proper bond between materials.

- B. Ground Wires: Adequate ground wires, to be used as screeds, shall be installed to establish the thickness and surface planes of the shotcrete work. Ground wires shall be placed so that they are tight and true to line and grade and in such a manner that they can be easily tightened.

3.3 PROPORTIONING AND MIXING

- A. Accurately control proportion of water to Portland cement to produce thorough and uniform hydration of the shotcrete that, when shot, forms a homogeneous mass containing neither sags nor dry sand formation. Proportion by mass per ASTM C94 or by volume per ASTM C685.
- B. Shotcrete shall have a minimum compressive strength of 4,000 PSI at 28 days. Shotcrete material shall have a water/cement ratio of 0.40 minimum-0.45 maximum per ACI 506R, Chapter 6, Proportioning and Preconstruction Testing; Section 6.3.3, Wet Mix Process.
- C. Discontinue shotcrete work if the time between the addition of mixing water to cement and aggregate, or cement to aggregates, and placement of shotcrete exceeds ninety (90) minutes when the ambient temperature is below 85 degrees Fahrenheit, or exceeds sixty (60) minutes when the ambient temperature is above 85 degrees Fahrenheit. Batch, mix and deliver wet-mixture shotcrete per ASTM C94 or C685.
- D. Hot Weather Shotcreting – Unless otherwise specified, do not place shotcrete when shotcrete temperature is above 95°F, unless prequalification testing shows that the required quality of materials can be achieved at high temperatures. The temperature of reinforcement and receiving surfaces shall be below 90°F prior to shotcrete placement.

- E. Cold Weather Shotcreting – Unless otherwise specified, shooting may proceed when ambient temperature is 40°F and rising. Stop shooting when ambient temperature is 40°F and falling, unless measures are taken to protect the shotcrete. Shotcrete material temperature, when shot, shall not be less than 50°F. Do not place against frozen surfaces.

3.4 SHOTCRETE PLACING, FINISHING, AND CURING

- A. Operations: Utilize a standard type of air compressor, capable of providing a minimum of 250 cubic feet of air per minute per nozzle.
- B. Placing: Except when shooting reinforcing, hold the nozzle perpendicular to and 2-1/2 to 3 feet from surface. At reinforcing bars, hold the nozzle so as to direct shotcrete behind the bars, and shoot each side of each bars separately. A nozzleman's helper equipped with an air jet shall precede the nozzle and blow out rebound or sand lodged behind bars, on forms, or placed shotcrete. Placing shotcrete horizontal members from the top is not allowed unless approved methods are employed to eliminate all rebound. Material shall emerge from the nozzle in a uniform flow. If flow becomes intermittent for any reason, direct the nozzle away from the surface until the flow is again steady and constant. Do not reuse rebound or loose sand for any purpose.
- C. Puddled Shotcrete: Use of "puddled shotcrete" in which the air pressure is reduced and the water content is increased to facilitate placing in difficult locations is not allowed. Do not place shotcrete where nozzle stream cannot impinge directly on the involved surface. Where difficult shooting conditions occur, obtain proper results by maintaining correct air pressure and water ratio and reduce supply of material.
- D. Construction Joints: Form joints with sloping beveled edges. Clean and dampen the hardened joint surfaces before placing additional shotcrete. Square edged construction joints are not allowed. The film of laitance which forms on the surface of the shotcrete shall be removed within approximately two hours after application by brushing with a stiff broom. If this film is not removed within two hours, it shall be removed by thorough wire brushing or sand blasting. Construction joints over eight hours old shall be thoroughly cleaned with air and water prior to receiving shotcrete.
- E. Finishing: Rod exposed surfaces to true planes and lines on reaching the thickness and plane established by forms and ground wires. Tamp and wood float surfaces level and provide a rough raked finish. Carefully coordinate finish requirements with other trades (ceramic tile, pool plaster) to ensure shotcrete finish is appropriate substrate for final finish material.
- F. Curing: Keep shotcrete continuously damp for not less than seven (7) days after placing. Use sealed curing sheeting or other approved curing method where water curing is not feasible. Do not use curing compound of any kind.

3.5 DEFECTIVE WORK

- A. Cut out, remove and replace, or repair to the satisfaction of the Owner's Representative, shotcrete not meeting minimum strength, not true, plumb or level, not to required elevations, containing cracks detrimental to performance or appearance, containing shavings, debris or with honeycombs or voids.
- B. Promptly perform Work required to repair, patch, replace, render properly cleaned surfaces (by sandblasting if necessary) or otherwise make good any defective shotcrete at Contractor's expense, including all expense of additional inspection, tests, or supervision made necessary as a result of defective shotcrete.

3.6 CLEAN-UP

- A. Upon completion of the Work of this Section, immediately remove all swimming pool shotcrete materials, debris and rubbish occasioned by this work to the approval of the Owner's Representative.

END OF SECTION

SECTION 13 11 04
SWIMMING POOL CERAMIC TILE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Swimming pool ceramic tile detailed on the Drawings, including, but not limited to, the following:

1. Waterline Face Tile (deep gutter pool)
2. Gutter Cap Tile (deep gutter pool)
3. Lane Line / Target Tile / 4'-6" Depth Tile
4. Depth Marker Tile (at cantilever deck)
5. Depth / Caution Marker Tile (at deep gutter pool decks)
6. Trim Tile (at steps)
7. Gutter Bullnose Tile (Rim flow pool)
8. Depth / Caution Marker Tile (on coping)
9. Zero Depth Entry Tile
10. International No Diving Tile
11. Pre-Cast Coping

1.2 QUALITY ASSURANCE

A. Qualifications of Workers:

1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least 5 years immediately prior to commencement of the Work.
2. For actual construction operations, use only trained and experienced workers with a minimum of 3 years' experience with the materials and methods specified.
3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of 5 years' experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.

B. Standards: In addition to complying with all pertinent codes and regulations:

1. Manufacture of all tile shall be in accordance with ANSI A-137.

2. Install ceramic tile in accordance with the recommendations contained in the 2024 "Handbook for Ceramic Tile Installation" of the Tile Council of America, Inc.

- C. Tolerances: Install all swimming pool ceramic tile straight, true, plumb and square within a tolerance horizontally and vertically of 1/8" in total distance. Waterline and gutter bullnose tile shall be level to 1/8 inch (+/- 1/16 inch) around entire perimeter of swimming pools.

1.3 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 01 33 00.
- B. Samples: Submit samples of each color and pattern in the specified groups. Character samples can be representative for review prior to screening of actual tile.
- C. Master Grade Certificate: Prior to opening ceramic tile containers, submit a Master Grade Certificate, signed by the manufacturer of the tile used and issued when the shipment is made, stating the grade, kind of tile, identification marks for the tile containers, and the name and location of the Project.
- D. Specifications: Submit manufacturer's recommended installation specifications for the Work.
- E. Submit proof of qualifications as specified in Article 1.2.A of this Section.

1.4 PRODUCT HANDLING

- A. Delivery: Deliver all materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.
- B. Storage: Store all materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project site.
- C. Protection: Use all means necessary to protect swimming pool ceramic tile before, during and after installation and to protect the installed Work specified in other Sections.
- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the City.

PART 2 - PRODUCTS

2.1 TILE

- A. Waterline Face Tile (Deep Gutter Pool)
 1. Material: All waterline face tile shall be glazed ceramic tile (Group III standard) as manufactured by Dal-Tile or equal.
 2. Size: 6 x 6 inches.
 3. Color: Dal-Tile #D-069, 'Sky Blue'. Contact Kylee Midura kylee.midura@daltil.com (858) 344-0019.

B. Gutter Cap Tile (Deep Gutter Pool)

1. Material: All gutter cap tile shall be glazed ceramic tile (Group III standard) as manufactured by Dal-Tile or equal.
2. Size: 2-1/2 x 6 inches (#A-7250).
3. Color: Dal-Tile #D-069, 'Sky Blue'

C. Lane Line / Target Tile / 4'-6" Depth Tile:

1. Material: Group 3 quality, frost proof unglazed ceramic mosaic tile with absorption rate of less than 1% as manufactured by Dal-Tile or equal.
2. Size: 1 x 1 inches.
3. Color: Dal-Tile #D-311, 'Black', in 25 Yard direction. Dal-Tile #D-621, 'Nautical Blue' in 25 Meter direction and at 4'-6" depth tile.

D. Depth Marker Tile (At Cantilever Deck Face):

1. Material: All depth marker tile shall be glazed ceramic tile as manufactured and/or distributed by Dal-Tile, Precision Tile Co., or equal.
2. Size: 4-1/4 x 4-1/4 inches.
3. Color: Dal-Tile #X-114, 'Desert Gray' with Black silk screen numbers.
4. Trim: Furnish trim pieces as indicated on the Drawings.

E. Depth / Caution Marker Tile (on Deck at Deep Gutter Pool)

1. Material: All depth marker tile shall be glazed ceramic tile as manufactured and/or distributed by Dal-Tile, Precision Tile Co., or equal.
2. Size: 1 x 1 inches
3. Color: Dal-Tile #X-114, 'Desert Gray' field with Black letters and numbers.

F. Trim Tile (on underwater steps)

1. Material: Group 3 quality, frost proof unglazed ceramic tile with absorption rate of less than 1% as manufactured by Dal-Tile or equal.
2. Size: 1 x 1 inches with S-812 quarter round. Color: Dal-Tile #D-311. 'Black' or
3. Size: 2 x 6 inches with integral quarter round. Color: Black, non-slip. Inlays #CPC00022.

G. Depth / Caution Marker Tile (on coping)

1. Material: Sandblast text into precast coping or stone to a depth of 1/8" max. and fill with contrasting color epoxy flush with finish surface. Text font style and epoxy

color to be approved by Owner prior to installation. Final location of markers to be approved by Owner prior to installation. Color as specified by Landscape Architect.

H. Zero Depth Entry Tile

1. Material: All depth/caution marker tile shall be unglazed ceramic mosaic tile with absorption rate of less than 1% as manufactured by Dal-Tile or equal.
2. Size: 1 x 1 inches
3. Color: D-621 "Nautical Blue".

I. "No Diving" Tile (at deep gutter pool):

1. Material: Frost proof unglazed non-slip ceramic mosaic tile with absorption rate of less than 120% as manufactured by Dal-Tile or approved equal.
2. Size: 6 x 6 inches.
3. Color: International "No Diving" symbol over white background. Inlays #C621500, 'White' field

J. Coping

1. Precast Coping: Han-Crete, Inc. or equal (909) 947-1543 to match detail on plans, Federal Stone or equal. (301) 271-7121 to match detail on plans

2.2 MORTAR

- A. Laticrete 3701 fortified mortar #LCR-37-1017.
- B. Site mortar mix shall comply with ASTM C270 standards.
1. Sand for Mortar: Comply with requirements of fine aggregate for concrete.
 2. Cement: Type I Portland Cement, conforming to ASTM C150.
 3. Hydrated Lime: Conforming to ASTM C206 or 207, Type S.
 4. Water: From a potable source.
- C. Water: From potable source.
- D. Mortar shall meet ASTM C627.

2.3 THIN SET MORTAR

- A. Laticrete 254 Platinum, Laticrete, Custom or equal.

- B. Water: From a potable source.
- C. Mortar shall meet ASTM C627

2.4 GROUT

- A. All tile grout shall be waterproof grout complying with the recommendations of referenced standards. Grout color shall be grey for dark backgrounds, white for light backgrounds (verify colors with City's Representative).

2.5 OTHER MATERIALS

- A. All other materials, not specifically described but required for a complete and proper installation of ceramic tile as indicated on the Drawings, shall be new, first quality of their respective kinds, and subject to the approval of the City's Representative.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Inspection:
 - 1. Prior to all Work of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.
 - 2. Verify that ceramic tile can be installed in accordance with the original design and all referenced standards.
- B. Discrepancies:
 - 1. In the event of discrepancy, immediately notify the City's Representative.
 - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
 - 3. Failure to notify the City's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive its Work.

3.2 INSTALLATION

- A. Method:
 - 1. Install all ceramic tile in strict accordance with installation method P601-90 of the 2024 Handbook for Ceramic Tile Installation of the Tile Council of America, Inc.

2. Be certain to install all ceramic tile perfectly level, flush, plumb, and to the finish grades and elevations indicated on the Drawings.

B. Interface:

1. Carefully establish and follow the required horizontal and vertical elevations to insure proper and adequate space for the work and materials of other trades.
2. Coordinate and cooperate as required with other trades to insure proper and adequate interface of ceramic tile Work with the Work of other trades.

3.3 GROUTING

- A. Follow grout manufacturer's recommendations as to grouting procedures and precautions.
- B. Remove all grout haze, observing grout manufacturer's recommendations as to use of acid and chemical cleaners.

3.4 EXTRA STOCK

- A. Provide one (1) unopened box of extra tile for 2.1A, 2.1B, 2.1C, 2.1F, 2.1G and 2.1J for City's use at a future time.

3.5 CLEAN-UP

- A. Upon completion of the swimming pool ceramic tile installation, thoroughly clean and polish the exposed surfaces of tile work. Completely clean work area of debris and rubbish occasioned by this Work and dispose of to the approval of the City's Representative.

END OF SECTION

**SECTION 13 11 05
SWIMMING POOL PLASTER**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Swimming pool plaster and waterproofing of swimming pool structures as indicated on the Drawings and herein specified.
- B. Start-up and operation instructions to City's operations and maintenance personnel and properly balance swimming pool water chemistry until the City takes occupancy.

1.2 QUALITY ASSURANCE

- A. Qualifications of Workers:
 - 1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least 5 years immediately prior to commencement of the Work.
 - 2. For actual construction operations, use only trained and experienced workers with a minimum of 3 years' experience with the materials and methods specified.
 - 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of 5 years' experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- B. Standards: Swimming pool plaster shall conform with requirements of Chapter 31B of California Building Code, 2019 edition. In addition, meet requirements of applicable portions of most current edition of the "Technical Manual," National Plasterers Council, Wauconda, Illinois.
- C. Start-up:
 - 1. Furnish a swimming pool water chemistry consultant, with a minimum of five (5) years' experience, possessing either AFO (Aquatic Facility Operator) or CPO (Certified Pool Operator) certification(s), to supervise and properly balance swimming pool water chemistry.
 - 2. Demonstrate to the City that all systems are fully operational and that calcium hardness, total alkalinity, chlorine residual and pH levels are within specified limits.
 - 3. Standards: Furnish labor and chemicals as required to condition the water properly to the following specifications:
 - a. Calcium Hardness: 200-400 parts per million (PPM)
 - b. Total Alkalinity: 80-100 PPM
 - c. Chlorine Residual: 1.00 to 2.0 PPM
 - d. pH Factor: 7.2 to 7.6

1.3 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 01 33 00.
- B. Submit proof of qualifications as specified in Article 1.2.A and 1.2.C.1 of this Section.

1.4 PRODUCT HANDLING

- A. Delivery: Deliver materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.
- B. Storage: Store materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project Site.
- C. Protection: Use all means necessary to protect the swimming pool plaster before, during, and after installation and to protect the installed Work specified in other Sections.
- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the City.

1.5 ENVIRONMENTAL CONDITIONS

- A. No plastering shall be done under unsuitable conditions of weather or temperature. No plastering shall be done when prevailing temperature is 40 degrees Fahrenheit or less.
- B. Do not install plaster during rain and, if rain commences after plastering has begun, immediately protect the plaster from rain by all means necessary until the plaster has set.
- C. Do not install plaster during wind greater than 10 mph and, if wind commences after plastering has begun, immediately protect the plaster from wind by all means necessary until the plaster has set.

PART 2 - PRODUCTS

2.1 CEMENT / AGGREGATE

- A. Luna Quartz® tiny pebble finish by Wet Edge Technologies. Altima® quartz finish by Wet Edge Technologies. Pebble-Fina® pool finish by Pebble Technologies.

2.2 COLOR

- A. All swimming pool plaster shall be white in color. Wet Edge Technologies shall be Luna Quartz® "Polar White". Wet Edge Technologies shall be Altima® "White". Pebble Technology shall be Pebble-Fina® "Classico". Contractor to obtain written approval on selected pebble color from the local Health Department prior to installation. Submit cut sheet, color sample and written approval for review by City's Representative and City."

2.3 WATER

- A. Water for swimming pool plaster shall be clean and free from injurious amounts of acid, alkali, and organics.

2.4 GUTTER, PUMP PIT, BACKWASH PIT & SURGE CHAMBER WATERPROOFING

- A. Xypex, Miracote Miraflex Membrane C, Hycrete Waterproofing System concrete additive or equal. Mist and apply per manufacturer's recommendations for specific application. Color shall be Gray.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Inspection:
 - 1. Prior to Work of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation can properly commence.
 - 2. Verify that swimming pool plaster can be installed in accordance with the original design and all referenced standards, including proprietary application techniques and application training/certifications.
- B. Discrepancies:
 - 1. In the event of discrepancy, immediately notify the City's Representative.
 - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
 - 3. Failure to notify the City's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive the Work.

3.2 INSTALLATION OF GUTTER, PUMP PIT, BACKWASH PIT & SURGE CHAMBER WATERPROOFING

- A. Provide 2 coats of the specified gutter and surge chamber waterproofing prior to plastering the swimming pool. Prepare surfaces to receive waterproofing and cure in conformance with manufacturer's recommendations. Provide steel trowel application method to ensure uniform smooth, dense surface finish.

3.3 INSTALLATION OF POOL PLASTER

- A. Outdoor Pools or Spas:

1. Completion of other work: DO NOT commence plastering of swimming pool(s) or spa(s) until the following conditions have been met:
 - a. The Health Department and/or other governing agencies have approved the pool(s) and/or spas) for plaster.
 - b. All concrete pool deck construction is complete and the pool decks have been thoroughly cleaned.
 - c. All landscaping in areas adjacent to the pool(s) or spa(s) is complete and the landscape irrigation system is operable.
 - d. All painting in the pool area is complete.
 - e. All welding and grinding in locations adjacent to the pool area are complete.
 - f. The backwash sewer connection is complete.
 - g. Pool(s) and/or spa(s) area(s) perimeter fencing installation is complete.
 - h. All trash and debris have been removed from areas adjacent to the pool(s) or spa(s), particularly those areas that are normally upwind from the pool(s) or spa(s).
 - i. All dust raising construction and/or activities in areas adjacent to the pool(s) or spa(s) are complete or mitigated.
 - j. The circulation pump(s) is/are operational.
 - k. The mechanical system has been flushed sufficiently to remove all dirt and debris from the piping system.
 - l. All necessary chemicals (Chlorine, pH adjuster, Sodium Bicarbonate and Calcium Chloride or any other required chemicals) are on site and ready for use.
 - m. Obtain written approval from the City and the City's Representative.

B. Indoor Pools or Spas:

1. Completion of Other Work: DO NOT commence plastering of swimming pool(s) or spa(s) until the following conditions have been met:
 - a. The Health Department has approved the pool(s) and/or spa(s) for plaster.
 - b. All work above the pool(s) and/or spa(s) is complete.
 - c. All painting in the pool area is complete.
 - d. All welding and grinding in locations adjacent to the pool area are complete.
 - e. The backwash sewer connection is complete.
 - f. All concrete pool deck construction is complete and the pool decks have been thoroughly cleaned.
 - g. The circulation pump(s) is/are operation.
 - h. The mechanical system has been flushed sufficiently to remove all dirt and debris from the piping system.
 - i. All necessary chemicals (Chlorine, Acid, Sodium Bicarbonate and Calcium Chloride) are on site and ready to use.
 - j. Obtain written approval from the City and the City's Representative.

- C. Contractor accepts all liability from damage done to the pool plaster if the pool(s) or spa(s) is (are) plaster before the completion of the above listed items or without the written approval of the City and the City's Representative.

D. POOL PLASTER AUTHORIZATION FORM:

1. The pool(s) and or spa(s) at SGT. JOHN PINNEY MEMORIAL PARK is/are hereby approved for the installation of the pool plaster. Pursuant to the requirements of specification section 13 11 05, paragraph 3.3.

City

Date

City's Representative / Project
Manager

Date

E. Preparation:

1. Do not apply plaster over dirt, rust, scale, grease, moisture, scuffed surfaces or conditions otherwise detrimental to the formation of a durable plaster finish.
2. Consult with manufacturer on application to specific surfaces being treated. Follow manufacturer's recommendation for curing of cast-in-place concrete or shotcrete surfaces prior to application of plaster.
3. Protect ceramic tile, decking, deck equipment, gratings, fittings and other items by suitable covering or masking.
4. Mask or remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures and similar items in place not to receive pool plaster. Following completion of plaster for each space or area remove masking. Re-install all removed items utilizing workers skilled in the trades involved.

F. Application:

1. Finish shall be applied to a uniform thickness of 3/8 inch to 1/2 inch over the entire surface. The walls shall be scratch-coated followed by a finish coat. Material applied to the floor after the walls have been applied shall be accelerated to assure uniform setting time throughout the pool surface.
2. Float the plaster to a uniform plane and trowel to a smooth, dense, impervious surface using extreme care to avoid stains.
3. Take special care in finishing around pool fittings, making sure to mask off or plug openings so as not to fill such openings with excess plaster. Be certain to completely enclose pool fittings with plaster to insure a leak-proof seal around pipes, fittings, lights, anchors, etc.
4. Accurately interface with the finish planes of items installed by other trades.
5. Quartz and pebble plaster finish is to be applied by a licensed applicator as approved by the manufacturer, and in accordance with manufacturer's training.

3.4 CURING

- A. Preparation: Anticipate the need for required equipment and have all such equipment immediately available for use upon completion of pool plastering.
- B. Pool Filling:

1. After the plaster has sufficiently dried and before drying has proceeded to a damaging point, cure the plaster by gradually filling the pool with water, preventing all damage to finished plaster surfaces.
2. Flow the water continuously until the pool is filled.
3. When the weather is hot and/or water pressure is low, keep the pool walls damp while the pool is filling.
4. Coordinate with Contractor to ensure that the pool is continuously monitored while filling to prevent overflow.

3.5 EQUIPMENT ACTIVATION

- A. All water chemistry and filtration mechanical equipment shall be operational upon filling of pool after plaster. Chemicals and other related support items as supplied by Contractor, shall be in supply at start-up.
- B. For the first 14 calendar days after completion of the pool plaster, brush all plastered surfaces at least twice a day and coordinate with General Contractor to ensure that the plaster is carefully maintained after the initial fourteen-day period. In addition, coordinate with the Contractor to ensure that pool filtration equipment is continuously running during the initial fourteen-day period.
- C. Start-up and provide qualified personnel to operate pool equipment for a period not less than 14 days after the pool is placed in operation, or until the City takes occupancy of the facility or letter of substantial completion. During this time, Contractor shall instruct and supervise the City's personnel in the various operating and maintenance techniques involved. Contractor shall be responsible for supply of chemicals during this not less than 14-day period and at time of turnover to City, chemical storage tanks shall be full. (City's personnel shall be fully trained and capable of assuming swimming pool maintenance tasks, training may begin before City takes occupancy).

3.6 CLEAN-UP

- A. Upon completion of swimming pool plaster, remove all materials, equipment and debris occasioned by this Work and leave the job site in a clean and presentable condition. Perform all such clean-up to the approval of the City's Representative.

3.7 WARRANTY

- A. All applicators must provide a minimum of 5-year warranty for application and workmanship additional to the manufacturer's warranty for product.

END OF SECTION

**SECTION 13 11 06
SWIMMING POOL EQUIPMENT**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Swimming pool equipment items required for this Work as indicated on the Drawings and specified herein.

1.2 QUALITY ASSURANCE

- A. Qualifications of Workers:
1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least 5 years immediately prior to commencement of the Work.
 2. For actual construction operations, use only trained and experienced workers with a minimum of 3 years' experience with the materials and methods specified.
 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of 5 years' experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- B. All equipment supplied or work performed shall comply with regulations governing public swimming pools and spas as contained within Chapter 31 of California Building Code, 2022 edition.

1.3 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 01 33 00.
- B. Required submittals include:
1. Swimming Pool Fittings as specified in Article 2.1 of this Section.
 2. Swimming Pool Deck and Mechanical Equipment as specified in Article 2.2 - 2.29 of this Section.
- C. Submit proof of qualifications as specified in Article 1.2.A of this Section.
- D. The equipment shown on the plans represent the first listed items in the technical specifications. The Contractor shall be responsible for all required field coordination and installation of any equal product to provide a fully working and warranted system. The Contractor shall submit detailed shop drawings for any products used other than the first listed specified items. Contractor provided shop drawings shall include details and quality equal to the original plans and construction documents. The Contractor shall provide any and all required engineering including but not limited to structural and anchorage requirements for any proposed equipment other than the first listed specified equipment. The Contractor is responsible to provide a factory certified representative(s) to start-up and provide on-site training for all swimming pool mechanical equipment provided.

1.4 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect swimming pool equipment items before, during and after installation and to protect the installed work specified in other Sections.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the City's Representative.

PART 2 - PRODUCTS

2.1 SAFETY EQUIPMENT

- A. First Aid Kit for 50 Persons with 3 wool blankets: Marine Rescue or equal. Quantity as required by the Department of Health, three (3) minimum.
- B. Rescue Tubes (minimum 49 inches long) and Life Ring Buoy (minimum 24 inches in diameter) U.S. Coast Guard Approved: Marine Rescue or equal. Quantity as required by the Department of Health, three (3) minimum.
- C. Throw Rope (3/16-inch diameter) complete with lemon foot, for use with Life Ring Buoy: Kiefer, United Industries, or equal. Quantity as required by the Department of Health, three (3) minimum.
- D. Spine board: CJ Penton Aquatics long board with 'L' bracket head immobilizer with foam pads and Velcro strap, 4 Velcro body straps or equal. three (3) total.
- E. Rescue Hooks, 16' long x 1-1/2" aluminum pole and stainless-steel mounting hardware: Kiefer, Pentair, or equal. Quantity as required by the Department of Health, three (3) minimum.
- F. Pool Safety Signs: As required by the Department of Health. Submittal required. Placement at the pool site shall be in conformance with Health Department Inspector three (3) sets minimum.

2.2 MAINTENANCE EQUIPMENT

- A. Commercial Pool Vacuum: Provide pool vacuum cart with lid-mounted bracket for electrical cord, and two rubber-tired ball bearing wheels with grease fittings. Cart and filter shall be fabricated from schedule 304 stainless steel with welds treated and passified. Provide an all-bronze pump with a 1 1/2 hp, 115/230 volt, maximum 20-amp draw @ 120 volts, single phase motor and a 6-inch bronze trap. Pump shall be UL and NSF listed, have 2-inch suction and 1 1/2 inch discharge fittings, and have a brass priming valve with hose bib. Entire pump assembly shall be anchored to vacuum cart with two stainless steel bolts. Provide a 100 foot 10 AWG 3/C SJ electrical cord with ground fault interrupter (GFI) plus. Cord shall be wired to a double pole, 30-amp switch which shall be mounted on pump motor. One (1) required.
- B. Heavy Duty Vacuum Hose: 2" x 50', with hose connector. Pentair, or Smooth Bore. Two (2) required.
- C. Utility Pole: 24-foot fiberglass with connectors. Pentair, or Skimlite. Two (2) required.
- D. Commercial Vacuum Head: 24-inch-wide "flexible" vacuum head. Pentair Model #R201186I. Two (2) minimum.

- E. Pool Wall Brush: 36-inch-wide professional quality. Pentair. Two (2) required.
- F. Leaf Skimmer: 30" x 8" x 12", professional quality. Pentair, or Spectrum. Two (2) required.
- G. Water Quality Test Kit, Professional Grade, Taylor Technologies Model #1741C, LaMotte Model #PRO250-NJ. One (1) required.
- H. Pool Robotic Pool Cleaner: The automatic pool cleaner shall be Enduro – Turbo Clean XL50, Two (2) required. Capable of operation via 120V, 220V in 50/60 Hz, or 24 VDC incoming power; 242 GPM or 14,530 gallons per hour. Utilize 20, 70, 105, 250 and 1,000 or 2,000 micron filter screens – all constructed of mesh.
 - 1. Warranty: The robotic cleaner shall carry a 7-year anti-corrosion warranty on the stainless-steel frame from the date of product start-up. The cleaner shall carry a two-year warranty against all defects in material and workmanship, from date of product start-up, including all components in the system not including wearable items.

2.3 FITTINGS

- A. Main Drain Frame & Grate: 18" x 36", 'Daldorado' DALMAX-SG-1836-28 Six (6) required, super sump with VGB compliant grates. Provide six (6) Hayward #SP-1056 1-1/2-inch collector tubes and two #SP-1055 Hayward 1-1/2-inch hydrostatic relief valve. Contractor shall provide to the City a Certificate of Compliance, signed by a licensed design professional, for main drain sump(s) and frame(s) and grate(s), as required by the Virginia Graeme Baker Act.
- B. Gutter Outlet Frame and Grate (12" x 12"): Lawson Aquatics #MLD-FGD-1212, twelve (12) required.
- C. Floor Return Inlet 1-1/2 inch Adjustable: StaRite #08417-0000, United Industries. Fifty-seven (57) required.
- D. Surface Skimmer: StaRite 2" #08650-1403 with solvent weld fittings. StaRite, Waterway or approved equal. Twelve (12) required.
- E. Swimming Pool Underwater Lights: J & J Electronics, pure white #F5W-120-100-P, 87-watt LED. Stainless steel niches, Pentair #78210600 with one-inch hubs. Twenty-eight (28) required.
- F. Junction Box for Underwater Lights, complete with strain reliefs: Hydrel #1719. Sixteen (16) required.

2.4 WET PLAY FEATURES

Product	Qty.	Total Flow
Waterbug #2 'Vortex' VOR-7581	1	12 GPM
Water Garden Turtle #2 'Vortex' VOR-7212	1	10 GPM
Tot Twister 'Vortex' VOR-7030	1	15 GPM
Water Garden Snail #2 'Vortex' VOR-7206	1	9 GPM
Flower #2 'Vortex' VOR-7550	1	22 GPM

Plux Water Trio 'Vortex' VOR-7391	1	30 GPM
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2.5 DECK EQUIPMENT

- A. Starting Platform Anchors: KDI Paragon 'Competitor' #23103DW, 6" deep, twenty (20) required, for concrete deck. 'Competitor' #23074, cover for dual wedge, 'Competitor' #23303, cover removal tool, two (2) required.
- B. Adjustable Starting Platforms: Track Start Competitor, sidestep #24527. Ten (10) required.
- C. Stanchion Sockets: 1.90" I.D. Bronze. KDI-Paragon 38201TC, eight (8) required.
- D. Stanchion Posts: 1.90" O.D. x .145 wall. KDI-Paragon, eight (8) #38106 8' stanchion posts, and #38105, and eight (8) #38301 hook and collar, no know equal.
- E. Lane Line Anchors: Heavy eye bolt with insert. KDI-Paragon #73017/18 or equal. Forty-six (46) required.
- F. Racing Lanes: Competitor #200341000 25M lane with disconnect to 25-yard lane, verify colors with Owner prior to ordering. Eleven (11) required. Provide vinyl covered stainless steel lane line extensions, Knorr System model #EP-009-0020, two (2) per lane. Provide two (2) additional lanes to be utilized for water polo courses.
- G. Provide Turnboard Elite individual lane bulkhead, model #1310010 as manufactured by Malmsten. One (1) total.
- H. Racing Lane Reel with Cover: KDI-Paragon #75111SS with cover #75133. Two (2) required.
- I. Moveable Lifeguard Chair: 1.90" O.D. x .065 wall. KDI-Paragon #20302. Seven (7) required.
- J. Recessed Steps, Set of 3: KDI-Paragon #32102. Seven (7) sets of three required.
- K. Figure 4 Grabrails: KDI-Paragon #30102, 1.90" O.D. x 109" wall. Seven (7) sets required.
- L. Handrail: KDI Paragon custom 3-bend, 1.90" O.D. x 0.65" wall. Seven (7) required.
- M. Anchor Sockets for Grab Rails, and Handrails: KDI-Paragon 28102. Forty-two (42) required. Verify with manufacturer's requirements prior to ordering.
- N. Stainless Steel Escutcheon Plates for Grab Rails, Handrails: Spectrum Model # Forty-two (42) required. Verify with manufacturer's requirements prior to ordering.
- O. Stationary Water Polo Goals: KDI-Paragon #36104, no known equal. Furnish complete with anchors and nets, #26201. One (1) pair required.
- P. Disabled Lift: Aqua Creek MTY-400, self-operated, or equal. Furnish complete with anchors, cover, extra battery pack and transporter cart #NV01902. All parts and accessories shall be Coastal Gray. Three (3) required.
- Q. Backstroke Pennants: 'Champion' 3/16-inch diameter vinyl coated cable #50-175; 'Champion' hardware package #53-030, and 'Champion' 12" x 18" vinyl coated polyester pennants #53-020 Lincoln Equipment, or Knorr Systems. Provide 80-foot tension cable with 'T' assembly for backstroke pennant connection.

R. Pool Cover System:

1. A pool cover system as described below shall be provided and shall include all the specified features, without exception. Submittal data must include complete documentation relating to all the specified features and include manufacturer's sales literature, specification sheets, and installation/operation/maintenance manuals. Upon written request by the specifying agent, the following samples must be provided: samples of tubing used for storage reel winding tubes and end frames; a sample winding tube bearing; a sample castor wheel assembly; and a cover sample measuring at least 8" x 11", including weighted side edge, reinforced end edge, and grommet.

2. Cover Material:

a. Material shall be woven, 10 by 10 count per inch, high-density polyethylene, ultraviolet stabilized film fabric, laminated to both sides of 1/8" thick, closed cell, medium density, white, polyethylene foam. The woven polyethylene film fabric shall be coated on both sides with an ultraviolet stabilized, chemically resistant polyethylene coating. The combination of film, foam and woven components shall be non-toxic, non-absorbent, non-permeable and buoyant. Color shall be blue on upper surface and black on under surface. In addition to the above, cover must meet the following requirements:

Thickness	1/8 inch minus or plus 10 percent
Foam Density	2 lbs. per cubic foot
Weight	5 oz. per square foot
*Tensile Strength	318 lbs. (ASTM 1682264)
*Tear Strength	60 lbs. (ASTM D2261-71)
*Bursting Strength: (Mullen Tester)	425 psi (ASTM 751-73)
Service Temperature	-40°F to +160°F
K Factor	.25 BTU/sq. ft.-Hr – degrees F/inch (ASTM D2326)
Reinforced Edge Tear Strength	1225 lbs. pull strength, corner to corner
Open Seam Tear Strength	70 lbs.

3. Cover Design Criteria:

a. Cover panels shall totally cover the surface of the pool without gaps or overlaps with reinforced cutouts to accommodate rounded corners, step areas, rails, etc. Cover panels shall be of the following quantities and sizes:

Qty.	Size
5	15' x 75'-1"
1	7'-1" x 75'-1"
3	13'-0" x 50'-0" with rail cuts
3	16'-0" x 40'-0"

b. Along end and side edges of each panel, a weighted material shall be sewn in and shall be continuous, non-corrosive and conform to the flat shape of the cover. End edges shall be reinforced with a double layer of polyethylene-coated film fabric and designed in such a manner as to prevent panels from dividing when the covers are being pulled across the water. On all corners, weighted edge shall wrap corners and be itself encapsulated by the two layers of end reinforcement. The entire corner construction shall be reinforced with an 1/8-inch-thick load dispersion plate and non-corrosive grommet.

c. Both ends of each cover panel shall be equipped with no less than three non-corrosive grommets and quick-release loops for easy connection to the storage reel or to the next cover panel. All sewing shall be ultra-violet stabilized and chemically resistant 100 percent polyester thread. Main body seams shall be welded, glued or heat sealed. Complete mechanical attachment with lock-stitched thread shall be required. Warning labels consistent with the recommendations of the Federal Consumer Protection Agency shall be permanently affixed to each end of each cover panel and to the sides of perimeter panels.

4. Storage Reels:

a. The following quantity, type, and size of storage reels shall be provided:

<u>Qty.</u>	<u>Winding Tubes Per Reel</u>	<u>Length of Winding Tubes</u>
4	3	16 Foot

- b. Storage reel frame, winding tubes, castors, brake shafts, cranks and fasteners shall be made of type 304 stainless steel. Each reel shall have six wheels, each of which shall be 6 inches in diameter, be rated at 1150 pounds load capacity and be made of solid polyurethane. Wheels shall be lubricateable through grease fittings on stainless steel axle shafts and have stainless steel swivel yoke assemblies. The reel shall have two frame mounted, screw-type brakes with pads that lock directly to the pool deck and have a total of 18 square inches of total braking surface. Castor brakes or other types of foot-operated or lever-operated brakes will not be considered equal. Each winding tube shall be 4 1/2 inches in diameter; have a wall thickness of .120 inches; and shall consist of continuous length of tubing without joints or welds. Reels with tubes fabricated from two or more pieces of tubing joined together will not be acceptable. End frames shall be fabricated from 1 1/2" inch square Schedule 304 stainless steel box beam tubing with .120" wall thickness. To facilitate field repair, 3/8" stainless steel bolts, nuts and washers shall be used to connect major reel frame parts, wheels, brakes, bearings and winding tubes. Reels that use welding to connect these components will not be considered equal. Winding tube bearings shall be heavy duty, self-aligning, pillow block ball bearings with set screws to secure tube shafts and prevent their lateral movement. All bearings shall be lubricateable through grease fittings. Plastic surface bearings will not be acceptable.
- c. Each storage reel shall be provided with a protective cover constructed of vinyl-laminated polyester cloth, 1000 denier, totaling 13 ounces per square yard.

5. Measuring and Training:

- a. A representative of the manufacturer shall visit pool site to confirm measurements prior to fabrication of cover, and once cover is delivered, train operating personnel and supervise initial installation of cover.

6. Warranty:

- a. Cover panels shall be provided with manufacturer's three- year full replacement warranty covering defects in material and workmanship. Storage reel shall be provided with manufacturer's 10-year warranty covering defects in material and workmanship.

2.6 COMPETITION POOL STRAINER

- A. 'Mer-Made' F.O. Series FRP basket strainer: One (1) 8" x 6" standard with acrylic lid and two (2) sets of stainless-steel strainers each. (150 lbs.) One (1) total.

2.7 COMPETITION POOL CIRCULATION PUMP

- A. 'Paco' 5095-7, 5" x 6" x 9.6" Type 'LC' end suction centrifugal pump; 1,760 RPM 208V 3PH; 20 HP; rated at 820 GPM at 60 feet TDH; 78.7% efficient; premium efficiency TEFC motor; epoxy coat all wet surfaces. 'Paco', 'Aurora' or equal. (760 lbs.) Provide 'SPCS' smart pump control system variable speed drive model SPCS020N4X4 system 24" x 24" x 10" deep. Coordinate mounting location to maintain desired clearances, 480V, 3PH. (156 lbs.). One (1) total.

2.8 ACTIVITY POOL CIRCULATION PUMP

- A. 'Jandy' JCP07-3AT-S, 3PH pump, 208V 7.5 HP with AcuDrive XS #AD075X-2303-N4X, 7.5 HP variable frequency drive, self-priming pump, 3520 RPM rated at 390 GPM at 60 ft. TDH with integral strainer. Pump to be programmed with normal flow rate of 320 GPM. One (1) total. (201 lbs.) Interlock booster pump with circulation pump to only allow booster pump operation with circulation system is operational. Provide pump with two (2) strainer baskets.

2.9 INSTRUCTIONAL POOL CIRCULATION PUMP

- A. 'Jandy' JCP05-3AT-S, 3PH pump, 208V 5 HP with AcuDrive XS #AD050X-2303-N4X, 5 HP variable frequency drive, self-priming pump, 3520 RPM rated at 265 GPM at 60 ft. TDH with integral strainer. Pump to be programmed with normal flow rate of 230 GPM. One (1) total. (201 lbs.) Interlock booster pump with circulation pump to only allow booster pump operation with circulation system is operational. Provide pump with two (2) strainer baskets.

2.10 ACTIVITY POOL BOOSTER PUMP

- A. 'Jandy' SHPF 1.5HP, 3PH pump, 208V 2.2 HP self-priming pump, 3450 RPM rated at 107 GPM at 60 ft. TDH with integral strainer. One (1) total. (57 lbs.) Interlock booster pump with circulation pump to only allow booster pump operation with circulation system is operational. Provide pump with two (2) strainer baskets.

2.11 COMPETITION POOL FILTER(S)

- A. 'EKO3' Gen 2 #EKO-42210-1006-T-3 automatic filter control (AFC) fully automatic hi-rate permanent media filter with 63 square feet of filter area rated at 945 GPM at 15 GPM/sq. ft. Complete with 8" face piping, 6" backwash, seismic anchorage. Provide all utilities, piping, valving, etc. (7400 lbs. each tank). Provide Signet P51530-PX flosensor with digital readout. One (1) system total.

2.12 ACTIVITY POOL FILTER(S)

- A. 'EKO3' Gen 2 #EKO-42230-0806-T-1 automatic filter control (AFC) fully automatic hi-rate permanent media filter with 23 square feet of filter area rated at 345 GPM at 15 GPM/sq. ft. Complete with 8" face piping, 6" backwash, seismic anchorage. Provide all utilities, piping, valving, etc. (8155 lbs. each tank). Provide Signet P51530-PX flosensor with digital readout. One (1) system total.

2.13 INSTRUCTIONAL POOL FILTER(S)

- A. 'EKO3' Gen 2 #EKO-34175-0806-T-1 automatic filter control (AFC) fully automatic hi-rate permanent media filter with 17.5 square feet of filter area rated at 262 GPM at 15 GPM/sq. ft. Complete with 6" face piping, 6" backwash, seismic anchorage. Provide all utilities, piping, valving, etc. (6085 lbs. each tank) Provide Signet P51530-PX flosensor with digital readout. One (1) system total.

2.14 COMPETITION POOL HEATERS

- A. Indirect fired pool heating package system 'Aguas' crest with smart touch control condensing modulating boiler, titanium plate and frame heat exchanger with CPVC connections factory assembled skid mounted package. California code controls, 1 1/2" natural gas connections, 3" water connections, 8" diameter vent size, PVC vented; 2,000,000 BTU per hour input, 97% efficient, provide 3/4" cold water with adjacent floor sink for condensate. 'Lochinvar' AP0200N, weight = 3,397 lbs. Two (2) total.

2.15 INSTRUCTIONAL POOL HEATER

- A. Indirect fired pool heating package system 'Aguas' crest with smart touch control condensing modulating boiler, titanium plate and frame heat exchanger with CPVC connections factory assembled skid mounted package. California code controls, 1 ½" natural gas connections, 3" water connections, 8" diameter vent size, PVC vented; 750,000 BTU per hour input, 97% efficient, provide ¾" cold water with adjacent floor sink for condensate. 'Lochinvar' AP0200N, weight 2623 lbs. One (1) total.

2.16 ACTIVITY POOL HEATER

- A. Indirect fired pool heating package system 'Aguas' crest with smart touch control condensing modulating boiler, titanium plate and frame heat exchanger with CPVC connections factory assembled skid mounted package. California code controls, 1 ½" natural gas connections, 3" water connections, 8" diameter vent size, PVC vented; 1,250,000 BTU per hour input, 97% efficient, provide ¾" cold water with adjacent floor sink for condensate. 'Lochinvar' AP0200N, weight 2801 lbs. One (1) total.

2.17 ACID STORAGE/FEED SYSTEM(S)

- A. Provide 'Chem-Tainer' 350 gallon #TC5256DC; dual storage/containment tank with lid seismically restrained; operating weight = (2920 lbs.). Complies with Fed. Reg. #40CFR-264-163, with FRP shelf brackets. Provide complete acid vapor recovery system. One (1) total. Competition pool feed system shall be 'LMI' #SD43-88P-KSI; 288 GPD at 150 PSI. One (1) total. Activity Pool and Instructional Pool feed systems shall be 'Stenner' 85M-5, 85 GPD @ 100 PSI. Both pumps with FRP shelf brackets. Two (2) total. Hard pipe to point of injection.

2.18 CHLORINE STORAGE/FEED SYSTEM(S)

- A. Provide 'Chem-Tainer' 1000 gallon #TC7485DC, one (1) total, dual storage/containment tank with lid seismically restrained; operating weight = (4165 lbs.). Complies with Fed. Reg. #40CFR-264-193. Competition Pool Feed System shall be 'LMI' #SD43-88P-KSI; 288 GPD at 150 psi, one (1) total, with FRP shelf bracket. Activity Pool and Instructional Pool feed systems shall be 'Stenner' 85M-5, 85 GPD @ 100 PSI. Both pumps with FRP shelf brackets. Two (2) total. Hard pipe to point of injection Hard pipe to point of injection.

2.19 CARBON DIOXIDE STORAGE FEED SYSTEM(S)

- A. Provide one (1) NOVO-750 750 lb. cryogenic liquid CO2 storage tank with remote fill port. 594 liquid lbs., (5,195 cubic feet of gaseous CO2 at NTP) one (1) total. Provide EKO-PH-MTS CO2 high efficiency feed system with alkalinity control, 0 to 160 SCFH feed capacity booster pump, piping injector, flowmeter, relays and acid feed alkalinity control. Three (3) systems total (92 lbs. each) Provide hard wired 'Analox' API KIT CO2 with audible and visual alarms in chemical room, UL 1971 standard listed, one (1) total.

2.20 ACTIVITY POOL ULTRAVIOLET SYSTEM

- A. 'Evoqua' #WF-115-4-N, validated at 396 GPM 4" flanged connection in line UV with one (1) lamp @ 1500 watts, 208V 1PH. Control unit: 208V 1 PH 20" x 20" x 10" deep, 66 lbs. Provide piping bypass, valving, ETS EZ valve strainer and install per manufacturer's recommendations, one (1) system complete.

2.21 WATER CHEMISTRY CONTROLLER

- A. Provide ethernet connection to BECS Technology model CS-BECSYS7-BP-E water chemistry controller. Provide complete system control package with BecSys protocol converter with Bacnet field server device for integration into the BMS. BMS interface to provide the following points of data: temperature, ORP, PH, water flow, alarm, alkalinity. BecSys, Impact, Wallace & Tiernan or equal. Three (3) total. Coordinate communication signal with MEP contractor.

2.22 COMPETITION POOL FILL SYSTEM

- A. 3" 'Cla-Val' fill system to include 3" 'Cla-Val' solenoid control valve #136-01BY, 3" bronze body with stainless steel disc retainer and diaphragm washer, bronze trim, flanged globe pattern, 120V at 60 hz. solenoid wiring shall be wired to water chemistry controller. Provide 6" air gap at fill point. See MEP plans for water supply piping

2.23 PUMP PIT

- A. 20'-0" x 10'-0" x 5'-0" deep with 1½" ø galv. steel guardrail. Provide waterproofing per specification section 13 11 05. Access ladder to be 'Fibergate' Dynarail FRP.

2.24 BACKWASH PIT

- A. 5'-0" x 10'-0" x 5'-0" deep with 8" ø P-trap outlet to sewer. Provide waterproofing per specification section 13 11 05. Coordinate with structural and plumbing plans.

2.25 EYEWASH/SHOWER

- A. Haws model #8309WC barrier free combination shower and eye/face wash with corrosion resistant protection. See MEP Sheets for supply piping. Two (2) total.

2.26 LIGHTING CONTACTOR PANEL

- A. 'Allen Bradley' #500L; panel shall be mounted in a NEMA 12 hinged cover – lockable enclosure. Contactors to be switched equal to 'Hubbell' #1557 mounted in J-box in mechanical room. Refer to electrical plans for location of owner coordinated remote underwater light switch.

2.27 ELECTRICAL

- A. Provide all electrical wiring, conduit, panel(s), starter/disconnect interconnects etc. as required for proper equipment installation per manufacturer's recommendations and shop drawings. Coordinate all work with other trades as required. Refer to electrical plans for all additional information.

2.28 POOL OPERATOR WORKSTATION DESK

- A. 'Total Lab Solutions' epoxy countertop with drop-in sink and two (2) end cabinets. Furnish with wall mounted two (2) faucets. 'Broen Boss' or approved equal. See MEP Plans for water supply piping.

2.29 ACTIVITY POOL / INSTRUCTIONAL POOL FILL SYSTEMS

- A. Niche mounted PEM model #L104-46 wall mounted sensor unit with PEM L104-100A, 115V UL listed control panel, solenoid valves, etc. 1" fill.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Inspection:
 - 1. Prior to installing the items of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.
 - 2. Verify that the swimming pool equipment items may be installed in strict accordance with original design, pertinent codes and regulations, and the manufacturers' recommendations.
- B. Discrepancies:
 - 1. In the event of discrepancy, immediately notify the City's Representative's.
 - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies are fully resolved.
 - 3. Failure to notify the City's Representative and give written notice of discrepancies shall constitute acceptance by the Installer of existing conditions as fit and proper to receive its Work.

3.2 INSTALLATION

- A. Supply and install items of swimming pool equipment in strict accordance with applicable codes and regulations, the original design, and the manufacturer's published recommendations, anchoring firmly and securely for long life under hard use.
- B. Coordinate with other trades to insure all imbedded items are set plumb and flush. Railing ends must have anchor sockets and escutcheon plates. Be certain that deck equipment and railings are properly bonded prior to imbedding.
- C. All equipment shall be braced and/or anchored to resist a horizontal force acting in any direction using the criteria shown on the Drawings.

3.3 INSTRUCTION

- A. The Contractor shall provide a factory certified representative(s) to start-up and certify proper installation, operation and full warranty status of all swimming pool mechanical equipment. The Contractor shall provide not less than two 8-hour days of on-site training for facility staff in the operation and maintenance of the swimming pool mechanical equipment and systems. The two 8-hour days shall be separated by a minimum of seven calendar days and be completed within the 14-day start-up period.

3.4 EQUIPMENT ACTIVATION

- A. All water chemistry and filtration mechanical equipment shall be operational upon filling of pool after plaster. Chemicals and other related support items as supplied by Contractor, shall be in supply at start-up.
- B. For the first 14 calendar days after completion of the pool plaster, brush all plastered surfaces at least twice a day and coordinate with General Contractor to ensure that the plaster is carefully maintained after the initial fourteen-day period. In addition, coordinate with the Contractor to ensure that pool filtration equipment is continuously running during the initial fourteen-day period.
- C. Start-up and provide qualified personnel to operate pool equipment for a period not less than 14 days after the pool is placed in operation, or until the City takes occupancy of the facility or letter of substantial completion. During this time, Contractor shall instruct and supervise the City's personnel in the various operating and maintenance techniques involved. Contractor shall be responsible for supply of chemicals during this not less than 14-day period and at time of turnover to City, chemical storage tanks shall be full. (City's personnel shall be fully trained and capable of assuming swimming pool maintenance tasks, training may begin before City takes occupancy).

3.5 CLEAN-UP

- A. Upon completion of swimming pool equipment, remove all debris, materials and equipment occasioned by this Work to the approval of the City's Representative.

END OF SECTION

SECTION 13 11 07
SWIMMING POOL MECHANICAL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Swimming pool mechanical piping as indicated on the Drawings for circulation and filtration systems, pool water heating systems, chemical control systems, booster pump systems and appurtenances.
- B. Domestic water system from points of connection within swimming pool mechanical equipment room to make-up water system.
- C. Filter backwash piping to point of connection with backwash retention pit as required.

1.2 QUALITY ASSURANCE

- A. Qualifications of Workers:
 - 1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least 5 years immediately prior to commencement of the Work.
 - 2. For actual construction operations, use only trained and experienced workers with a minimum of 3 years' experience with the materials and methods specified.
 - 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of 5 years' experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- B. Standards:
 - 1. All equipment supplied or work performed shall comply with Chapter 31 of California Building Code, 2022 edition.
 - 2. Work shall be performed in accordance with the applicable editions of all National, State and local codes, laws, regulations and ordinances, including the following:
 - 3. American National Standards Institute (ANSI).
 - a. American Society for Testing Materials (ASTM).
 - b. American Waterworks Association (AWWA).
 - c. American Welding Society (AWS).
- C. Do not construe anything in the Drawings or Specifications to permit Work not conforming to these requirements.

1.3 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 01 3300.
- B. Required submittals include:
 - 1. Pipe and Fittings as specified in Article 2.2 of this Section.
 - 2. Valves as specified in Article 2.3 of this Section.
 - 3. Pressure / Vacuum Gauges as specified in Article 2.4 of this Section.
 - 4. Pipe Hangers and Supports as specified in Article 2.5 of this Section.
 - 5. Sleeves and Waterstops as specified in Article 2.6 of this Section.

- C. Submit proof of qualifications as specified in Article 1.2.A of this Section.

1.4 PRODUCT HANDLING

- A. Delivery: Deliver all materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.
- B. Storage: Store all materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project site.
- C. Protection: Use all means necessary to protect swimming pool mechanical items before, during and after installation and to protect the installed Work specified in other Sections.
- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the City and at no additional cost to the City.

1.5 JOB CONDITIONS

- A. Cooperate with entities performing Work specified in other Sections to so that no conflict of new construction or occupied space may occur. Should any installation Work be done without such craft coordination, that Work so installed shall be removed and re-installed.

PART 2 - PRODUCTS

2.1 PRODUCT QUALITY

- A. Materials and equipment shall be new, of the best quality for the purpose intended, and shall be clearly marked with the manufacturer's name and nameplate data or stamp and rating. As far as practicable, materials and equipment shall be of one manufacturer.

2.2 PIPE AND FITTINGS

- A. PVC Schedule 40: Type 1, normal impact, NSF approved for solvent welding applications, ASTM Specification D-1785, color shall be white. Dura, Lasco, or equal.
- B. PVC Schedule 80: Type 1, normal impact, NSF approved for solvent welding applications, ASTM Specification D-1785, color shall be gray. Dura, Lasco, or equal.
- C. CPVC Schedule 80 Influent/Effluent Heater Piping: Type 1, normal impact, NSF approved for solvent welding applications, ASTM Specification D-1785, color shall be gray. Dura, Lasco, or equal.
- D. Cold plunge piping shall be schedule 80 throughout, from the cold plunge to the pool mechanical room. Install insulation on all cold-water PVC schedule 80 piping. Provide NBR/PVC closed-cell pipe insulation, pre-slit, pre-glued with overlap, $\frac{3}{4}$ " wall thickness with a temperature range between -70° to 220°F for schedule 80 PVC pipe. Install pipe insulation per the manufacturer's recommendations

- E. PVC DR25: Conforming to ASTM D-1784, use with epoxy coated bell and spigot-type fittings or epoxy coated mechanical joint by flange adapters with epoxy coated cast iron fittings as specified in Article 2.2 (F), below. Johns-Manville "Big Blue", Diamond Plastics, or equal.
- F. Copper Tubing: ASTM Specification B-88, hard drawn, with ANSI Standard B16.22 wrought copper fittings.
- G. Steel: ASTM Specification A-120, Schedule 40 black or galvanized pipe with ASTM A-47 150 lb. banded malleable iron threaded fittings.
- H. Cast Iron: ASTM Specification B16.1, cast iron flanged fittings, provide epoxy coating as required for use with chlorinated water.

2.3 VALVES

- A. Ball Valves:
 - 1. For pool system: True-Union design, PTFE seat material with FPM or FKM Double O-ring stem seals, locking handle, NSF certified. PVC schedule 80 body for below grade installation. PVC Schedule 80 body for above grade installation. Furnish ball valves on all pipe diameters 2 1/2 inches or less with a rating of at least 200 psi at 73 degrees Fahrenheit. Asahi, Iplex, or Nibco.
 - 2. For copper pipe system: 3-piece full-port Bronze body valve with Teflon seat, 'Apollo', 'Nibco' or equal.
- B. Butterfly Valves:
 - 1. Epoxy coated cast or ductile iron body, 316 stainless steel disc and stem, viton seat material, furnish hand wheel/gear operators on all valves 8 inch and larger. DeZurick, Keystone, Iplex or equal.
 - 2. PVC body, PVC disc and EPDM construction suitable for chlorinated water applications. Stem shall be of 316 stainless steel and non-wetted. Valves shall be self-gasketed design with a convex sealing arrangement. Valves 1-1/2" – 10" shall be rated to 150 psi and 12 inch valves shall be rated to 100 psi at 70 degrees Fahrenheit. Asahi Pool-Pro, no known equal.
- C. Check Valves: Wafer-type, epoxy coated cast or ductile iron body, 316 stainless steel plates and shaft, viton seat material. Centerline, Metraflex, or equal.
- D. Swimming Pool / Activity Pool Surge Chamber Float Valve(s): EPD #2-0020-230 Float Control Valve, 10" line size, and EPD #2-0020-229 float control valve, 8" line size, two (2) total as manufactured by Environmental Products Division of Doughboy Recreational, Rancho Cucamonga, CA, no known equal.
- E. Surge Chamber Isolation Valve: Butterfly valve, tapped lug style, bronze body, stainless steel stem, bronze disc, phenolic back-up ring, EPT seat material. Provide stainless steel shaft extension, shaft housing and tool operator located 2'-0" above floor level with deck access grate as required. DeZurick, Keystone, Asahi, Spears, Iplex or equal.
- F. RP Backflow Preventer: Febco #835-B for 2 inch and smaller; #825 for 2-1/2 inch and larger. Febco, Watts, or equal.
- G. Swimming Pool / Activity Pool Make-up Water Control: 3 inch 'Cla-Val' solenoid control valve #136-01BY; 3-inch duct iron, epoxy coated body with cast iron disc retainer and diaphragm washer, bronze trim, flanged globe pattern, 120V at 60Hz. Solenoid wiring shall be wired to water chemistry controller. Provide 6-inch air gap at fill point. Two (2) systems total.

2.4 PRESSURE / VACUUM GAUGES

- A. Furnish and install pressure and vacuum gauges on the discharge and suction sides of all pumps. 2 inch or 2 ½ inch diameter dial, bottom connection, chrome ring, shut-off cock and snubber. Ranges shall be selected to indicate between mid-point and two-thirds of maximum range under design conditions. Marsh, Terice, or equal.

2.5 PIPE HANGERS AND SUPPORTS

- A. General:
 - 1. The requirements of this Section relates to various requirements of the Agreement, General and Supplementary Conditions, Specifications, Drawings, and modifying documents which are part of the Construction Contract. Responsibility for coordination of all such applicable requirements will be that of the Contractor.
- B. Description:
 - 1. This section provides guidelines and limitations for the support of all mechanical, electrical, plumbing or architectural items from the building structure, and for the seismic bracing of such items.
 - 2. Design and install all support and bracing systems as required for the swimming pool systems. Provide for attachment to portions of the building structure capable of bearing the loads imposed. Design these systems to not overstress the building structure.
- C. Quality Assurance:
 - 1. Design and install all support systems to comply with the requirements of the 2022 California Building Code, Chapter 16A.
 - 2. Seismic bracing is to be designed by a professional engineer licensed in the State of California.
 - 3. For the seismic bracing of mechanical, electrical and plumbing system, refer to "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems" by Sheet Metal and Air Conditioning Contractors National Association, Inc., (SMACNA) for guidelines.
- D. Submittals:
 - 1. Submit shop drawings for all substructures and attachment methods.
 - 2. Submit proposed alternative methods of attachment for review and approval by the City's Representative, prior to deviating from the requirements given below.
 - 3. For all pipe hangers and support systems, submit structural calculations and details which include all resultant forces applied to the building structure and are prepared and signed by the Contractor's licensed California professional engineer. Calculations will be reviewed for compliance with design criteria, not for arithmetic.
- E. Materials:
 - 1. Use Kin-Line, Grinnel, or equal.
 - 2. Support all pipelines individually with hangers, each branch having at least one hanger. Lateral brace as noted and required.
 - 3. Support piping near floor with steel stanchions welded to end plates secured to pipe and floor.
 - 4. Support vertical piping at each floor level. Install coupling in piping at each support. Coupling shall rest on and transmit load to support. Isolate copper from steel supports with vinyl electrician's tape around pipe and coupling.
 - 5. Use Stoneman "Trisolator," Unistrut, or equal, isolators at each hanger and other support points on bare copper tubing system.
 - 6. For PVC pipe, space hangers 4 feet apart for pipe sizes 1 inch and under, 5 feet apart for pipe sizes 1-1/4 inch to 2 inch, and 6 feet apart for pipe sizes over 2 inches. Space

hangers for horizontal pipes at a maximum of 6 feet for copper 2 inch and smaller and for steel 1-1/4 inch and smaller; 10 feet for copper 2-1/2 inches and larger and for steel 1-1/2 inch and larger.

7. Size hanger rods, screws, bolts, nuts, etc., according to manufacturer's sizing charts.
8. Trapeze hangers may be used for parallel lines.
9. Use galvanized or cadmium plated hangers, attachments, rods, nuts, bolts, and other accessories in pool mechanical room, high humidity areas, or where exposed to weather. Hot dip galvanize all items which are not factory furnished. Plating for hinged movements must be done at the factory.
10. Lateral Bracing: To prevent swaying of the piping systems, provide angle iron bracing and anchor into wall or overhead framing. Piping shall be braced or anchored in such a way as to resist a horizontal force of 50 percent of its operating weight in any direction.
11. Do not use wire or other makeshift devices for hangers.
12. Furnish all substructures and fasteners required to comply with the limitations given below. Use material as specified in the various sections and as appropriate to their use.
13. Install stainless steel or FRP Unistrut, pipe clamps/hangers, supports/bracing with stainless steel hardware in the chemical storage rooms, surge/balance tanks, or any other corrosive environment.

F. Guidelines & Limitations:

1. Each Contractor will coordinate the load requirements from all subcontractors so that no combination of loads overstresses the building structure or exceed the limitations given below.
2. Concrete Structure:
 - a. Support all loads hung from concrete structure with cast-in-place inserts, unless drilled-in anchors are specifically approved in writing prior to placing the concrete.
 - b. Concrete anchors must not penetrate into reinforcing bars. Where the anchors boring indicates the presence of reinforcing bar, patch hole with an epoxy type grout and relocate anchor 12 diameters away.
 - c. Individual expansion anchors cannot support any loads greater than 300 pounds or manufacturer's specified load capacity without approval.
3. Steel Structure:
 - d. Hang no more than 20 pounds per metal deck rib in any span.
 - e. At beams, hang all beam loads greater than 40 pounds concentric to beam, not off the flanges.
 - f. Attached no loads to the beams or girders greater than the following without specific approval from the City's Representative;
 - 1) Roof beams and girders: 300-pound point load or 600-pound total load for a single span.

G. Seismic Bracing:

1. Design and install seismic bracing to not ground out vibration and sound isolation systems.
2. All items of mechanical and electrical equipment 60 inch or more in height are to be seismically braced whether such bracing is shown or not.

2.6 SLEEVES AND WATERSTOPS

- A. Provide sleeves where work of this Section passes through fire rated partitions, floors and ceilings, concrete slabs or exterior of structure. Caulk clearance space using sealant appropriate for application in conformance with manufacturer's recommendations and Title 24 of California Code of Regulations. 3M, Dow Corning, or equal. In lieu of sleeves and caulking, "Link Seal" products may be used.

- B. Provide prefabricated waterstops as indicated on the Drawings at all pipe penetrations through structures containing stored water (i.e., swimming pools, balance/surge tanks, etc.) to insure leak-proof seals.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Inspection:
 - 1. Prior to Work of this Section, carefully inspect the installed Work of other trades and verify that such work is complete to the point where this installation may properly commence.
 - 2. Verify that items of this Section may be installed in accordance with the original design and referenced standards.
- B. Discrepancies:
 - 1. In the event of discrepancy, immediately notify the City's Representative.
 - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
 - 3. Failure to notify the City's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive his work.

3.2 ABBREVIATIONS AND SYMBOLS

- A. Abbreviations and symbols on the Drawings are those most commonly used. Obtain clarification from the City's Representative on any questionable items before bid.

3.3 GENERAL PIPING REQUIREMENTS

- A. Size any section of pipe for which size is not indicated or any intermediate section erroneously shown undersized the same size as the largest pipe connecting to it. Sizes listed are nominal.
- B. Cut pipe accurately to job measurements and install without springing or forcing, true to line and grade, generally square with building and/or structures and adequately supported to prevent undue stress on pipe, fittings and accessories.
- C. Make changes of direction with manufactured fittings. Street ells, bushings, reducing flanges, close nipples or bending of pipe is not allowed.
- D. Use great care to install piping in accordance with best practice. Plastic pipe shall be "snaked" in trenches to allow for thermal expansion.
- E. All above grade, below grade and buried or imbedded PVC shall be installed using solvent weld fittings. Also, each and every fitting and pipe end shall be prepared with solvent primer. Fittings shall be joined individually and with enough time between assembly of adjacent joints to allow them to seal solidly. After joining, an even ring of primer must be visible around the entire fitting. If any fittings are installed without visible primer, the fitting shall be removed and discarded and piping recut, rechamfered and joint made up again using a new fitting. All procedures, methods and techniques used to make up solvent weld joints shall be in strict accordance with manufacturer's recommendations.

- F. Arrange pipe and hangers to allow for expansion, contraction and structural settlement. No pipe shall contact structure except penetrations as shown on the Drawings.
- G. Provide dielectric connections between copper and dissimilar metals. In copper systems, threaded piping including connections to equipment shall be brass pipe and fittings. Install dielectric connections in vertical sections of piping only.
- H. Run pipe full size through shut-off valves, balancing valves, etc. Change pipe size within three pipe diameters of final connection to control valves, fixtures and other equipment.
- I. Provide unions or flanges at connections to equipment, on service side of valves and elsewhere as required to facilitate ease of maintenance.
- J. Locate equipment shut-off valves as close to equipment as possible maintaining easy valve access.
- K. Make all connections between domestic water systems and equipment or face piping with approved backflow prevention devices as required.
- L. All PVC pipe exposed to direct sunlight shall be painted with two coats of Exterior Acrylic Semi-Gloss Paint, Sherwin Williams or equal. Color to be selected by the City's Representative. Prior to painting the PVC pipes, the exterior of all PVC pipes shall be wiped with Methyl Ethyl Ketone, or an equal, to remove the glaze from the pipes.
- M. The Main Drain pipe must run either level or uphill from the main drain sump, through the surge pit (if applicable) and then to the circulation pump.

3.4 TRENCH EXCAVATION AND BACKFILL

- A. Excavation:
 - 1. Excavate and backfill trenches as required for the Work of this Section. Conform to requirements of Section 13 11 01.
 - 2. The Contractor shall perform all excavation of every description and of whatever materials encountered, to the depths indicated on the Drawings or as necessary. The Contractor shall dispose of the excavated materials not required or suitable for backfill as directed, and shall perform such grading as may be necessary to prevent surface water from flowing into the trenches. The Contractor shall provide adequate equipment for the removal of storm or subsurface waters, which may accumulate in the excavated areas.
- B. Trenching:
 - 1. Excavate trenches to lines and grades as indicated on the Drawings and with banks as nearly vertical as practicable.
 - 2. Bottoms of trenches shall be accurately graded to provide uniform bearing on undisturbed soil for the entire length of each section of pipe.
 - 3. The width of the trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench wall shall not exceed 8" on either side of the pipe. The width of trench above the top of pipe may be wider if necessary.
 - 4. Over-depth excavations shall be filled with tamped sand to required grades.
 - 5. Excavations of 5 feet or more in depth shall be shored or supported in conformance with rules, and regulations of State and Federal Governments. Shoring shall be constructed, maintained and removed in a manner to prevent caving of the excavation walls or other load on the pipe.
- C. Backfilling:

1. Material for backfilling of pipes shall be approved granular material less than 2 inches in diameter obtained from the excavation. No material of a perishable, spongy or otherwise unsuitable nature shall be used as backfill.
2. Backfilling of pipe trenches shall commence immediately after installation and testing to preclude damage to the installed pipe. Backfill around pipe shall be carefully placed so as not to displace or damage the pipe, and shall be carried up symmetrically on each side of the pipe to one foot above the top of the pipe. The material shall be carefully compacted or consolidated before additional backfill is placed.
3. Backfill above an elevation of one foot above the top of pipe in conformance with requirements of Section 13 11 01. Material for balance of backfill shall be approved granular material less than 6 inches in diameter taken from the excavation.
4. Unless otherwise indicated on the Drawings, all pipe shall have a minimum of 18 inches of cover.

3.5 GENERAL EQUIPMENT REQUIREMENTS

- A. Position equipment to result in good appearance and easy access to all components for maintenance and repairs.
- B. Install piping, flues, breeching and ducts so that they do not interfere with equipment access.
- C. Install level, secure and out of moisture. Provide shims, anchors, support straps, angles, grouted bases, or other items as required to accomplish proper installation.
- D. All screws, nuts, bolts and washers shall be galvanized, cadmium plated or stainless steel. After fabrication, hot-dip galvanize unfinished ferrous items for outdoor, below grade or other use subject to moisture.
- E. Extend ½ inch Schedule 40 black steel pipe lubrication tubes from all hard to reach locations to front of equipment or to access points. Terminate with proper type of lubrication fitting.

3.6 VALVES AND STRAINERS

- A. If no shut-off is indicated, provide ball valves at inlet connections and balance valves at outlet connections to fixtures and equipment. Provide proper valve trim for service intended.
- B. Use no solder end valves unless noted otherwise; provide adapters in copper tubing systems.
- C. Locate valves with stems above horizontal plane of pipe. In general, locate valves within six (6) feet of floor, out from under equipment, in accessible locations with adequate clearance around hand wheels or levers for easy operation.
- D. Provide all valves, cocks and strainers, full pipe size unless indicated otherwise.
- E. Provide hand wheel operators on all valves 6 inches and larger, under 6 inches lever operators may be used.
- F. Provide tool operated valve with stainless steel shaft extension and 'on deck' tool operation for surge chamber butterfly isolation valve.

3.7 IDENTIFICATION OF PIPING

- A. Identify each valve by a numbered brass tag with hole and brass chain mounted on valve stem or handle. Tag to be a minimum of 1 inch in diameter and numbers at least ¼ inch high stamped into tag. Valves and plumbing lines shall be labeled clearly with the source or destination descriptions.
- B. Install an identification chart in a plastic or glass framed enclosure, which schematically illustrates the proper operation of all piping systems and indicates number and location of all valves and control devices within the system.
- C. The direction of flow for the recirculation equipment shall be labeled clearly with directional symbols such as arrows on all piping in the equipment area. Where the recirculation equipment for more than one pool is located on site, the equipment shall be marked as to which pool the system serves.

3.8 TESTS

- A. Perform tests in presence of City's Representative with no pressure loss or noticeable leaks.
- B. Do not include valves and equipment in tests. Include connection to previously tested sections if systems are tested in sections.
- C. Perform tests as follows:

<u>System</u>	<u>Test Pressure</u>	<u>Test Medium</u>	<u>Duration</u>
Skimmer Lines and Lawson Main Drain sump lines	20 psig	Water*	4 hours
Pool Piping	50 psig	Water*	4 hours
Pool Main Drains	30 psig	Water*	4 hours
Domestic Water	150 psig	Water*	4 hours

*Never test PVC pipe or fittings with air or other gases, always use water.

3.9 PIPE MATERIAL APPLICATION

- A. PVC Schedule 40: Below grade swimming pool piping and domestic water piping up to 12-inch line size; use standard solvent weld fittings.
- B. PVC Schedule 80: Above grade swimming pool piping up to 12-inch line size; use solvent weld Schedule 80 or epoxy coated cast iron fittings.
- C. Type L Hard Copper: Above grade domestic water piping.
- D. CPVC Schedule 80; Pool Heater Piping.
- E. Schedule 40 Steel: Natural gas piping.
- F. Pipe Insulation for Cold Plunge or Cold-Water Piping: Install pipe insulation on all cold water PVC schedule 80 cold plunge circulation piping located in the pool mechanical room and exposed above grade piping. Provide NBR/PVC closed-cell pipe insulation, pre-slit, pre-glued with overlap, ¾" wall thickness with a temperature range between -70° to 220°F for schedule 80 PVC pipe.

3.10 CUTTING AND DRILLING

- A. Cutting or drilling necessary for installation of Work of this Section shall be done only with approval of City's Representative.

3.11 CLOSING-IN OF UNINSPECTED WORK

- A. Do not cover or enclose Work before testing and inspection. Re-open Work prematurely closed and restore all Work damaged.

3.12 QUIETNESS

- A. Quietness is a requirement. Eliminate noise, other than that caused by specified equipment operating at optimum conditions, as directed by City's Representative.

3.13 FLUSHING OF LINES

- A. Flush or blow out pipes free from foreign substances before installing valves, stops or making final connections. Clean piping systems of dirt and dust prior to initial start-up.
- B. Just prior to plastering the pool, under the observations of the IOR, the pool mechanical system shall be flushed using the pool circulation pump. Circulate water through the mechanical system until the effluent water from the pool return heads runs clean.

3.14 CLEAN-UP

- A. After all Work has been tested and approved, the Swimming Pool Subcontractor shall thoroughly clean all parts of the equipment installations, including all pool pipe and fittings in the pool mechanical room. Exposed parts shall be cleaned of cement, plaster and other materials and all grease and oil spots removed with solvent.
- B. The Swimming Pool Subcontractor shall remove debris from the Project site. Cartons, boxes, packing crates and excess materials not used, occasioned by this work shall be disposed of to the satisfaction of the City's Representative.
- C. If the above requirements of clean up are not performed to the satisfaction of the City's Representative, the City reserves the right to order the work done, the cost of which shall be borne by the Swimming Pool Subcontractor.

END OF SECTION

SECTION 13 11 08
SWIMMING POOL ELECTRICAL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide labor, materials and equipment as required to install the swimming pool electrical system including but not limited to:
1. A complete and operable system of service equipment, switchboards, panelboards, conduits, switches, time clocks and wiring for power and lighting, motor control centers.
 2. Junction and/or pull boxes, conduits, disconnects, starters, contactors, wiring and connection of all motors and mechanical equipment, including connection and wiring of line voltage controls associated with the mechanical systems.
 3. Swimming pool underwater lighting systems.
 4. Swimming pool timing system outlets and scoreboard.
 5. Complete grounding system as required and shown on the Drawings.
 6. Complete equipotential bonding system as required and shown on the Drawings.
 7. Adjusting and preliminary operation of the completed electrical system as described in Article 3.6, A of this Section.
 8. Cleaning of all completed Work and installation adjustment of all trim and decorative items.

1.2 QUALITY ASSURANCE

- A. Qualifications of Workers:
1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
 2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years' experience with the materials and methods specified.
 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years' experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- B. Ordinances and Codes: Materials and construction shall conform with all applicable code requirements, including:
1. National Electrical Code, latest edition; Electrical Safety Orders of the State of California; Department of Industrial Relations; regulations of the State Fire Marshal; rules and regulations of the Board of Underwriters of the Pacific, UL 50, 50E and NEMA 250 rating.
 2. Chapter 31 of California Building Code, 2022 edition.
- C. Verification of Conditions:
1. 1. The locations shown on the Drawings are diagrammatic only and the exact finish location of equipment and materials cannot be indicated. Therefore, locations of all Work and equipment shall be verified to avoid interferences, preserve head room and

keep openings and passageways clear. Changes shall be made in locations of equipment and materials which may be necessary to accomplish these purposes.

- D. Preliminary Operations and Testing:
 - 1. Motor driven equipment shall be tested for correct rotation and completion of all connections.

1.3 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 01 33 00. Requests for substitutions shall conform with requirements of Article 1.10.A of Section 13 11 00.
- B. Required submittals include:
 - 1. Conduit and Fittings as specified in Article 2.2 of this Section.
 - 2. Panelboards as specified in Article 2.6 of this Section.
 - 3. Circuit Breakers as specified in Article 2.7 of this Section.
 - 4. Motor Starters as specified in Article 2.10 and 2.11 of this Section.
 - 5. Fuses as specified in Article 2.13 of this Section.
 - 6. Time Clocks as specified in Article 2.14 of this Section.
 - 7. Ground Fault Circuit Interrupters as specified in Article 2.15 of this Section.
 - 8. NEC required corrosion resistant enclosures, cabinets and boxes as specified in Article 2.8, 2.11, 2.16 & 2.18 of this Section.
- C. Submit proof of qualifications as specified in Article 1.2.A of this Section.

1.4 PRODUCT HANDLING

- A. Delivery: Deliver all materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.
- B. Storage: Store all materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project site.
- C. Protection: Use all means necessary to protect swimming pool electrical materials before, during, and after installation and to protect the installed Work specified in other Sections.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Materials shall be new, in unbroken packages and bear the U.L. label of approval.
- B. Equipment of one type shall be by same manufacturer. One type of equipment for classifications such as:
 - 1. Switchboards, panels, buss duct, disconnect switches and allied items.
 - 2. Conduit.
 - 3. Wire.
 - 4. Conduit fittings.

5. Fixtures of the same general type.
6. Wiring devices.

2.2 CONDUIT AND FITTINGS

- A. Conduit within or under buildings or where exposed outdoors shall be rigid metal threaded, hot dipped galvanized, or U.L. approved plastic except where noted otherwise on the Drawings. Metallic conduit shall be of the same metal between outlets or terminals.
- B. Use flexible metallic conduit only for short connections of motors and where specifically called for on Drawings. Maximum length shall be 40". Use only liquid tight flexible metal conduit. Install an unbroken #12 AWG insulated copper grounding conductor in each liquid tight flexible conduit with permanent connection at motor junction box and service panel ground.
- C. Protect, before installation, metallic conduit runs in all slabs laid on grade or in contact with the earth or exposed in damp locations, with two (2) heavy coats of asphaltum rust-resisting compound.
- D. Encase conduits 2-1/2" or larger run underground, outside, or under buildings, in concrete envelopes a minimum of 3" thick, except as indicated otherwise on Drawings or stubouts. Conduits 2 and smaller laid 18" below finish surface in soil.
- E. Low voltage runs underground outside buildings, 1-1/4" or smaller, may be G.I. or sherardized steel conduit, with machine applied wrapping equal to double wrap or Scotch-Wrap #50 tape, half lapped and quadrupled at joints in lieu of concrete encasement.
- F. Service conduits through foundations or concrete members shall run through metal sleeves with adequate clearances for full movement of the conduit. Do not run conduits through footings.
- G. Secure conduits run exposed on surfaces with one hole heavy-duty straps or fasten with matching fittings to inserts or trapezes, parallel to building walls and ceilings.
- H. Cap all conduit or duct stub-outs with standard factory caps; except cap threaded steel conduit with B.I. water pipe caps in outdoor locations.
- I. Use conduit fittings as manufactured by Crouse-Hinds Company, Appleton Electric Co., or equal.
- J. Employ U.L. liquid tight fittings for use with liquid tight flexible metal conduit.
- K. Use unions as manufactured by Appleton, O-Z/Gedney, or equal. The use of running threads will not be permitted.
- L. Exposed conduit and fittings in chemical rooms shall be nonmetallic rigid polyvinyl chloride, corrosion resistant rated suitable for installation in corrosive environments and in accordance with the latest NEC requirements.

2.3 EQUIPOTENTIAL BONDING/GROUNDING

- A. Bond together and ground to a common ground at a single point all metallic conduit, piping systems, pool reinforcing steel, metal parts of ladders, lifeguard stands, handrails and their supports and the like. The solid copper bonding conductor shall not be smaller than #8 copper.

2.4 WIRING CONNECTIONS

- A. Make connections without strain on conductors, allowing the conductors to take a natural position after connections or taps are made. Include all strand of wire in making the connection.
- B. Make connections for wiring by one of the following means:
 - 1. Make all taps or connections to conductors with compression type connectors except those smaller than #8 B&S gauge may have soldered connections. Solderless connections for #10 AWG or smaller may be used and shall be "Scotchlok", Buchanan, or equal. For #8 AWG or larger, they shall be T&B "LockTite", Burndy "Versitaps", or equal.
 - 2. All cable or conductor terminal lugs shall be Burndy "Quicklug", IlSCO, or equal. Two-piece stamped lugs and solder lugs will not be approved.
 - 3. Paint taped splices in damp or outdoor locations with two (2) coats of insulating paint.
 - 4. Tag all branch circuit wires with circuit number at the panelboard and at each point of use with linen or plastic tags.

2.5 CONDUCTORS

- A. Copper RHW or THW. Do not make splices between boxes.

2.6 COLOR CODING

- A. Neutrals (identified conductors shall be white).
- B. Phase conductors shall be red for phase B; blue for phase C.
- C. Green shall be used for mechanical equipment and receptacle grounds only.

2.7 MOTOR WIRING

- A. Make final connections to motors with the required AWG (Minimum #12), Flamenol machine tool wire, 19 strand. Control wiring for equipment shall be Flamenol machine tool wire, 19 strand of required AWG. Provide corrosion resistant junction boxes at each item of equipment to change from standard building wiring to machine tool wire.
- B. Phase motors as proper in direction of rotation.

2.8 PANELBOARDS

- A. Panelboards shall be flush or surface mounting as indicated with circuit breakers as shown on panel schedule, hinged lockable doors, index card holders and proper bussing.
- B. Where indicated on the drawings, panelboards shall be furnished with subfeed breakers and/or lugs, split bussing, contractors, time switches, relays, etc., as required.
- C. All panelboards shall be keyed alike.
- D. All panelboard enclosures shall be corrosion resistant rated in accordance with the latest NEC requirements.
- E. Furnish corrosion resistant panelboard enclosures and terminal cabinets with Yale 46515 flush locks and LL806 keys except where indicated otherwise herein. Fasten the trim to panel boards and terminal cabinet by means of concealed, bolted or screwed fasteners accessible only when the door is open.
- F. Panelboards 208/120 volt, three phase, 4 wire, S/N or 120/240 volt, single phase, 3 wire, S/N.

Panelboard types as manufactured by:

Westinghouse
General Electric
Square D

Type B10B
Type NLAB
Type NQOB

- G. Panelboards for 480/277 volt, three panes, 4 wire, S/N.

Panelboard types as manufactured by:

Westinghouse
General Electric
Square D
Sylvania
I.T.E.

Type Pow-R-Line 2
Type AE
Type NEHB
Type NH1B
Equal

- H. Panelboard for bussing sizes thru 400 amp shall be 20" wide surface mounted type. Recess mounted type shall have a 20" wide (maximum) recess metal enclosure with trim plate cover extending 1" on all sides of enclosure. Depth shall be 5-3/4" nominal. Height of panel as required for devices.
- I. Provide 6" additional gutter space in all panels where double lugs are required, or where cable size exceeds bus size. Minimum bottom gutter space shall be 6" high. 12" additional gutter space may be required for aluminum feeders where used.
- J. Panelboards shown on the drawings with relays, time clocks or other control devices shall have a separate metal barriered compartment mounted above panel with separate hinged locking door to match panelboard. Provide mounting sub-base in cabinet for control devices and wiring terminal strips.
- K. Panelboard shall have a circuit index card holder removable type, with clear plastic cover. Index card shall have numbers imprinted to match circuit breaker numbers.

2.9 CIRCUIT BREAKERS

- A. Breakers shall have a minimum short circuit interrupting rating of 10,000A symmetrical for panelboard voltage thru 240 volt and 14000A for panelboards thru 600 volts or as specified on the drawings. In no case shall the interrupting rating be less than the bus withstand rating unless noted otherwise on the drawings.
- B. Circuit breakers as manufactured by the following companies only are acceptable:
 - 1. General Electric Company
 - 2. Square D Company
 - 3. Westinghouse Company
 - 4. I.T.E. Company
- C. Circuit breakers shall be arranged in the panels so that the breakers of the proper trip settings and numbers correspond to the numbering in the panel schedules on the drawings. Circuit numbers of breakers shall be black-on-white micarta tabs or other previously approved method. Circuit number tabs which can readily be changed from front of panel will not be accepted. Circuit number tabs shall not be attached to or be a part of the breaker.
- D. Where two or three pole breakers occur in the panels, they shall be common trip units. Single pole breakers with tie-bar between handles will not be accepted.
- E. All circuit breakers shall be padlockable in the "off" position. Locking facilities shall be riveted or mechanically attached to the circuit breaker (submit sample for approval). Other means of attachment shall not be accepted without prior written approval of City's Representative.
- F. Where branch circuit breakers supply the power to motors and signal systems, the breakers shall be furnished with lockout clips, mounted in the "on" position. The breakers shall be able to trip automatically with lockout clips in place.
- G. Panelboard circuit breakers shall be bolt-on type.

2.10 BUSSING

- A. Bussing shall be rectangular cross section copper, or full length silver or tin-plated aluminum.
- B. Bussing shall be braces to withstand symmetrical short circuit ratings as follows or as noted on drawings. In no case shall bus short circuit bracing be less than specified circuit breakers.
- C. Each panelboard shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.

2.11 POOL MECHANICAL EQUIPMENT ENCLOSURES, TERMINAL CABINETS & MISC CABINETS

- A. All pool mechanical equipment enclosures, terminal cabinets and miscellaneous cabinets in the pool mechanical room or chemical storage rooms shall be corrosion resistant rated in accordance with the latest NEC requirements. Enclosures and all cabinets shall be flush mounted (except where noted a surface) of the size indicated on the drawings, and complete

with hinged lockable doors and the number of 2-way screw terminals required for termination of all conductors. Terminal cabinet locks to operated form same key used for panelboards. The trim to terminal cabinets shall be fastened by means of concealed bolted or screwed fasteners accessible behind door to terminal cabinets. Terminal cabinets shall have 5/8" plywood backing.

- B. Provide engraved nameplate on each enclosure and cabinet indicating its designation and system (i.e., Swimming Pool - Panel 'SP').

2.12 MOTOR CONTROL INDIVIDUAL STARTERS

A. Manual Motor Starters:

1. Provide flush or surface mounting manual motor starters with number of poles and size of thermal overload heaters as required for the motor being controlled (equipped with overload heaters, one for each motor lead). Back boxes shall be supplied with all flush mounting starters whether they are toggle type requiring only a 4" square outlet box or the larger type requiring a special box and cover designed to accept the particular unit. All box types shall be corrosion resistant rated in accordance with the latest NEC requirements.
2. Unless otherwise noted on the drawings, all manual starters for single phase motors, smaller than 1 h.p., shall be the compact toggle type. Manual starters for all single-phase motors, 1 to 5 h.p., and all three phase motors up to 5 h.p. shall be the heavy-duty type.
3. Where manual motor starter is shown with pilot light, the pilot light shall be installed in a separate outlet box adjacent to the starter outlet, and engraved nameplate in indicate function of pilot light.
4. The following motor starters as manufactured by:

Manufacturer	Single Phase 1HP and Below	Others
Arrow Hart	Type RL	Type LL
General Electric	CR 101	Class CR 1062
I.T.E.	Class C10, C11 or C12	Class C20
Square D Company	Class 2510, Type A	Class 2510, Type B & C
Westinghouse	Type MS	Type A100
Allen Bradley	Equal	Equal.

B. Individual Magnetic Motor Starters:

1. Magnetic motor starters shall be A.C. line voltage, across-the-line units in a corrosion resistant rated enclosure in accordance with the latest NEC requirements.
2. All starters located outside of a building whether or not indicated shall be W.P. (weatherproof), and all starters noted W.P. shall be furnished in a corrosion resistant rated stainless-steel enclosure in accordance with the latest NEC requirements.
3. Starter shall be horsepower rated for the motor controlled, and shall be equipped with properly sized overload elements. Every pole shall be with overload element.
4. Verify the exact motor current and voltage characteristics with the Contractor supplying the motor before installation of a starter.
5. Each starter shall be equipped with "Hand-Off-Auto" switch or stop-start pushbutton as required.

6. Coils shall be designed to operate on voltage indicated on control diagrams and have built-in-under the voltage release for coil circuit to drop motor starter off the line when the line voltage drops below normal operating voltage.
7. The coil control circuit shall be independently fused, sized to protect coil.
8. Starters to be equipped with running pilot light indication with a "Push-to-Test" feature.
9. Magnetic starters shall have a minimum of two auxiliary contacts. Additional auxiliary contacts shall be provided as required to comply with the requirements of the wiring diagrams on the electrical and mechanical drawings and the description of the function in the Mechanical Section of the Specifications.
10. Starters shall comply with NEMA standards, size and horsepower ratings as indicated on drawings.
11. The following types of magnetic motor starters as manufactured by:

Manufacture	Type
General Electric	Class CR 106
I.T.E.	Class A20
Square D Company	Class 8536
Westinghouse	Type A200 (Size 4 Max.) or Class II-200 (Sizes 5-8)

2.13 INDIVIDUAL COMBINATION MOTOR STARTERS

- A. Combination starter shall incorporate fused disconnect switch and individual magnetic motor starter. Combination starters shall be mounted in a corrosion resistant rated enclosure in accordance with the latest NEC requirements.
- B. Starters shall comply with NEMA standards, size and horsepower ratings as indicated on drawings General Electric, Square D, Westinghouse or I.T.E.
- C. The disconnect handle used on combination starters shall control the disconnect device with the door opened or closed. The disconnect handle shall be clearly marked as to whether the disconnect device is "ON" or "OFF", and shall include a two-color handle grip, the black side visible in the "OFF" position indicating a safe condition, and the red side visible in the "ON" position indicating an unsafe or danger condition.
- D. All starters used in combination starters shall be manufactured in accordance with the latest published NEMA standards, sizes, and horsepower ratings. These starters shall be furnished with three melting alloy type thermal overload relays.
- E. Thermal units shall be of one-piece construction and interchangeable. The starter shall be inoperative if a thermal unit is removed.

2.14 MOTOR CONTROL CENTER, INTERLOCKS AND CONTROL DEVICES

- A. Refer to mechanical and plumbing drawings and specifications and provide all control devices including timeswitches, relays and interconnection of starters as required.

- B. Mount all relays and timeswitches in a separate compartment in motor control center unless otherwise indicated.
- C. Whether shown on mechanical and plumbing drawings or control center schedules or not, where motors are controlled by external devices (i.e., thermostats, relays, float or pressure switches, etc.) or interlocked with other motors, each motor starter to be equipped with a "Hand-Off-Auto" selector switch in starter cover. Other starters equipped with a "Start' Stop" pushbutton station in starter cover. The Contractor shall be responsible to submit a complete and detailed set of shop drawings, electrical schematic design along with electrical component cut sheets from the MCC panel or the interlock control device manufacturer. RSD Total Control: Allan Pearson 949-380-7878, South Coast Controls: Anthony Ellis 714-998-5656 or equal.

2.15 FUSES

- A. Fuses shall be dual element, current limiting type, U.L. Class RK5 unless otherwise indicated on the drawings. Provide one spare set of fuses of each size and type in each motor control center.

2.16 TIME CLOCKS

- A. Time clocks shall be provided for all underwater lighting systems and swimming pool circulation pumps not controlled by filter microprocessors.
- B. Contacts shall have a minimum rating of 40 amperes at 277V.
- C. Timing motor shall be heavy duty synchronous, self-starting, high torque type, and shall be rated at 120, 208, 240, 277 volt 60 Hz.
- D. Motor shall operate normally at temperature range of -60 degrees Fahrenheit to +120 degrees Fahrenheit.
- E. Dial shall be 3" diameter, clearly calibrated with day/night zones and 24-hour rotation, with gear to provide one revolution yearly which automatically varies the on/off settings each day according to seasonal changes. Day and month of the year shall show clearly through calendar window on the dial.
- F. Time clocks shall be equipped with 7-spoke omitting wheel marked with days of the week.
- G. Time clocks shall be housed in a corrosion resistant rated enclosure in accordance with the latest NEC requirements.
- H. Acceptable manufacturers are Intermatic, Tork, Paragon, or equal.

2.17 GROUND FAULT CIRCUIT INTERRUPTERS

- A. Minimum rating shall be 20 amperes, 125V, 5 milliampere trip setting, Class A per UL943.
- B. Manufacturer to be Crouse-Hinds, Leviton, or equal.

2.18 BOXES

- A. Boxes shall be of the size required by ordinances or larger, must be corrosion resistant in accordance with the latest NEC requirements where concealed or exposed on ceilings or walls.
- B. Outlets to be surface where wiring is exposed and flush in areas where conduit is concealed.
- C. Provide surface outlets with proper corrosion resistant surface covers. Box and cover shall be deep enough to provide at least 1/4" clearance between back of device and back of box. Where box contains more than one device, use a corrosion resistant rated gang box with proper cover in accordance with the latest NEC requirements. Surface outlet boxes shall be of the threaded hub type wherever below 8'0".
- D. If necessary, for cable installation, additional pull boxes or junction boxes may be installed in accessible locations. Exposed pull boxes and junction boxes shall be corrosion resistant rated in accordance with the latest NEC requirements.
- E. Where exposed to weather pull boxes larger than outlet boxes are required, galvanized code gauge sheet steel boxes may be used with covers attached by brass machine screws may be used. Boxes exposed to the weather shall be approved for the purpose, and conduit entrances shall be on the bottom made by means of an interchangeable hub with gasket and adapter nut. Pull boxes not shown on Drawings may be added only after approval of size and location is obtained.
- F. For outlets exposed to weather or where noted, cast outlet boxes shall be Crouse-Hinds, Appleton, or equal. Boxes shall have proper number and size hubs. Device plates, covers, adapters and boxes shall be as manufactured by Crouse-Hinds, Appleton, or equal.
- G. Exposed junction boxes, outlet boxes and pull boxes for pool chemical rooms shall be non-metallic suitable for a corrosive environment and in accordance with the latest NEC requirements.

2.19 IDENTIFICATION MARKINGS

- A. Plainly mark all motor and electrical appliance control equipment indicating the equipment controlled with engraved metal tags.
- B. Provide laminated plastic nameplates on panelboards on the outside of the door at the top indicating panel designation and feeder source.
- C. Provide laminated plastic nameplates on distribution switchboards and motor control centers at the top center indicating panel designation and feeder source.
- D. Identify each distribution switchboard and motor control center circuit breaker with a laminated plastic nameplate indicating its' use.
- E. Type panelboard directories on the forms provided with the equipment, indicating the use of each branch circuit breaker.
- F. Fasten all laminated plastic nameplates to surfaces with two (2) or more screws.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify conditions at the Project site before submitting bid. Be responsible for providing all necessary wiring for the new electrical systems. Wherever wiring is being disrupted due to remodeling or changes, reconnect existing and provide new wiring circuits to accomplish a fully operable system at no additional cost to the City.

3.2 COORDINATION

- A. The Drawings are essentially diagrammatic and indicate the desired location, size, routes, connection points, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the Work so as to provide the best possible installation in the available space and to overcome difficulties, limitations or interference wherever encountered. Be responsible for the correct placement of this Work, the proper location and connection in relation to Work of other trades, for determining the exact location of all conduits, outlets and equipment, and for installing the conduits in such a manner as to conform to the structure, avoid obstruction, preserve headroom and keep openings and passageways clear. Particular attention is directed to the close coordination required on exposed Work. Locations shown on Architectural or Mechanical Drawings if different than those shown on Electrical Drawings should be communicated to the City's Representative in writing for clarification.

3.3 INSTALLATION

- A. Trenching and Backfill: Conform with requirements of Section 13 11 01. Provide minimum cover as required by Code.
- B. Conduit Installation:
 - 1. Conduit and metallic raceway systems shall be mechanically and electrically continuous from sources of current to all outlets in a manner to provide a continuous grounding path. Close ends of conduit during construction to prevent entrance of dirt or moisture.
 - 2. Securely fasten conduit to the building construction within three feet of each outlet and within every ten feet thereafter. Secure it to boxes, cabinets, pull boxes, terminals with two locknuts and ends equipped with bushings or a terminal fitting. Cut square with ends carefully reamed.
 - 3. Make bends or elbows so that the conduit will not be injured or flattened.
 - 4. Use insulated metallic bushings in all places where bushings are required.
 - 5. Run exposed conduits level or plumb and parallel to the construction members of the building. No cutting across or diagonal runs will be permitted. Neatly surmount structural obstructions encountered on conduit runs by the use of fittings or pull boxes.
 - 6. Identify feeder conduits by stamped metal tags secured to exposed section of conduit in main or sub-panels.
 - 7. Make up all threaded conduit joints gas and watertight with conductive sealer except conduit above ground in dry indoor locations.
 - 8. Rigidly support all boxes independently of the conduit system.
- C. Connections to Equipment:

1. Fully connect, in an approved manner, all electrical outlets, apparatus, motors, equipment, fixtures, wiring devices and appliances whether they are installed under the Electrical Contract or not, which require electrical connections, to the corresponding electrical system outlet.
2. Where the Work of this Section requires connections to be made to equipment that is furnished and set-in-place under other Sections, obtain such roughing-in dimensions from the manufacturer or supplier of each item as required and assume full responsibility for the installation of the connections thereto.

3.4 ADJUSTMENT AND CLEAN-UP

- A. Preliminary Operation: Should the City's Representative deem it necessary to operate the electrical installation or any part thereof prior to Substantial Completion of the Work, consent to such preliminary operation and supervise conduction of same. Subcontractor shall pay all costs occasioned by such operation. Preliminary operation shall not be construed as an acceptance of any Work installed under this Contract.
- B. Clean-up: Upon completion of the Work of this Section, immediately remove all swimming pool electrical materials, debris and rubbish occasioned by this Work to the approval of the City's Representative.

END OF SECTION

SECTION 21 13 13
FIRE SUPPRESSION SPRINKLER SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fire sprinkler system for protection of buildings.

B. Related Requirements: The requirements of this Section, NFPA 13 shall take precedence over requirements found in the following:

1. Division 01 - General Requirements.

1.02 SUBMITTALS

A. Manufacturer's Data:

1. Submit complete and detailed equipment and material list of items to be furnished and installed under this section.
2. Submit manufacturer's specifications and other data required to demonstrate compliance the plans and specified requirements.

B. Drawings:

1. Submit shop drawings of wet pipe fire protection sprinkler system in compliance to NFPA 13, Standard for the Installation of Sprinkler Systems, Sprinkler systems shall comply with the provisions of NFPA 13.
2. Shop drawings shall fully comply with the most stringent provisions of this specification and plans, and with the applicable codes and standards.
3. Shop drawings shall be same size as the Contract Drawings and shall be produced using AutoCAD.

C. Regulatory Requirements:

1. Installation of fire sprinkler system shall not vary from the plans unless alterations have been approved by City of Ridgecrest Fire Department.
2. Complete NFPA 13 Standard for Installation of Sprinkler Systems. Standard.

D. Closeout Submittals: Submit in accordance to Section 01 7700, Contract Closeout, and as specified herein:

1. Record Drawings:

- a. Record drawings of installed Work shall be maintained current on the Project site, available for Fire Marshal and the Project Inspector to review.
- b. At completion of installation submit Record Drawings signed by installing Contractor in AutoCad format, including:

- 1). Record Specifications.
- 2). Record Product Data: Include specific model, type and size for equipment and material installed.
3. Record Test Results.
4. Maintenance Manuals.

1.03 QUALITY ASSURANCE

- A. Comply with applicable national or local codes and standards.
- B. Except where exceeded by the requirements of these specifications, the following are made part of this section: prints and details, and provisions of the NFPA 13 Standard for Installation of Sprinkler Systems.
- C. Qualifications of Manufacturer: Products used in work of this section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a 5 year history of successful production that is acceptable to the Architect.
- D. Qualifications of Installer: shall have a current C-16 license in the State of California in the installation of fire sprinkler systems.

1.04 FIRE SERVICE WATER CONNECTION

- A. The Owner shall pay fees and provide for the fire main POC (point of connection), consisting of the installation of a single detector check valve (if one is required) and meter shut off valve inside a meter vault.
- B. Fire Service Mains shall be provided with approved Meter Service to meet backflow protection minimum requirements

1.05 PRODUCT HANDLING

- A. Comply with the provisions specified in Sections 22 05 00 and 22 05 13.

1.06 COORDINATION

- A. Coordinate activities in accordance with provisions of Section 22 05 00.

1.07 JOB CONDITIONS

- A. Unscheduled utility flow interruptions are not permitted. Schedule service interruptions in advance, with the OAR.

1.08 EXTRA MATERIALS FOR MAINTENANCE

- A. Provide spare sprinkler heads in quantity equal to 2 percent of total number of each type of sprinkler head installed. There shall be no less than two heads of each type and temperature rating provided, and in no case less than six spare sprinkler heads per building. There shall be no fewer than 6 spare sprinkler heads for up to 300 sprinkler heads installed; no less than 12 spare sprinkler heads for up to 1,000 sprinkler heads installed; and no less than 24 spare sprinkler heads for the sites with more than 1,000 sprinkler heads installed. Spare sprinkler heads shall be kept inside of spare sprinkler head box(s). A spare sprinkler wrench for each

type of sprinkler head shall also be provided inside of each spare sprinkler head box, at each building. Locations of spare sprinkler boxes shall be located at:

1. Fire Sprinkler Riser, when enclosed and secure.
2. Plant Manager's Office, when Fire Sprinkler Riser is exposed.

PART 2 - PRODUCTS

2.01 FIRE PROTECTION SYSTEM DESCRIPTION

A. General: Provide systems complete including, but not limited to:

1. Provide underground and above ground sprinkler piping including trenching and backfilling. Materials and equipment shall be UL/FM listed and approved as required by NFPA 24 for their application. Required signage shall be provided and installed as required by NFPA 13.
2. Provide overhead sprinkler system with sprinklers installed as required according to type, location and temperature rating.

B. Sprinkler Heads:

1. Provide chrome pendent spray type sprinkler heads with matching escutcheons in areas with finished ceilings. Exterior escutcheons shall be poly-coated or concealed type to prevent rusting and oxidation.
2. Provide upright sprinklers in areas with exposed piping.
3. Provide poly-coated glass bulb corrosion resistance type sprinklers heads in areas exposed to a corrosive environment such as parking garages and coastal air.
4. Sprinklers shall be glass bulb type, with hex-shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation,
5. Sprinklers in concealed spaces, exterior locations, and other areas that will experience over 100 degrees F ambient temperature shall be furnished with 200 to 225 degree rated sprinklers. Sprinkler heads in boiler rooms, furnace rooms, or heater rooms shall be furnished with sprinklers rated at 250 to 290 degrees F. If a sprinkler is directly affected by a spotlight, steam, or other heat source, a 350 degree F or higher sprinkler head shall be furnished. Sprinkler heads in other locations, unless otherwise noted, shall be 155 to 165 degrees F rated.
6. Automatic fire sprinkler head type shall be as follows:
 - a. In areas with ceiling heights of nine-feet or lower, sprinkler heads installed shall be recessed or fully concealed.
 - b. Ceilings eight-feet or lower shall be provided with fully concealed sprinkler heads.
 - c. Areas with ceiling height of nine-feet or lower, that are not constantly supervised such as corridors, arcades, students restrooms, and other restrooms shall be provided with fully concealed sprinkler heads.

7. Sprinkler heads in light hazard occupancies are required to be Quick Response sprinklers as required in NFPA 13. Sprinkler heads shall be of the same manufacturer throughout the building/site as indicated. Sprinklers shall typically be ½ inches NPT, standard orifice, minimum 5.6 nominal K factor, UL listed for 175 psi, and listed for light and ordinary hazard occupancies.
8. Other specialized sprinkler heads such as walk-in refrigerator or freezer heads, side wall, ¾ inches sprinklers above 5.6 K factor, and those sprinklers with a K factor below 5.6, shall only be used where required by project condition. Large drop sprinkler heads and extended coverage sprinkler heads shall not be installed.
9. Sprinkler head location shall be designed and installed in an aesthetically pleasing manner and should generally be located in center of 24-inch by 24-inch ceiling tiles and in center of 24-inch by 48-inch ceiling tiles in the 24-inch direction and no closer than 12-inch from the edge in the 48-inch direction.
10. UL/FM listed Sprinkler head guards shall be provided on Sprinkler heads installed at seven feet six inches above floor or lower in exposed locations, or that are deemed subject to damage. Sprinkler head guards shall securely fasten with bolt-on feature to the base of the sprinkler or be a factory installed guard. Guards shall also be provided on upright and sidewall heads where sprinklers are installed at seven feet six-inch heights or lower.

C. Fire Sprinkler Systems:

1. Underground piping: Comply with the requirements of Section 33 11 00, Site Water Distribution Utilities.
2. Provide an underground UL/FM listed PVC or Ductile iron supply line connected to detector check meter or water main as indicated. Install site water mains no closer than 10'-0" parallel to the building foundations. Underground fire water lines shall be installed 36 inches below grade. Tracer wire shall be installed in accordance with Section 33 1100: Site Water Distribution Utilities.
3. Fire Department Connection (FDC) with check valve (wafer type) shall be provided after the backflow preventer, and before the building fire sprinkler riser(s), located where the FDC will be accessible to the fire department from the street or sidewalk without obstructions. No shut off valve shall be allowed on the FDC line as per NFPA 13. FDCs shall have a height between two and four-foot above the ground.
4. PIVs shall be electrically supervised regardless the number of fire sprinkler served (CBC 903.4), and set at a height of three feet to the top and have the handle locked in place with a break-a-way lock.
5. Provide a UL listed, FM approved FDC, approved Double check detector assembly backflow preventor, approved equal.Check valves, shut-off valves, drain valves, ITV, and flow indicator at the locations required.
6. Flow indicator shall activate the fire alarm system between 45 and 90 seconds, and activate a local alarm on the outside of the building continuously with water flow. Connection of this switch is a part of the Work of Division 26. Shut-off including valves on the fire main backflow preventer shall be electrically supervised according to CBC 903.4,, NFPA 13 and Section 28 31 00 – "Fire Detection and Alarm".

7. Pipe through ceilings at head locations shall be furnished with a two piece, or fully concealed escutcheon. Unless otherwise designated, escutcheons shall be identical and match the other escutcheons of the same type throughout the building or site. Piping through walls and ceilings shall have a split ring chrome escutcheon.
 - a. Flexible stainless steel sprinkler head drop system may be used. Flexible drops shall be UL listed, FM approved, and shall be compatible with ceiling systems. Flexible drop length shall be included in the Hydraulic Calculations. The drop system shall include the required support bracing.
8. Furnish and install required signs, spare heads, special wrenches, and spare sprinkler head boxes as required to satisfy NFPA 13, and this specification.
9. Sprinkler system piping shall be provided with complete drainage as required by NFPA. Test valve discharge shall be piped away from planters to asphalt areas. Furnish protection of piping against accidental or malicious damage.
10. Upon completion of the Work of this section, and before Substantial Completion, subject system, including underground supply connection, to tests required. A minimum hydrostatic test shall be two hundred pounds (200 psi) or fifty pounds (50 psi) in excess of the maximum system working pressure, whichever is greater, for two hours with no leaks or loss of pressure per NFPA 13. The Project Inspector shall be furnished with a NFPA 13 test certification.
11. Local fire sprinkler alarm requirements shall be accomplished with a vane or paddle type water flow detector switch and an electrically powered fire sprinkler horn located on the street side of the building and connected to the fire alarm control panel with secondary power provided from the fire alarm batteries. The drilled out disk shall be attached to the mounting U-bolt. Time delay shall be set at 45 to 60 seconds. Mechanically activated water bells with alarm valve and pressure switch are prohibited.
12. Seismic separation assemblies shall be located between the buildings if space allows accessibility. Otherwise they shall be located inside the building providing the most space. Swing joints may be fabricated on site using flexible groove couplings and six grooved (Victaulic) 90 degree elbows in a teepee formation (see NFPA 13, figure A.9.3.3). Seismic separation assemblies can also be made utilizing a manufactured, UL/FM listed swing joint assembly rated at a minimum 175 psi.
13. Hanging, bracing and support shall utilize only UL/FM listed approved products, and comply with NFPA 13, Chapter 9 requirements for rod and bolt sizes except for the following: 4 and 6 inch pipe shall be supported by a minimum ½ inch hanger rod, 8 inch pipe shall be supported by a minimum 5/8 inch hanger rod, 10 and 12 inch pipe shall be supported by a minimum ¾ inch hanger rod. Hanger rods in exterior locations and in parking structures shall have Electrodeposited Zinc Coating per ASTM B633 to prevent rusting.
14. Building Fire Sprinkler riser assemblies shall be provided as follows. Every building shall be provided with an accessible and electrically supervised riser shut off valve at a height not to exceed five-feet above the floor. Every building riser assembly shall be equipped with a check valve followed by a main drain valve and then the flow indicating switch and pressure gauge immediately after the shut-off valve. In cases where a riser assembly is provided for each floor in the building, a check valve, main drain and flow switch shall be provided for each floor; the main building shut-off shall

not be required. An electrically supervised Post Indicator Valve located outside the building may serve as the building riser shut-off valve.

2.02 MATERIALS

A. Access Panel:

FAP-1	Square, steel, prime-coated, with vandal-proof door lock operated by Allen wrench:			
	Smith	Josam	Elmdor	Or equal
	4760		DW – AKL	

B. Globe or Angle Valves: UL/FM listed.

AV-1	Bronze angle valve: 2 inches and smaller, screwed-in bonnet, threaded ends, rising stem:			
	Nibco	Kennedy	Fairbanks	United
	T-301	98 SD	0210	126T
				Or equal

C. Automatic Fire Sprinkler Head, UL/FM listed:

AFSH-1	Brass pendant type for areas with suspended ceilings:			
	Victaulic	Tyco	Viking	Reliable
	V27	TY 3231	VK302	F1FR56
AFSH-2	Brass upright type for areas with no ceilings:			
	Victaulic	Tyco	Viking	Reliable
	V27	TY3131	VK300	F1FR300
AFSH-3	Chrome or poly coated semi recessed type with semi-recessed escutcheon:			
	Victaulic	Tyco	Viking	Reliable
	V27	TY3231	VK302	F1FR56
AFSH-4	Fully concealed type sprinklers; chrome cover:			
	Victaulic	Tyco	Viking	Reliable
	V38	TY3531	VK462	F4FR
			VK404	G4A
				Or equal

D. Backflow Prevention Assemblies:

BPV-1	Reduced Pressure Principle Backflow Prevention Assembly (RP) type for meter service protection (MSP) requirements:			
	Ames	Febco	Watts	Wilkins
	4000SS	860 OS&Y	909 RP	975 RP
	C400	880 OS&Y	957 RP	375 RP
	M400		994 RP	
BPV-2	Reduced Pressure Principle Detector Assembly (RPDA) for MSP requirements:			
	Ames	Febco	Watts	Wilkins
	5000SS	860 DA	909 RPDA	950 DA

C500 M500	880 DA	957 RPDA 994 RPDA	350 DA
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E. Gear Operated Butterfly Valves:

GOBFV-1 Grooved end Gear Operated Butterfly Valve, 300 psi, for fire protection sprinkler risers. UL listed, FM approved, with weatherproof gearbox and double pole/double throw monitor switch, double seal design for bubble tight shut off at 175 psi. Corrosion-resistant, fusion-bonded nylon II body coating, easy to read position indicator:

Kennedy Figure 82M	Nibco GD-4765-8N, 300 psi	Victaulic 705W 300 psi	Tyco 580 300 psi	Or equal
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GOBFV-2 Wafer Type Gear Operated. Butterfly Valve, same requirements as GOBFV-1:

Kennedy Figure 82W	Nibco WD-3510 300 psi	Or Equal
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F. Check Valves:

CV-1 Bronze check valves: 2 inches and smaller, 200 psi WOG, bronze disc, swing type, conforming to MSS-SP-80-97, threaded ends:

Crane 37	Nibco T-433-Y	Stockham B-319	United 62T	Or Equal
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CV-2 Iron check valves: 2-1/2 inches and larger, class 175, composition disc, swing type, bolted cap, UL listed, FM approved flanged ends:

Stockham G-940	Kennedy 126	Tyco Model G	Clow F5380	Or Equal
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CV-3 Wafer Type Check Valve:

United Wafer Check #90 Or equal.	Nibco KW-900-W	Mueller A-2102
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CV-4 Grooved Check valve 2 1/2 inch and larger:

United 67 Or equal.	Gruvlock 7800	Reliable Mode "G"	Victaulic Series 717	Tyco 590F
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G. Escutcheons

ES-1 Chrome plated, or white poly-coated, 2-piece canopy (escutcheon), 2.25 to 3.5 inches in extended position:

FPPI 01 - 401 Chrome or White	Tyco No. 401 Chrome or White	Reliable HBC (chrome) HBW (white)	Or equal
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ES-2	Chrome plated or white poly coated, 2-piece recessed:			
	FPPI	Tyco	Reliable (semi recessed)	Or equal
	01 - 400	410	GF2-C (chrome)	
	01 - 402	420	GF2-W (white)	

H. Flow Indicators:

FIA-1	Listed by State Fire Marshal, with double pole, double-throw switch, one normally open and one normally closed, UL listed and FM approved:			
	Potter-Roemer	Notifier	Or equal	
	VSRF Series	WFR Series		

I Outside Stem and Yoke Gate Valves:

OS&Y-1	Bronze Gate Valves: 2 inches and smaller, class 175, solid bronze wedge disc, OS&Y, copper silicon alloy stem, UL/FM listed, threaded ends:				
	Stockham	Crane	Nibco	United	Or equal
	B-133	459	T-14	18	
OS&Y-2	Iron gate valves: 2 ½-inch and larger, class 175, IBBM, OS&Y, solid wedge disc, Teflon-impregnated packing, UL/FM listed, flanged ends:				
	Stockham	Crane	Kennedy	Mueller	Victaulic
	G-634	467	68	A-2073	771
	Or equal.				
OS&Y-3	2 ½-inch and larger, epoxy coated, resilient wedge, 175 pounds gate valve for riser valves, P.I.V., and shut off:				
	Clow	Nibco	Kennedy	Mueller	Or equal
	F-6136	617-0	KV-4068	A-2360	

J. Gate Valves:

GV-1	Bronze gate valves: 2-inch and smaller, class 175, solid bronze wedge disc, rising stem copper silicon alloy stem, UL/FM listed, threaded ends:				
	Stockham	Crane	Grinnell	United	Or equal
	B-133	459	Fig. 66	14	
GV-2	Iron gate valves: 2 ½-inch and larger, class 175, IBBM, solid wedge disc, Teflon impregnated packing, UL/FM listed, flanged ends:				
	Stockham	Crane	Kennedy	Mueller	Victaulic
	G-634	467	68	A-2052	772
	Or equal.				

K Gear Operated Ball Valves:

GOBV-1	Threaded ball valve for sizes two inches and smaller:			
	Nibco	KT-505W-4	Victaulic	728
	Or equal.			

L. Seismic Swing Joints:

- SJ-1 UL/FM Approved flexible seismic connector with grooved, or threaded ends for seismic separation requirements.
- SJ-2 Fabricated swing joints as per NFPA 13 using six groove 90 degree elbows and flexible groove couplers such as Victaulic style 75.

M. Post Indicator Valves:

- PIV-1 Vertical Indicator Posts: Furnished for underground valves, post must provide a means of knowing if the valve is open or shut, UL/FM listed. (Where a backflow assembly is provided, the shutoff valves on the backflow preventer satisfy the requirement for a post indicator valve to control the fire main and FD Connection):

Stockham	Kennedy	Grinnell	Or equal
G-951	2945	F-750	
Clow	Mueller	Victaulic	
F-576	2945	774	

- PIV-2 Posts Indicator valve: Furnished for underground valves. Ductile iron fusion bonded epoxy coated resilient wedge gate valves: 4 inches and larger, class 175 lb, non-rising stem, mounting plate for indicator post, UL/FM listed, flanged or mechanical ends (in accordance with NSF 61).

Stockham	Kennedy	Clow	Mueller	Victaulic
G-635	71X	F-6100	2360	772
O equal				

N. Sprinkler Guards:

- SPG-1 Sprinklers installed at seven feet six inches above floor or lower in exposed locations, or that are deemed subject to damage shall be equipped with a UL/FM listed, head guard. Guards shall be listed, supplied and approved for use with the sprinkler by the sprinkler manufacturer. Sprinkler head guards shall securely fasten with bolt-on feature to the base of the sprinkler or be a factory installed guard. Guards shall also be provided on upright and sidewall heads where sprinklers are installed at seven feet six-inch heights or lower.

Reliable	Viking	Tyco	FPPI	Victaulic
Or equal.				

O. Sprinkler Horn:

- SPH-1 UL/FM approved, surface-mounted, weatherproof and red finished:

Horn:	Bell:	Wheelock equal
HRK System Sensor	SSM-24-10 System Sensor	
24 V-DC	24 V-DC	
Weatherproof with	Weatherproof with	
BBS-2 back-box for	WBB box for	
Surface mount	Surface mount installation	

P. Hangers, Supports, Bracing:

HSB-1 Tolco products or UL listed and FM or equal.

Q. Threaded fittings:

TF-1 Ductile iron, 300 psi rated, UL listed, FM or NFPA approved.

TF-2 Cast iron fittings, 175 psi rated, UL listed, FM or NFPA approved:

Anvil Ward Taylor Or equal

TF-3 Malleable Iron, 300 psi rated, UL, Listed, FM or NFPA approved

TF-4 Galvanized, 175 psi rated, UL Listed, FM or NFPA approved

R. Fire Sprinkler Pipes and Standpipes:

FSP-1 Fire sprinkler pipe: 1 inch through 2-inch, Schedule 40, black or galvanized steel meeting ASTM Standards A53, A135, or A795. Pipe Corrosion Resistance Ratio (CRR) shall be 1.00 or greater. Pipe may be threaded or grooved. 2 ½-inch and larger to be Schedule 10 black steel or galvanized steel ASTM Standards.

a. Piping 2 inches and smaller shall have threaded joints and fittings in concealed, non-accessible locations. Groove coupler connections (Victaulic, Viking VGS, or equal) on pipe sizes 1 inch through 2 inches are acceptable in accessible areas with required seismic bracing provided. Plain end connections such as "Plainlock" and "FIT" are prohibited.

b. For pipe sizes 2 ½-inch and larger, a grooved type (Victaulic, Viking VGS, or equal), welded, threaded and flanged connections may be used. Any connection that does not utilize a threaded, welded or grooved connection is prohibited, except for mechanical tee bolt-on branch outlet fittings sizes 2-inch and smaller (Victaulic 920 and the 920N).

c. Submit Verification from manufacturer stating that piping material furnished meets above criteria; (i.e.: threadable pipe has a UL assigned CRR of 1.00 minimum, that it meets ASTM A53, A135 or A795, and it is UL listed, FM or NFPA approved.)

FSP-2 Ductile iron pipe, AWWA C151 or approved equal (for pipes below grade). Gasketed self retaining joints per ASME/ANSI B16.4.

FSP-3 Plastic, PVC, thick wall (cast iron OD sized), DR 14 (200 PSI). UL listed for fire main service (underground). Gasketed self retaining joints - Johns Manville Blue Brute AWWA C900, JM Eagle C900 water pipe or approved equal.

- FSP-4 Fire Sprinkler Pipe: 1 inch through 3-inch, Copper meeting NFPA 13 Standards. Pipe may be grooved.
- FSP-5 Flexible Fire Sprinkler Head Connectors: 1 inch pipe size flexible stainless steel fire sprinkler head connectors "Flex Head Industries" Models 2024, 2036, 2048, 2060 and 2072, or equal..

2.03 ACCESSORIES AND APPURTENANCES

- A. Escutcheons: Polished chrome plated split-ring type for exposed piping at every penetration inside finished rooms.
- B. Guards: Provide sprinklers with guards at ceiling at or under seven feet six-inch high and where subject to damage or vandalism.
- C. Miscellaneous: Provide accessories and appurtenances for a complete system.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel or groove plain end ferrous pipe ends.
- B. Remove scale and foreign matter, from inside and outside of pipes, before assembly.
- C. Provide piping connections to equipment with flanged or grooved connections.

3.03 INSTALLATION

- A. Install underground supply line connected to detector check or water main indicated. Braced or clamped bends shall be in accordance with requirements of NFPA 24. Provide vertical clamp rods at flange and spigot piece of risers, long enough to pass through riser's base flange where required. Furnish concrete thrust blocks where required. Tracer wire shall be installed as per Section 22 0553: Plumbing Identification on PVC underground piping.
- B. Install FDCs, check valves, shut-off valves, gauges, Inspector's test and drain assemblies and flow indicator. FDC must be installed so that it is unobstructed and accessible for the Fire Department's first response unit.
- C. Pipe through floors, wall, and ceilings, at head locations, shall be furnished with required sleeves, and escutcheons and fire caulking where indicated and/or required by code. Escutcheons shall be polished chrome plated unless other finish is selected by the Architect.
- D. Sprinkler system shall be provided with complete drainage facilities in accordance with CBC standards. Drain discharge may discharge into a sewer, storm drain, sump pit or street gutter. Fire sprinkler drains shall not discharge onto a playground or across a sidewalk.

Discharge to plumbing fixtures is prohibited due to the inability of a plumbing fixture to receive a full flow of water from a fire sprinkler drain valve under working pressure.

- E. Upon completion of the Work of this section, and before Substantial Completion, subject the entire system, including underground supply connections, to tests as required by NFPA 13, and CBC standards and furnish the Owner with a certificate of compliance as required.
- F. Close nipples are prohibited. Threaded unions are prohibited. Where a threaded union or coupling is needed, a groove type fitting (Victaulic or equal) shall be used instead. If a groove style coupling is used in a concealed area, an access panel allowing full access to that connection shall be provided.
- G. Fire sprinkler systems piping hangers, seismic bracing, anchors and supports shall conform to NFPA 13, CBC and other applicable codes and the requirements of this specification.
- H. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer.
- I. Tee branch outlets on fire sprinkler mains shall be by the use of a threaded ductile iron tee fitting, a groove type tee fitting, (Victaulic or equal), or by the use of a thread-o-let welded on by a certified welder as required by NFPA. Mechanical tee bolted branch outlet fittings or approved equal.
- J. Sprinkler lines within the building shall be concealed within the structure. Risers shall be installed in utility, supply rooms or similar service areas whenever possible, and shall not obstruct access, or maintenance of other equipment within the space. Mains and risers shall be located within the area protected by the sprinkler system unless otherwise approved by fire authorities having jurisdiction.
- K. Sprinklers that have been dropped, damaged, have cracked bulbs, or show a visible loss of fluid shall not be installed.
- L. Sprinkler bulb protectors shall be removed by hand after sprinkler installation. Tools or other devices to remove the protector that could damage the bulb in any way shall not be used.
- M. Routing of piping in non-concealed exposed areas shall be subject to the Architect's review in the final shop drawings.
- N. Underground piping shall have a minimum of 36 inches of cover to grade. Underground pipe shall be installed on a flat not less than 6-inch thick undisturbed sand bed. After required pressure-leak test, pipe shall be covered with sand not less than 6 inches thick, before backfilling. Comply with NFPA Standards. Piping is not allowed to be underground below the building floor slab.
- O. Provide approved backflow prevention assemblies. Installations of backflow prevention assemblies shall be tested and certified by a certified backflow prevention device tester prior to Substantial Completion. Tests shall be performed in the presence of the Project Inspector. Test reports shall be turned over to the Project Inspector for mailing to proper agency.
- P. Provide shunt trip when sprinklers are installed in the elevator machine rooms and elevator hoist way unless the sprinklers are located 2 feet or less from the hoist way pit floor.

- Q. Test valve (ITV) shall be provided..ITV discharge and main drain lines shall be piped to a sump pit or to the outside of the building to within a foot from the ground where it will drain away from the building to an exterior storm drain.
- R. Each building with a sprinkler riser shall be furnished with an accessible shut off riser valve installed no higher than five feet from the finish floor. Each floor shall have a separate shut off valve with flow switch, and shall be securely enclosed or secured with a chain and break-a-way lock. Also see section 2.01- C-12 of this specification.

3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.05 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose at off-project site.

END OF SECTION

SECTION 22 0500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section provides the basic plumbing requirements that apply to the Work of Division 22.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 22: Plumbing
3. Division 23: HVAC
4. Division 26: Electrical.

1.02 REGULATORY REQUIREMENTS

- A. Current federal Safe Drinking Water Act (SDWA) regulations require the furnishing of lead-free pipe, solder, and flux in the installation or repair of plumbing in non-residential facilities connected to public drinking water systems. Under this regulation, solders and flux are considered lead-free when they contain 0.2 percent lead or less. Under California regulations pipes and pipe fittings are considered lead-free when they contain 0.25 percent lead or less as defined in California Assembly Bill 1953 (AB 1953). No pipe, pipe fittings, or any other fitting or fixture intended to convey or dispense water for human consumption by drinking or cooking is allowed in the domestic plumbing system, if they do not meet the low lead definition of AB 1953. Weighted average lead content of the wetted surface area of pipes, fittings and fixtures may not exceed 0.25 percent.

1. Provide lead-free water pipe, solder, and flux materials that meet the standards as outlined by the federal SDWA regulations and California AB 1953 if installed in drinking water system.
2. Collect pipe, solder, and flux material samples as required by the Project Inspector. Test samples shall be delivered to an Owner designated testing laboratory for testing of lead content.
 - a. Test samples for lead content by the atomic absorption spectrophotometry method.
3. Materials found not conforming to SDWA and California AB 1953 regulations shall be deemed defective Work and shall be replaced with lead-free materials.
4. Comprehensive testing of the remaining materials for their lead content shall be performed as required by the Project INSPECTOR.

- A. Materials, fabrication, equipment, and installation shall comply with industry standards and code requirements. Where manufacturer's recommendations exceed industry standards, the manufacturer's recommendation shall establish the minimum standard. As a minimum, standards from the following organizations shall apply:
1. ANSI - American National Standards Institute.
 2. ASME - American Society of Mechanical Engineers.
 - a. ASME Boiler and Pressure Vessel Code.
 - b. ASME B31 - Standards for Pressure Piping.
 3. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers.
 4. ASTM - American Society for Testing and Materials.
 - a. ASTM A53 Specification for Welded and Seamless Pipe.
 5. AWWA - American Water Works Association.
 6. CSA - Canadian Standards Association.
 7. FM Global - Factory Mutual Global
 8. IAPMO - International Association of Plumbing and Mechanical Officials.
 9. NFPA - National Fire Protection Association.
 10. OSHA - Occupational Safety and Health Administration.
 11. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association.
 12. UL - Underwriters Laboratories Inc.
 13. Intertek (ETL Certification).
- B. Materials, fabrication, equipment, and installation shall comply with federal, state, and local codes including, but not limited to, the following:
1. CBC, California Building Code, and CMC, California Plumbing Code.
 - a. Latest edition as adopted by the State of California including amendments effective on the Effective Date of the Contract.
 2. California Code of Regulations, Title 8, Industrial Relations, Division 1, Chapter 4, Division of Industrial Safety.
 3. OSHA - Occupational Safety and Health Administration.
 4. CDPH - California Department of Public Health.
 5. SCAQMD - South Coast Air Quality Management District.
- C. Specifications or Drawings shall not be construed to permit deviation from the requirements of governing codes unless approval has been obtained from legally constituted authorities having jurisdiction, and the Architect. The Contract Documents may contain more stringent requirements than those legally required.
- D. Permits and Fees: Refer to the General and Supplementary Conditions.

1.03 SUBMITTALS

- A. Provide submittals in accordance with Section 01 3300: Submittal Procedures and with specific requirements of Division 22 sections, as applicable.
- B. The above information shall become the basis for inspecting and testing materials and actual installation procedures performed in the Work.
- C. Shop Drawings: Submit one additional copy when control diagrams having line voltage connections are indicated. Shop Drawings shall be specifically prepared for the Work of this Project. Drawings prepared in accordance with requirements of Section 01 3113: Project Coordination and Section 01 3300 may be provided by the Architect to serve as a background for the Shop Drawings. Shop Drawings shall comply with the requirements of Section 01 3113 and Section 01 3300 and shall indicate at a minimum:
 - 1. Complete system layout of equipment, components, plumbing fixtures, piping, indicating service clearances, and pipe sizes, fitting types and sizes and pipe elevations, distances of pipes and equipment from building reference points and hanger support locations. The above items shall be coordinated on the shop drawings according to the requirements of Section 01 3113.
 - 2. Schedule and description of equipment, piping and fittings.

1.04 PROJECT RECORD DOCUMENTS

- A. Comply with provisions of Section 01 7700: Contract Closeout.
- B. Project Record Drawings:
 - 1. Provide a complete set of plumbing and fire protection drawings in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks and plotter pen color/line thickness settings on CD-ROM. Also submit one set of full size reproducible plots on vellum and 3 sets of prints.
 - 2. Before Contract Completion, deliver corrected and completed prints to the OAR. Delivery of project record documents to the OAR does not relinquish responsibility of furnishing required information omitted from project record documents.
- C. Operation and Maintenance Manuals:
 - 1. Submit two copies of operation and maintenance manuals in required form and content. If no revisions are required, furnish one additional copy. If revisions are required, one copy shall be returned with instructions for changes; perform such changes and return three copies of manuals. Manuals shall be bound in accordance to Section 01 7700. Deliver manuals to the OAR. Submit an electronic copy of the entire manual in PDF file format.
 - 2. Contents of Manual:
 - a. Title sheet with Project name, including names, addresses and telephone number of Contractor, installer, and related equipment suppliers.
 - b. Manufacturer's operating instructions including, but not limited to, the following:

- 1) Identification of components and controls.
 - 2) Trouble shooting checklist and guidelines.
 - 3) Recommendations for optimum performance.
 - 4) Warnings and safety precautions on improper or hazardous operational procedures or conditions
- c. Manufacturer's product data and parts and maintenance booklet for each item of equipment furnished under Division 22 that includes the following as a minimum:
- 1) Manufacturer's model, identification and serial numbers.
 - 2) Exploded view of assembly drawings identifying each component or part with the relevant part number.
 - 3) Directory of manufacturer's representatives, service contractors and part distributors.
 - 4) Maintenance and trouble-shooting instructions, including schedule for preventive maintenance, periodic inspection and cleaning criteria.
- d. Project Record Drawings: Complete set of plumbing, fire protection and control system drawings in 50 percent reduced print format shall be furnished with the manual. Submit the above record drawings on CD-ROM in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks, and plotter pen color/line thickness settings.
- e. Testing, Adjusting, and Balancing reports: Submit as specified in Section 23 0593.
- f. South Coast Air Quality Management District (SCAQMD) permits to install and operate boilers, water heaters and other fuel burning equipment and third-party source test reports as required by SCAQMD to allow start-up and operation of equipment.
- g. Industrial waste permits.
- h. Valve directory complete with location, function, size, and model of each valve with reference to the project record drawings.
- i. Equipment and component identification chart complete with location, function, size, and model of each equipment or component with reference to the project record drawings.

1.05 COORDINATION

- A. Contract Documents indicate extent and general arrangement of Work under Division 22. Contractor shall coordinate work in accordance with Section 01 3113 requirements and make adjustments as required to provide maximum headroom, a neat arrangement to keep passageways and openings clear to provide accessibility and provisions for maintenance, and to meet code requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.
- B. Do not store plastic pipe or materials in direct sunlight.

1.07 PRELIMINARY OPERATION

- A. OAR may require any portion of plumbing Work to be operated before Substantial Completion. Such operation shall be in addition to regular tests, demonstrations and instructions required under the Contract Documents, and shall be performed as required.
- B. Notify the INSPECTOR at least 24 hours in advance of lighting or re-lighting pilots.

1.08 TRAINING OF OWNER PERSONNEL

- A. Training of Owner's personnel shall include:
 - 1. A minimum of 4 hours of on-site overview of the overall Plumbing System.
 - 2. Refer to Division 22 sections for specific training on each of the components of the Plumbing System.
- B. Contract shall include the cost of training Owner operation and maintenance personnel in operating, adjusting, maintenance, trouble-shooting, and Project site repair of each component, equipment, or system provided under this Contract.
- C. Operational and maintenance training shall be conducted on the Project site, unless indicated otherwise.
- D. Upon completion of Owner training, a completion certificate indicating the nature of the training and a description of the systems, complete with equipment and component lists shall be issued to each trainee. The certificate should be issued in duplicate with one copy retained by OAR.
- E. An attendance sheet with the names and signatures of all participants attending the training shall be submitted to the OAR and kept as part of the project documents.

1.09 GUARANTEES AND DAMAGE RESPONSIBILITY

- A. Sound of water flowing in piping shall not be transmitted to building structure. Operation of mechanical system shall not produce operational sounds that can be heard outside of rooms enclosing apparatus or equipment.

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Unless otherwise specified, materials and equipment shall be new, in good and clean condition. Equipment, materials, and components shall be of the make; type and model number noted on Drawings or specified. Pieces of equipment of the same type shall be by the same manufacturer.
- B. Whenever an item is listed by a single proprietary name, with or without model number and type, it shall be for purpose of design only, to indicate characteristics and quality desired. Proprietary designation listed on Drawings, or listed first in Specifications, is used as a basis for design to establish a standard for quality and performance and space requirements.
- C. Equipment and materials indicated or required to be installed outdoors shall be of the type that is designed, manufactured, listed or approved by authorities having jurisdiction for outdoor installation by being resistant to the adverse effects of weather. The additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.
- D. For substitution of materials or products, refer to the General Conditions.

PART 3 – EXECUTION

3.01 SERVICE INTERRUPTIONS, OFF-SITE, GAS AND WATER

- A. Schedule Work so there shall be no service interruptions of existing systems or systems during normal hours of operation of affected systems and facilities.
- B. When service interruptions are mandatory, arrange in advance with the OAR as to time and date of such interruptions.
- C. Systems, which are interrupted, shall be returned back into operation in such manner that they will function as originally intended.

3.02 CUTTING, NOTCHING, AND BACKING

- A. Conform to California Building Code, Title 24, Part 2, for notches and bored holes in wood and for pipes and sleeves embedded in concrete and for cuts in steel, as detailed on structural Drawings.
- B. Where pipes pass through or are located within one inch of any construction element, install a resilient pad, ½ inch thick minimum, to prevent contact.
- C. Furnish provisions for recesses, chases, and accesses and provide blocking and backing for proper reception and installation of plumbing Work.

3.03 LOCATION OF PIPING AND EQUIPMENT

- A. Location of piping, apparatus and equipment indicated on the Drawings is approximate and shall be altered to avoid obstructions, preserve headroom, and provide free and clear openings and passageways.
- B. Trenches parallel to footings shall not be closer than 18 inches to the face of footings and shall not be below a plane having a downward slope of 2 horizontal to one vertical, from a line 9 inches above bottom of footing.
- C. Pipe in tunnels shall be installed close to one side of tunnel to provide maximum space for passage. Pipe shall not be installed through crawl hole unless otherwise specified or detailed on Drawings.
- D. Place equipment in locations and spaces indicated, disassemble and/or reassemble equipment as required by Project conditions.

3.04 TESTS AND TESTING

- A. Tests shall be as required under the applicable sections of Division 22, including this Section.
- B. Additional tests may be required in the case of products, materials, and equipment if:
 - 1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.
 - 2. Performance testing and results may also be required on certain items which are as specified, including fan, and pump performance.
- C. Piping Tests:
 - 1. Perform tests required to demonstrate that operation of plumbing systems and their parts are in accordance with Specifications covering each item or system, and furnish materials, instruments and equipment necessary to conduct such tests. Tests shall be performed in presence of the Inspector, and representatives of any governmental agency having jurisdiction. Work shall not be concealed or covered until required results are provided.
 - 2. If required tests are not performed, Owner may provide in accordance with the Contract Documents.
 - 3. Pressure gauges furnished in testing shall comply with CPC. Air shall be bled from lines requiring hydrostatic or water tests.
 - 4. Systems shall be pressure-tested in accordance with pipe testing schedule below. Pipe test shall indicate no loss in pressure after a minimum duration of 4 hours at test pressures indicated. Where local codes require higher test pressures than specified herein for fire sprinkler systems, local codes shall govern.
 - 5. Fuel gas lines shall be first tested with piping exposed, before backfilling trenches or lathing; second with piping in finished arrangement, backfilled and paved where required, and walls finished.

6. Piping systems may be tested as a unit or in sections, but entire system shall successfully meet requirements specified herein, before final testing by the Inspector.
7. Repair of damage to pipes and their appurtenances or to any other structures resulting from or caused by these tests, shall be provided.

D. Pipe Testing Schedule:

System Tested	Test Pressure (psig)	Test With:
Durham system, glass or plastic acid waste, vent and roof drain (except pipes running under a slab or underground)	Fill with water to top of highest vent; allow to stand two hours, or longer, as required by Inspector. Minimum head required for any joint shall be 10 feet in building.	Water
Cast-iron soil, waste and interior downspout, condensate drain from air conditioning equipment	10 feet of water, vertically	
Storm water disposal lines	Running water test	Water
Vacuum pump or condensate pump discharge and condensate return piping	150	Water
Domestic water piping	200	Water
Standpipes, wet or dry	300	Water
Fire sprinkler piping	200	Water
Gas piping(steel threaded or plastic)	60 (both tests)	Air
Gas piping (steel welded)	100 (both tests)	Air
Gas welding station	1-1/2 Working pressure 100 min.	Dry nitrogen
Compressed air piping	175	Air

E. Equipment Performance Assurance Tests:

1. Before operating any equipment or systems, a thorough check shall be performed to determine that systems have been flushed and cleaned as required and that equipment has been properly installed, aligned, lubricated, and serviced. Factory instructions shall be checked to verify installations have been completed and recommended lubricants have been installed in bearings, gearboxes, crankcases, and similar equipment. Particular care shall be furnished in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Equipment shall also be checked for damage that may have occurred during shipment, after delivery, or during installation. Damaged equipment, products, and materials shall be replaced or repaired as required.
2. Upon completion of the above, adjust the system settings to within normal operating conditions to prevent the system from being damaged upon start-up.
3. Run-test the equipment after start-up for five consecutive days. Tests shall include operation of all equipment and systems for a period of not less than two 8 hour periods at 90 percent of the full specified capacities.

4. Equipment Start-up Reports: For each equipment or system on which start-up is performed, submit 8 copies of start-up report for review by the Architect.
 - a. The start-up report shall include the manufacturer's standard start-up form completed and signed by the start-up technician.
5. Provide, maintain, and pay costs for equipment, instruments, and operating personnel as required for specified tests.
6. Provide electric energy and fuel required for tests.
7. Final adjustment to equipment or systems shall meet specified performance requirements.
8. Equipment, systems, or Work deemed defective during testing shall be replaced or corrected as required. Test until satisfactory results are provided.

F. Specific Coordinated Plan for Test and Balance:

1. Provide a narrative of the operational intent that clearly describes the function and sequence of operation of each component, equipment, or system installed. Instruct designated Owner personnel in the operation of the installed systems.
2. Prior to final test and balance, plumbing equipment and systems shall be operated and tested as indicated in Article 3.04.F above to demonstrate satisfactory overall operation of the installed systems.
3. Welding performed as part of this Division may be subject to radiographic inspections at random in accordance with requirements specified in Section 22 0513: Basic Plumbing Materials and Methods.

3.05 NOISE AND VIBRATION REDUCTION

- A. Correct noise or vibration caused by plumbing systems. Provide all necessary adjustments to specified and installed equipment and accessories to reduce noise to the lowest possible level
- B. Correct noise or vibration problems caused by failure to install work in accordance with Contract Documents. Include all labor and materials required as a result of such failure. Pay for re-testing of corrected noise or vibration problems by the project acoustical consultant including travel, lodging, test equipment expenses, etc.

3.06 PROTECTION, CARE AND CLEANING

- A. In addition to storage criteria of the General Conditions, and provisions under Section 01 5000: Construction Facilities and Temporary Controls, the following shall be provided:
 1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.
 2. Protect installed Work.
 3. Replacements: In case of damage, immediately provide repairs and/or replacements as required.

4. Protect covering for bearings, open connections to tanks, pumps, compressors and similar equipment.
5. Interior of piping shall be maintained free of dirt, grit, dust, and other foreign materials.
6. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.
7. Before initial start-up and again before Substantial Completion, piping shall be drained and flushed to completely remove grease and foreign matter. Pressure regulating assemblies, traps, strainers, boilers, flush valves, and similar items shall be thoroughly cleaned. Tag system with an information tag listing responsible party and date of element, before initial start-up and again before Substantial Completion. Compressed air, oil, and gas piping shall be blown out with oil-free compressed air or inert gas.

END OF SECTION

SECTION 22 05 13 - BASIC PLUMBING MATERIALS AND METHODS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section prescribes basic materials and methods generally common to the Work of Division 22.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 22: Plumbing.
3. Division 26: Electrical.
4. Division 33: Site Improvements.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01, Section 22 0500 and specific requirements of each section of Division 22.

- B. Types of welding rods to be used.

1.03 QUALITY ASSURANCE

- A. Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, SISPI, NFPA, FM, UL, CPC (California Plumbing Code), CMC (California Plumbing Code), CSA.

- B. Conform to provisions of Section 22 0500: Common Work Results for Plumbing.

- C. Manufacturer of plumbing products must be third-party certified to ANSI/NSF Standard 61, Section 9 certification, and ANSI/NSF 372 to demonstrate compliance with the federal requirements for lead contribution to drinking water, the Safe Drinking Water Act SDWA, and the California Health and Safety Code Section 116875.

- D. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the ARCHITECT.

1.04 COORDINATION

- A. Coordinate related Work in accordance with provisions of Section 01 3113: Project Coordination.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.
- B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 22 0500, manufacturer's instructions or as required.
 - 1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.

2.02 MANUFACTURERS AND MATERIALS

- A. Ball Valves: 2-inch and smaller:

BV-1: Class 150, 600 psi, Bronze, CWP two piece construction with reinforced TFE seats, full port, adjustable packing gland, (no threaded stem designs allowed), threaded or solder ends.

Manufacturer: NIBCO T-685-66-LF/S-685-66-LF, Hammond UP8303A/UP8513, Milwaukee UPBA400S/ UPBA450S, or equal.

BV-2: Class 150, 600 psi, Stainless Steel, CWP two piece construction with reinforced TFE seats, full port, adjustable packing gland, (no threaded stem designs allowed), threaded or solder ends.

Manufacturer: NIBCO T-585-S6-R-66-LL, Milwaukee BA260, or equal.

Ball Valves in Insulated Piping: Use extended operating handle of non-thermal conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. NIBCO Nib-Seal Handle.

- B. Butterfly Valves:

BFV-1 Centerline Series A, 200 psi CWP tight shut-off.

- 1. Body: Lug type ductile iron. Suitable for bi-directional dead-end service at rated pressure without use of downstream flange.
- 2. Disc: Bronze, or aluminum bronze.
- 3. Stem: One or two-piece, 400 series stainless steel.

4. Seat and O-Rings: EPDM.
5. Upper and Lower Stem Bearings: Copper alloy or non-metallic material.
6. Operators: Valves 6 inches and smaller, with lever handle. Valves 8 inches and larger, with manual gear operator and disc position indicator.
7. Manufacturers:
 - a) Valves 2.5 to 6-inch: Milwaukee ML 233E, Hammond 6411-03, or equal.
 - b) Valves 8-inch and larger: Milwaukee ML 333E, Hammond 6411-03, NIBCO LD 2000, or equal.

C. Check Valves:

1. Bronze, 2-inch and smaller:

CHV-1: 200 psi, CWP horizontal swing, Y pattern, renewable seat and disc, threaded ends.

Manufacturer: NIBCO T-413-Y-LF, Milwaukee UP-509, Hammond UP-904, or equal.

APPLICATION: USE ON DOMESTIC HOT AND COLD WATER SYSTEMS.
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CHV-2: 200 psi, CWP, bronze body, horizontal swing, Y pattern, renewable seat and disc, solder ends.

Manufacturer: Nibco S-413-Y-LF, Hammond Up-943, or equal.

APPLICATION: USE ON DOMESTIC HOT AND COLD WATER SYSTEMS.
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D.

Earthquake Valve:

EQV-1: Mechanically triggered by seismic movement, complying with state of California seismic response specifications, UL listed and certified by D.S.A. Size and pressure as required or indicated on Drawings. (Minimum 1/4 psi, maximum 10 psi. Earthquake valve shall shut off gas automatically during an earthquake to prevent an explosion or fire. Valve shall be Koso California seismic valve, or equal.

1. Not sensitive to vibrations caused by passing trucks or accidental bumping.
2. Sensitive to wide amplitude G's only. Preset at factory for the correct G-rating.
3. Positive sealing from minus 10 degrees F. to 150 degrees F.
4. Visual open-close indicator.
5. Manual reset.
6. Plumb line for mounting.
7. Tripping mechanism has non-creeping rolling latch.
8. Install valve per manufacturer's recommendations only.

E. Expansion Tank:

ET-1: Pressurized, vertical, steel expansion tank for potable water systems with FDA approved, replaceable, heavy duty, butyl rubber blend diaphragm, polypropylene lined dome, 1/2 inch, 3/4 inch, 1 inch or 1 1/2-inch NPT system connection, 1/2 inch or 3/4 inch drain, 0.302 inch-32 standard automobile tire valve type charging connection, lifting rings and a floor mounting skirt for vertical installation. The tank must be constructed in accordance with Section VII of the ASME Boiler and Pressure Vessel Code and stamped for 125 psi working pressure. The tank must be also rated for a continuous working temperature of 240 degrees F. Provide weather and rust resistant coating.

Manufacturer: Bell and Gossett, Wheatley, Taco, Amtrol, or equal.

APPLICATION: FOR POTABLE WATER USE SUCH AS DOMESTIC HOT WATER SYSTEM. PROVIDE AT EACH DOMESTIC HOT WATER HEATER OR SYSTEM.

F. Gate Valves:

GATE VALVES IN A DOMESTIC PLUMBING SYSTEM INTENDED TO CONVEY WATER FOR HUMAN CONSUMPTION SHALL COMPLY WITH QUALITY ASSURANCE, ARTICLE 1.03.

1. Bronze, 2-inch and smaller:

GV-1: Class 125, 200 psi, CWP, bronze body and bonnet, non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Manufacturer: NIBCO T-113-LF, Milwaukee UP105-P2, Hammond UP645, or equal.

APPLICATION: USE ON DOMESTIC HOT AND COLD WATER SYSTEMS.

GV-2: Same as GV-1, except solder ends:

Manufacturer: NIBCO S-113-LF, Milwaukee UP115, Hammond UP647, or equal.

APPLICATION: SAME AS GV-1. PROVIDE IN YARD BOX, TO EACH GROUP OF FIXTURES BEHIND ACCESS PANELS, WHERE VALVES ARE LOCATED NEAR CEILING AND BEAMS.

2. Bronze, 2-1/2-inch and larger:

GV-3: Class 125 250 psi CWP iron body, flanged ends, bolted bonnet with wheel handle, resilient wedge, non-rising stem.

APPLICATION: FOR USE IN WALLS FOR DOMESTIC COLD WATER SYSTEM.

Manufacturer: NIBCO F-619-RW, or equal.

GV-4: Class 125, 250 psi CWP iron body, flanged ends, bolted bonnet with 2-inch operating nut, resilient wedge, non-rising stem, fusion bonded epoxy coated.

APPLICATION: FOR USE BELOW GRADE FOR DOMESTIC COLD WATER SYSTEM.

Manufacturer: NIBCO F-619-RW-SON, or equal.

GV-6: Class 125, 200 psi CWP, bronze body and bonnet non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends.

Manufacturer: Hammond IB645, Crane 1701, Milwaukee 105, American 3F, NIBCO T-113, or equal.

APPLICATION: SHUT-OFF AND ISOLATION OF EQUIPMENT AND DEVICE FOR NATURAL GAS SYSTEM.

G. Globe Valves:

1. Bronze, 2-inch and smaller:

GLOBE VALVES IN A DOMESTIC PLUMBING SYSTEM INTENDED TO CONVEY WATER FOR HUMAN CONSUMPTION SHALL COMPLY WITH QUALITY ASSURANCE OF ARTICLE 1.03.

GLV-1: Class 125, 200 psi, CWP, screw-in bonnet, Teflon disc, threaded ends:

Manufacturer: Milwaukee UP502-P2, Hammond UP440-P2, or equal.

GLV-2: Class 125, 200 psi, CWP, screw in bonnet, Teflon disc, soldered ends.

Manufacturer: Hammond UP418, Milwaukee UP1502, or equal.

USE ON DOMESTIC HOT AND COLD WATER SYSTEMS.

H. Heater Vent Pipe:

1. Schedule Number:

HVP-1 Shall be UL approved for service specified. Concealed heater vent pipe, including pipe in or through attic spaces, shall be double wall metal vent pipe. All others may be Type B, or B.W. Clearances must comply with conditions of UL listing.

Manufacturer: American Metal Products Co., Inc., Simpson Dura-Vent, AmeriVent, Hart & Cooley Mfg. Co., Metalbestos, or equal.

I. Piping and fittings:

PIPES AND FITTINGS IN A DOMESTIC PLUMBING SYSTEM INTENDED TO CONVEY WATER FOR HUMAN CONSUMPTION SHALL COMPLY WITH QUALITY ASSURANCE ARTICLE 1.03.

1. Piping shall be continuously and permanently marked with manufacturer's name, type of material, size, pressure rating, and the applicable ASTM, ANSI, UL, or NSF listing. On plastic pipe, date of extrusion must also be marked.
2. Underground non-ferrous pressure pipes shall be installed with proper color tracer wires. Refer to color code provisions in Section 22 0553: Plumbing Identification.

P-1: Hub less Cast-Iron pipe and fittings to comply with ASTM A888

Manufacturer: American Foundry, Tyler or equal.

PF-1a: Cast iron Soil or Waste no-hub coupling with neoprene gasket s. Stainless steel corrugated shield and stainless-steel clamps.

P-2: ABS Schedule 40 Plastic Piping, fittings and solvent cement joint. Materials to comply with ASTM D2661

TO BE USED IN CORROSIVE SOIL.

Manufacturer:

Manufacturer: Charlotte, Spears or equal.

P-3: CPVC SCH80 Pipe and fittings with Solvent Cement Joints. Chem Drainpipe and fitting complying with ASTM F2618

Manufacturer: Charlotte Pipe and Foundry or equal.

P-4 Copper drainage tube, inside structure and above grade. Type DWV hard temper, ASTM B 306.

Manufacturer: Mueller, Anaconda, Cerro Brass, Cambridge-Lee, Halstead, or equal.

USE OF COPPER TUBING TYPE DWV IS PROHIBITED FOR CONDENSATE DRAINAGE.

PF-4a: Cast brass drainage fittings ASA B 16.23, ASTM B 42.

Manufacturer: Mueller Brass, Nibco, Stanley Flagg, Lee Brass, or equal.

P-5: Copper water tube, Type L hard, ASTM B88. (For above ground use only.)

Manufacturer: Mueller, Cambridge-Lee, Halstead, or equal.

USE OF COPPER TUBING TYPE M IS PROHIBITED.

PF-5a: Copper Press-Connect pressure fittings, comply with ASME B16.51 “Copper Alloy Press-Connect Pressure Fittings”,

PROVIDE WITH P-4 OR P-5 PIPE.

PF-5b: Wrought copper - solder type ANSI B 16.22.

Manufacturer: Mueller Brass, Nibco, Lee Brass, or equal.

PROVIDE WITH P-4 OR P-5 PIPE, SOLDER, AND FLUX SHALL BE LEAD-FREE. FLUX SHALL BE AN APPROVED WATER-SOLUBLE MATERIAL.

PF-5c: Grooved end type— ASTM B75 or B152 and ANSI B16.22 wrought copper, bronze sand casting per ASTM B584-87 copper alloy CDA 836 per ANSI B16.18. Couplings shall be CTS style 606 supplied with angle pattern bolt pads for rigidity, coated with copper coated alkyl enamel. Gaskets shall be pre-lubricated Flush seal type.

Manufacturer: Victaulic, or equal.

FOR DOMESTIC HOT AND COLD WATER 2 ½-INCH AND LARGER COPPER APPLICATIONS. PROVIDE WITH PIPING SCHEDULE NUMBER P-5.

P-6: Copper water tube, Type K hard, ASTM B88 for underground applications.

Manufacturer: Mueller, Cerro Brass, Cambridge-Lee, Halstead, or equal.

All underground piping to be protected from corrosive soil.

Options:

1. Prevention of soil contact. Soil contact may be prevented by encasing the tubing using PVC pipe with solvent-welded joints.
2. Installation of a factory-coated copper pipe with a minimum 25-mil thickness such as Kameo’s Aqua Shield, Mueller’s Streamline Protec, or equal. The coating must be continuous with not cuts or defects.
3. Installation of 12-mil polyethylene pipe wrapping tape with butyl rubber mastic over a suitable primer. Protect wrapped copper tubing by applying cathodic protection [er NACE Standard SP0169.

P-7: Black steel pipe, Schedule 40, ASTM A53, Type E, ERW.

Manufacturer: US Steel, or equal.

PF-7a: Malleable iron, Class 125, ANSI B 16.3, threaded or welded Schedule 40 black steel for 1 1/2-inches and below and welded for 2-inch and above.

Manufacturer: Stockham, or equal.

PF-7b: Grooved end type– ASTM A395 and A536 ductile iron; ASTM A234 WPB forged steel; fabricated from ASTM A53 carbon steel. Couplings shall be supplied with angle-pattern bolt pads for rigidity, except in locations where flexibility is desired. Gaskets shall be pre-lubricated.

Manufacturer: Victaulic, Galvanized or painted, or equal.

PF-7c: MegaPressG, ASME B31, Carbon Steel, – For aboveground piping 2-inches and below. Provide fittings with Hydrogenated Nitrile Butadiene Rubber, HNBR Sealing Element.

Manufacturer: Viega, or equal.

PF-7d: Malleable Iron, class 125, ANSI B 16.3, threaded schedule 80 black steel.

Manufacturer: Stockham, or equal.

P-8: Polyethylene plastic pipe, ASTM D 2513, Standard Dimension Ratio 11 rated at 80 psi working pressure and 73° Fahrenheit for 3 inches and smaller, SDR 11.5 rated at 76 psi and 73° Fahrenheit for 4 inches and above, butt or socket type fittings, joined by heat fusion, orange or yellow color. Installer shall be certified by the manufacturer for this kind of joint installation.

Manufacturer: CPCHEM (Chevron Phillips Chemical Company LP) PE 2406, or equal.

APPLICATION: FOR NATURAL GAS BELOW GRADE ONLY. TRANSITION TO ANODE-LESS STEEL RISER AT METER, REGULATOR, OR BUILDING WALL.
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PF-8a: Polyethylene plastic fittings, ASTM D 3261 and D 2683, Standard Dimension Ratio 11 rated at 80 psi working pressure and 73° Fahrenheit for 3 inches and smaller, SDR 11.5 rated at 76 psi at 73° Fahrenheit for 4 inches and above, butt or socket type fittings, joined by heat fusion, Installer shall be certified by manufacturer for joint installation. Color orange or yellow.

Manufacturer: CPCHEM, (Chevron Phillips Chemical Company LP), or equal.

PF-8b: Polyethylene transition risers, for PF-13a above, Transition fitting must have a minimum vertical height of 36 inches from the horizontal

connection which will allow for a 6-inch steel riser above ground. Polyethylene transition risers shall be anodeless.

Manufacturer: Central Plastics Company, or equal.

APPLICATION: INSTALLED IN A GAS PIPING SYSTEM FOR THE PURPOSE OF PROVIDING A TRANSITION FROM HORIZONTAL BELOW GROUND (POLYETHYLENE) TO A VERTICAL ABOVE GROUND (STEEL). TRANSITION MUST BE MADE ON THE HORIZONTAL SIDE OF THE GAS PIPING SYSTEM AND MEET ASTM STANDARDS FOR POLYETHYLENE PLASTIC PIPE AND FITTINGS.

- J. Pipe and Fitting Requirements Schedule: Unless otherwise specified or indicated on Drawings, pipe and fittings shall be installed in accordance with the following table:

TABLE I
PIPE AND FITTING SCHEDULE

Use	Limits	Pipe	Fittings
Waste and Vent – Sanitary – Cast Iron	All sizes within building. Above grade.	P-1	PF-1a
Waste and Vent – Sanitary – ABS underground piping in corrosive soils.	Sizes 6” or less Underground, Below Slab on Grade and within 5’ of Building.	P-2	P-2
Waste and Vent – Sanitary – Chem Plastic	Size 8”. Underground, Below Slab on grade and within 5’ of building	P-3	P-3
Indirect drains and drains From Equipment	All Sizes	P-4	PF-4a
Domestic Hot and Cold Water above Slab on Grade	Interior only, all sizes	P-5	PF-5a, or PF-4b or PF-5c
Domestic Cold Water underground.	Within 5’ from building, All sizes	P-6	P-6
Natural Gas, Interior	Interior and within 5’ of building	P-7	PF-7a, and PF-7b, PF-7c and PF-7d
Natural Gas, exterior	On Site to 5’ of building	P-8	P-8a and P-8b

Use	Limits	Pipe	Fittings
Storm Drainage	All sizes within building	P-1	PF-1a,
Storm Drainage	All Sizes, Underground, Below Slab on grade and within 5' of building	P-2	P-2

K. Pipe Isolators:

PLA-1 Absorption pad shall be not less than ½ inch thick, unloaded. Pad shall completely encompass pipe.

APPLICATION: FOR COPPER PIPING.

Manufacturer: Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator, or equal.

PLA-2 PLASTIC CUSHION TO FORM AN INSULATING LINER AND ELIMINATE METAL TO METAL CONTACT WHEN SECURING COPPER TUBES AND PIPES IN AIR CONDITIONING AND REFRIGERATION INSULATION PREVENTING GALVANIC EROSION. (ACOUSTICAL TYPE FOR SOUND ABSORPTION).

Manufacturer: Hydra-Zorb Cushion Clamps, Acousto-Clamp, or equal.

L. Pressure Gage: Aluminum or steel case, minimum 4 ¼-inch dial; pressure type or combination vacuum-pressure type, with provisions for field calibration. Dial indicator to indicate pressure in psi with accuracy to within plus or minus 0.5 percent of maximum dial reading. Furnish gages with restriction screw, size 60, to eliminate vibration impulses. Black case and ring, bourdon tube of seamless copper alloy with brass tip and socket. Three way gage cock, constructed of brass with stuffing box, 1/2 inch couplings, with fixed or movable cap nut to shut off pressure gage.

PG-1 Pressure type, black drawn steel case, 4-1/2-inch glass dial, range approximately twice line pressure.

Manufacturer: Marsh Keckley, Terice, Weksler, Weiss, or equal.

M. Plug Valves:

PV-1 2 inches and smaller: Rockwell No.114, lubricated plug type, 200-pound., water operating gauge pressure iron body and plug, regular pattern, threaded, with indicating arc.

Manufacturer: Walworth, Homestead, WKM, or equal.

APPLICATION: ISOLATION AND ON-OFF APPLICATION FOR GAS SYSTEM.

PV-2. 2 ½-inch and larger: Rockwell No.115 and No.165 lubricated plug type, 200 pound water operating gauge. Iron body and plug, regular pattern, flanged, with indicating arc.

Manufacturer: Walworth, Homestead, WKM, or equal.

APPLICATION: SAME AS PV-1.

N. Safety Relief Valves:

SRV-1: Combination temperature and pressure relief type. CSA approved. Set to open at 125 psi pressure.

Manufacturer: Watts: 40L, Cash-Acme: NCLX-1, or equal.

APPLICATION: HOT WATER SYSTEM.

SRV-2: Same as SRV-1, except provide on storage type water heater with anode in dip tube.

Manufacturer: Watts: 100XL, Cash-Acme: NCLX-1, or equal.

APPLICATION: SAME AS SRV-1.

SRV-3 Spring type, ASME and NB stamped and certified with manual lifting device for air or gas.

Manufacturer: Bailey, Cash-Acme, Watts, Keckley, or equal.

APPLICATION: GAS SYSTEM AND COMPRESSED AIR SYSTEM.

O. Strainers:

STR-1 Description: Wye type with monel or stainless steel strainer cylinder (manufacturer's standard mesh), and gasketed machine strainer cap. Where indicated on Drawings, provide with valved (globe valve) blowout piping, same size as blowout plug.

1. 2-inch and smaller:

C.M. Bailey No.100-A, 250 lb., cast iron body, threaded, Keckley: Style B, Spirax Sarco Y-type, or equal.

2. 2 ½-inch and larger:

C.M. Bailey No.100-A, 125 lb., cast iron body, flanged, or Victaulic style 732, 300 psi, ductile iron body, grooved, fusion bonded epoxy coated.

Manufacturer: C.M.Bailey, Armstrong, Muessco, Keckley 'A', or equal.

APPLICATION: OIL AND GAS SYSTEMS.

STR-2 Y pattern cast iron bodies, 125 psi, monel screen. Open area at least twice the cross-sectional area of IPS pipe in which strainer is installed and may be woven wire or perforated type. Screwed ends for sizes up to 2 inches, flanged ends fusion bonded epoxy coated for 2 ½-inch and larger perforations, in accordance with the following:

1. Steam service - 40 square mesh.
2. Other services - 16 square mesh.

Bailey No.100, Armstrong, RP&C, Keckley or equal.

APPLICATION: SAME AS STR-1.

STR-3 Flanged, bucket type, semi-steel body, 125 psi, stainless steel screen with 1/8 inch diameter perforations, all sizes.

Manufacturer: Bailey No.1, Zurn 150 Series, RP&C, Keckley GFV, or equal.

APPLICATION: DOMESTIC COLD AND HOT WATER SYSTEM. MOUNT ABOVE GRADE FOR WATER SERVICE).

STR-4 Grooved, T-pattern, ductile iron body, 300 psi, stainless steel frame and mesh basket, grooved ends.

APPLICATION: DOMESTIC HOT AND COLD WATER SYSTEM EXCEPT FOR HIGH PRESSURE SYSTEM.

P. Vent Caps:

VC-1 Vandal-proof hood type, for plumbing vent lines.

Manufacturer: Stoneman Engineering and Mfg., Semco 1550, or equal.

EDIT NOTE: APPLICATION: SANITARY DRAINAGE SYSTEM.

- Q. Flanges: Flanges shall be furnished and installed at each flanged connection of each type of equipment, tanks, and valves. Faces of flanges being connected shall be furnished alike. Connection of a raised face flange to a flat-faced flange is not permitted. Flanges shall conform to following schedules:

TYPE OF PIPE	FLANGE
Screwed black or galvanized grooved steel pipelines.	125-pound black cast iron screwed flange, flat faced or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.
Welded or grooved steel pipe, except high pressure steam lines.	150-pound black forged steel welding flanges, 1/16 inch raised face ASTM A 105, Grade II or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.
Copper and brass pipe or tubing.	150 pound cast bronze, flat-faced flange with solder end or grooved flange adapters, Victaulic Style 641, Tyco-Grinnell Fig. 61, Gruvlok Fig. 6084, or equal.

1. Gasket material for flanged connections shall be full faced or ring type to suit facing on flanges and shall be furnished in accordance with following schedule:

<u>SERVICE</u>	<u>TYPE</u>
Cold water	1/16-inch-thick neoprene

Grooved end flange adapters supplied with pressure responsive elastomeric Gaskets supplied with grooved flange adapters shall be pre-lubricated by the manufacturer. Grade of gasket to suit intended service.

R. Unions:

1. Unions shall be furnished and installed in accordance with the following requirements (unless flanges are furnished):
 - i. At each threaded or soldered connection to equipment and tanks, except in Freon or fuel gas, piping systems, whether indicated or not.
 - ii. Immediately downstream of any threaded connection to each manually operated threaded valve or cock, and each threaded check valve, yard box or access box except those in Freon piping systems, whether indicated or not.
 - iii. At each threaded connection to threaded automatic valves (except those in Freon piping systems) such as reducing valves and temperature control valves, whether indicated or not.
 - iv. If grooved piping is used, couplings shall serve as unions. Additional unions are not required
2. Unions shall be located so that piping can be easily disconnected for removal of equipment, tank, or valve.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this Section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.

- B. Pipe Installation:

1. Install piping parallel to wall and provide an orderly grouping of proper materials and execution.
2. Piping shall clear obstructions, preserve headroom, provide openings and passageways clear, whether indicated or not. Verify the Work of other Divisions to avoid interference.
3. If obstructions or the Work of other Divisions prevent installation of piping or equipment as indicated by the Drawings, perform minor deviations as required by the ARCHITECT.
4. Install piping after excavation or cutting has been performed. Piping shall not be permanently enclosed, furred in, or covered before required inspection and testing is performed.
5. Exposed polished or enameled connections from fixtures or equipment shall be installed with no resulting tool marks or threads at fittings. Residue or exposed pipe compound shall be removed from exterior of pipe.
6. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members, provide such members with reinforcement steel straps of Continental Steel & Tube Co., ULINE, Independent Metal Strap, or equal.
7. Reduce fitting where any change in pipe size occurs. Bushings shall not be furnished unless specifically reviewed by the ARCHITECT, or indicated on Drawings.
8. Piping subject to expansion or contraction shall be anchored in a manner, which permits strains to be evenly distributed. Swing joints or expansion loops shall be installed. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping. Seismic loops required at all building separations.
9. Immediately after lines have been installed, openings shall be capped or plugged to prevent entrance of foreign materials. Caps shall be left in place until removal is necessary for completion of installation.
10. Couplings shall not be installed except where required pipe runs between other fittings are longer than standard length of type of pipe being installed and except where their installation is specifically reviewed by the ARCHITECT.
11. Water piping shall be installed generally level, free of traps, unnecessary offset, arranged to conform to building requirements, clear of ducts, flues, conduits, and other Work. Piping shall be arranged with valves installed to

provide for complete drainage and control of system. Piping shall not be installed which causes an objectionable noise from flow of water therein under normal conditions. Refer to Section 23 0500: Common Work Results for Plumbing.

12. Water lines may be installed in same trench with sewer lines, provided bottom of water line is 12 inches minimum above top and to the side of sewer line.
13. Changes in pipe sizes shall be furnished with eccentric reducers, flat on top. Offsets to clear obstruction shall not be installed so as to produce air pockets.

C. Pipe Sleeves and Plates:

1. Provide pipe sleeves of Schedule 40 black steel pipe or Schedule 40 PVC plastic pipe in concrete or masonry walls, footings, and concrete floors below grade. Provide adjustable submerged deck type sleeves at locations where pipes pass through concrete floors, except concrete slab floors on grade, and at locations where soil pipe for floor type water closets passes through concrete floors.
2. Sleeves shall provide ½ inch clearance around pipes, except plastic pipe shall have 1 inch clearance. Caps of deck type sleeves shall be removed just prior to installation of pipe. Area around sleeves shall be smooth and without high or low spots. Sleeves in walls shall not extend beyond exposed surface of wall. Sleeves in concrete floors and walls shall be securely fastened to forms to prevent movement while concrete is being placed.
3. Piping installed on a roof shall clear the roof surface by 10 inches minimum, with or without insulation. Bottom of individual fittings may infringe on 10 inches clear space but not groups of fittings or fittings located within 27 inches of each other.
4. Stiles shall be provided to facilitate crossing of piping when parallel piping runs are laterally greater than 12 inches out-to-out, or any pipe is higher than 18 inches, and more than 40 feet long or runs between two or more major pieces of equipment or housings greater than 20 feet apart. Stiles shall be not less than 20 inches wide with a minimum tread depth of 10 inches. Where stiles are required, they shall be located so greatest obstructed distance is 30 feet.
5. Where pipes pass through waterproofed walls, floors, or floors on grade, sealant with Link-Seal Modular Seals, or equal, between pipe and sleeve to provide a waterproof joint. Where earth is in contact with pipe on both sides of a wall or foundation, the waterproof joint is not required. Commercial rubber compression units may be furnished instead of sealed sleeves if reviewed by the ARCHITECT.
6. A swing joint, or other required device, shall be furnished and installed in hot water lines with 10 feet of sealant or compression joint to allow for expansion.
7. Provide polished, chrome-plated flanges when plumbing pipes pass through walls at plumbing fixtures, etcetera as specified in Section 22 4000 Plumbing. Provide polished steel, chromium-plated split floor and ceiling plates at locations where pipes pass through walls, floors, ceilings, and partitions in finished portion that neatly conceals pipe insert.
8. Pipe sleeves shall be provided where pipes intersect footings or foundation walls and sleeve clearances shall provide for footing settlement, but not less than one inch all around pipe.

D. Welding of Pipe and Qualifications of Welder:

1. Joints above grade or accessible conduit or tunnels in steel piping may be either welded or screwed unless specifically indicated otherwise on Drawings or specified. Joints in below grade steel piping, whether in insulation or not, shall not be welded, unless otherwise indicated.
2. Welded joints in pipe shall be continuous around pipe and shall comply with ASME B31: Code for Pressure Piping, unless otherwise specified.
3. Each pipe weld shall be stamped with welder's identification mark. Welding shall be performed by welders possessing a valid certificate of qualification for welding carbon steel welding pipe in horizontal position (2G) and horizontal fixed position (5G) in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code, by an OWNER-recognized, DSA approved testing laboratory.
4. Before any welder performs welding on the Work, furnish the INSPECTOR with a copy of welder's valid qualification papers and obtain verification. Welder qualification is not valid unless it has been issued while welder was performing work for current employer and has performed type of work described by qualification in the preceding 3 months.
5. Welding performed under these Specifications is subject to special tests and inspections including rigid Ultra Sonic Testing (UT) and radiographic inspection at random, in accordance with Technique for Radiographic Examination of Welded Joints by an OWNER recognized, DSA approved testing laboratory.

E. Unacceptable Welds and Repairs to Welding:

1. Welds containing any of the following types of imperfections shall be deemed defective Work:
 - i. Cracks of any type.
 - ii. Zones of incomplete (in excess of 1/32 inch) fusion or penetration.
 - iii. Elongated slag inclusions longer than 1/4 inch.
 - iv. Groups of slag inclusions in welds having an aggregate length greater than thickness of parent metal in a length 12 times the thickness of the parent metal.
 - v. Undercuts greater than 1/32 inch.
 - vi. Overlaps, abrupt ridges or valleys.
3. When a defective weld is detected by examination as outlined above, two additional welds shall be radiographed at locations selected by the Project Inspector. If the two selected welds demonstrate compliant welding, then the two tested welds shall be deemed to be in compliance. Welding revealed by radiographs to be defective Work shall be removed, repaired, and tested by radiograph.
4. If either of the two selected welds demonstrates welding deemed to be defective Work, all welding in that portion of the Work shall be deemed defective Work and either: all welds shall be cutout, prepare new ends for welding and weld to comply with this Specification, or radiograph all welds, removing and repairing only such welding deemed to be defective Work.

5. Repair welding shall be performed in a manner in full compliance with ASME B31. The welded joints or repairs shall be spot examined with UT or radiographic tests in accordance with foregoing requirements.
 6. OWNER shall cause to be performed additional random UT and radiographic examinations of welds. OWNER shall be responsible for the costs of any UT and radiographic examinations found to be in compliance with specified requirements.
 7. Installer shall be responsible for the costs of UT and radiographic re-examinations of welds deemed defective Work and not in compliance with this Specification and shall repair or replace said welds in accordance with specified requirements.
- F. Welding Rods: Submit a written list of materials and proposed type of welding rods.
- G. Backing Rings: Backing rings may be submitted for installation provided the Product Data is submitted with the material list.
- H. Qualification Tests for Low-pressure Welding:
1. Tests shall be performed on 3-inch standard weight pipe ASTM A53, Grade A, and shall be welded by acetylene and electric arc. Each sample shall consist of 2 pieces, each 10 inches long, with 30-degree bevel at point weld.
 2. Two 20-inch samples shall be performed in the 2G and two 20-inch samples in the 5G positions, with positions defined in Section IX, ASME Boiler and Pressure Vessel Code. Welds shall have the reinforcement ground or machined flush to the surface of the pipe before testing. Samples shall be tested as full section tensile.
 3. Weld shall develop a load of 90 percent of 50,000 psi, i.e., 45,000 psi or shall develop a fracture in parent metal.
 4. Each qualified welder shall carry an identification card listing welder's name, date of test, and type of welding tests passed; signed by the welder and the laboratory.
 5. A valid certificate of qualification issued in compliance with requirements of the ASME Boiler Pressure Vessel Code Section IX shall qualify a welder for issuance of a certificate for low-pressure pipe welding.
- I. Certificates of Qualification for Welding of Unfired Pressure Vessels:
1. Certificates of qualification shall be issued by a laboratory recognized by the OWNER in compliance with the requirements of the ASME Boiler Pressure Vessel Code Section IX. Qualifications shall be for both acetylene and arc welding of Schedule 40 ASTM A53, Type B, steel welded or seamless pipe in the Horizontal Position (2G) and the Horizontal Fixed Position (5G) as defined by said code.
 2. Certificate described above is not valid unless it has been issued while welder was working for his current employer, and unless welder has performed type of work described by certificate in the preceding three months. Requirements for possession of a valid certificate shall not be waived for welders fabricating unfired pressure vessels when the Specifications require compliance with ASME code or when welding pipe carries working pressures greater than 75 psi and temperatures greater than 250 degrees F.

J. Pipe Joints and Connections:

1. Pipe and tubing shall be cut per IAPMO Installation Standards. Pipe shall have rough edges or burrs removed so that a smooth and unobstructed flow shall be provided.
2. Hot tapping of gas lines is strictly prohibited.
3. Threaded Pipe: Joints in piping shall be installed according to the following service schedule:
 - i. Soap Piping: Litharge and glycerine, or Expando, Gasoila, or equal.
 - ii. Plastic Piping: Teflon pipe joint compound tape.
 - iii. Oxygen Piping: Wash threads with S.P., rinse, blow-dry and apply litharge and glycerine.
 - iv. Cleanout Plugs: No compound shall be used. After inspection and test, plugs shall be removed, cleaned, greased, and replaced.
 - v. Other services furnish sealant, suitable and as reviewed by the ARCHITECT.
4. Threads on pipe shall be cut with sharp, clean, unblemished dies and shall conform to ANSI/ASME B2.1 for tapered pipe threads.
5. Joint compounds shall be smoothly placed on male thread and not in fittings. Threaded joints shall be installed tight with tongs or wrenches and sealant of any kind is not permitted. Failed joints shall be replaced with new materials. Installation of thread cement or sealant to repair a leaking joint is not permitted.
6. Sharp-toothed Stillson, or similar wrenches, is not permitted for the installation of brass pipe or other piping with similar finished surfaces.

K. Copper Tubing and Brass Pipe with Threadless Fittings:

1. Silver brazed joints shall be used for attaching fittings to non-ferrous metallic refrigerant piping.
2. Non-pressure gravity fed condensate lines may be soldered with 95/5 solder.
3. Silver brazing alloy, Class BCUP-5. Surfaces to be joined shall be free of oil, grease, and oxides. Socket of fitting and end of pipe shall be thoroughly cleaned with emery cloth and wiped to remove oxides. After cleaning and before assembly or heating, flux shall be installed to each joint surface and spread evenly. Heat shall be applied in accordance with instructions in the Copper Tube Handbook issued by Copper Development Associates. Joints constructed of rough bronze fittings shall be provided as recommended by manufacturer.
4. Do not overheat piping and fittings when installing silver brazing.
5. Joints in non-ferrous piping for services not covered above shall be installed with solder composed of 95/5 tin/antimony, ASTM B32, Grade 5A. Surfaces to be jointed shall be free of oil, grease, and oxides. Sockets of fitting and end of pipe shall be cleaned with emery cloth to remove oxides. Solder flux shall be sparingly installed and solder added until joint is completely filled. Do not overheat. Excess solder, while plastic, shall be removed with a small brush in order to provide an uninterrupted fillet completely around joint. Random inspection of joints shall be conducted by Project Inspector to ensure joints are lead-free.

6. Grooved end joints for copper piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
 7. Pressed fittings for copper or copper alloy pipe or tubing shall have an elastomeric O-ring that forms the joint. The pipe or tubing shall be fully inserted into the fitting, and the pipe or tubing marked at the shoulder of the fitting. Pipe or tubing shall be cut square, mechanically cleaned and reamed prior to joining to remove all burrs (interior and exterior) and restore full inside diameter and a smooth, chamfered exterior surface. The fitting alignment shall be checked against the mark on the pipe or tubing to ensure the pipe or tubing is inserted into the fitting. The joint shall be pressed using the tool recommended by the manufacturer.
- L. Ring-Type Pipe: Joints shall be installed in accordance with manufacturer's instructions with grooved couplings, fittings and rubber rings. Couplings and pipe shall be compatible and of the same manufacturer. Rings shall be accurately located and installed by grooves in coupling. Pipe shall be installed with zero deflection unless otherwise specified. Pressure pipe shall be furnished with thrust blocks at each offset point.
- M. Welded Pipe Joints:
1. Joints in welded steel pipelines shall be installed by oxyacetylene or electric arc process. Welding shall be continuous around pipe and provided as specified.
 2. Butt welds shall be of the single V-type, with ends of pipe and fittings beveled approximately 37 ½ degrees. Piping shall be aligned before welding is started with the alignment maintained during welding.
 3. Welds for flanges and socket fittings shall be of the fillet type with a throat dimension not less than pipe wall thickness.
- N. Grooved End Pipe Joints: Grooved end joints for carbon steel piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- O. Joints shall be Vic-Press 304TM, or equal, made with Victaulic Series 'PFT' tools and the appropriate sized jaw. Pipe shall be certified for use with Vic-Press 304TM system, and shall be square cut, properly deburred and cleaned, and marked at the required location to insure full insertion into the fittings and/or couplings.
- P. Polyethylene (Plastic) Pipe:
1. Joints shall be installed by the heat fusion method, in accordance with manufacturer's recommendations and IAPMO installation standard IS 12, for natural gas.
 2. Pipe Riser at Meter, Regulator and Building Wall: Prefabricated, anodeless type, utilizing a grade level transition between underground polyethylene pipe

and gas supply steel pipe of riser outlet, R. W. Lyall Co., or equal. Below grade to above grade transition shall be installed in a welded, epoxy coated, steel casing.

3. Connections to Existing Pipe Line or Branch:

- a. Steel-to-plastic (PE): Provide manufacturer's prefabricated standard transition fitting, transition from epoxy-coated steel pipe to plastic, R. W. Lyall Co., or equal.
- b. Plastic-to-plastic, PVC to PE: Provide manufacturer's prefabricated standard transition fitting, transition from PVC to epoxy-coated steel pipe to PE; R.W. Lyall Co., or equal.
- c. Plastic-to-plastic, PE to PE: Provide manufacturer's standard fused tapping tee assembly with shut-off feature.

4. Provide PE reinforcing sleeves where PE pipe is fused to multi-saddles, service punch tee, reducing tees, transition fittings and anodeless risers.

Q. Valves: Valves shall conform to the following:

1. Piping systems shall be furnished with valves at points indicated on Drawings and specified, arranged to provide complete regulating control of piping system throughout building and the Project site.
2. Valves shall be installed in a neat grouping, so that parts are easily accessible and maintained.
3. Valves shall be full size of line in which they are installed, unless otherwise indicated on Drawings or otherwise specified, and shall be one of types specified.
4. Provide chain operators on valves 2-inch and larger located 7 feet or more above the servicing floor level.
5. Valves for similar service shall be of one manufacturer.
6. Except where otherwise specified, valves shall be Belimo, Victaulic, Stockham, Crane, Jenkins, Milwaukee, Hammond, American, NIBCO, Hoffman, or equal.
7. Ball valves below grade in yard boxes shall have stainless steel handles.
8. Hose bibs in dense garden areas shall be $\frac{3}{4}$ inch in size with one hose bib in the lunch pavilion 1 inch in size. Other hose bibs shall be $\frac{3}{4}$ inch lock shield type. Bibs shall be furnished with vacuum breaker protection.
9. Safety valves and pressure relief valves shall have stamp of approval as required by ASME and shall be provided with annual test lever. Where a hot water storage tank is heated by means of a coil, pressure relief valve shall have a steam BTU discharge rating of the coil. Discharge pipe from safety or pressure relief valves shall be not less than one pipe size larger than inlet pipe size of valve. Discharge pipe shall terminate as indicated and shall be free of traps. In addition to locations specified, pressure relief valves shall be installed in the following locations:
 - a. On discharge side of each pressure-reducing valve.
 - b. On each water heater connected to a hot water storage tank and other pressure vessels.
 - c. On cold water line to each water heater or hot water storage tank when there is a check valve, backflow prevention valve or similar device

- between water heater or hot water storage tank and meter or relief valve at the pressure reducing valve assembly.
 - d. On discharge side of each air compressor.
 - e. On each air receiver connected to an air compressor.
 - 10. Temperature relief valves and combination temperature and pressure relief valves shall be as specified and furnished as set forth in this Section. Discharge pipe from relief valves shall be not less than discharge area of valve or valves it connects, based on discharge area of valves, and shall terminate as indicated and free of any traps. Valves shall be installed at following locations:
 - 11. A combination temperature and pressure relief valve or combination of valves on each heating hot water storage tank. Temperature sending element shall extend into water inside tank.
 - 12. Manual air vent valve assemblies shall be installed at each high point of hot water space heating and chilled water piping systems. Valves shall discharge through 1/4 inch diameter copper tubing and drain to nearest floor sink. Automatic type air vent valve shall only be installed where specifically indicated. Radiator, convectors, and finned pipe convectors shall be fitted with packless radiator valves, angle or straight pattern. Each convector or radiator installed as part of a space hot water heating system shall be furnished with a manual-type air vent valve.
- R. Strainers: Strainers shall be installed on each water main (except for fire line) downstream of the meter, above grade, when a pressure regulator assembly is not installed. Main strainer shall be of Y-flange or groove type. On closed loop chilled and heating hot water systems pump systems, a strainer shall be installed at each pump inlet and upstream of each flow control valve assembly. The control valve assembly may include a modulating temperature control valve and a flow-limiting valve, manufactured by Griswold, AutoFlow, Flow Control Industries, Inc., or equal.
- S. Hangers and Supports:
- 1. Piping shall be securely fastened to building structure by approved iron hangers, supports, guides, anchors, and sway braces to maintain pipe alignment to prevent sagging and to prevent noise or excessive strain on piping due to uncontrolled or seismic movement under operating conditions. Hangers and supports shall conform to Manufacturer's Standardization Society Specification SP-69. Hangers shall be relocated as required to correct unsatisfactory conditions that may become evident when system is placed into operation. Appliances, heat exchangers, storage tanks, and similar equipment shall be securely fastened to structure in accordance with seismic requirements. Outdoor metal hangers and supports shall be hot-dipped galvanized steel, unless otherwise specified.
 - 2. Hose faucets, compressed air outlets, and similar items at ends of pipe branches shall be rigidly fastened to building construction near point of connection.
 - 3. Piping shall not be supported by wire, rope, wood, plumbers' tape, or other non-recognized devices.

4. Hangers and supports shall be designed to support weight of pipe, fittings, weight of fluid and weight of pipe insulation, and shall have a minimum factor of safety of five, based on ultimate tensile strength of material installed.
5. Burning or welding of any structural member under load is not permitted. Field welding not specified on Drawings or reviewed Shop Drawings is not permitted without review by ARCHITECT and DSA.
6. Burning holes in beam flanges or other structural members is not permitted without review by the ARCHITECT and DSA.
7. Pipe hangers on piping covered with low temperature insulation shall be installed on outside of insulation and not in contact with pipe unless otherwise detailed on Drawings. Insulation shall be protected by 18 gage galvanized steel shield, with a minimum length of 10 inches, installed completely around pipe covering between covering and hanger. Installing hangers directly on pipe and butting adjoining sections of insulation against hanger is permitted provided void and hanger rod are properly insulated and sealed so that no sweating occurs at hangers.
8. Hanger rods shall be fastened to structural steel members with suitable beam clamps. Clamps shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco I beam, Fig.62 for maximum 1000 pounds.
 - b. Tolco I or WF beam, Fig. 329, for maximum of 1290 pounds.
9. Hanger rods shall be fastened to concrete inserts in concrete slabs or beams. Inserts shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco Fig.310 for maximum of 600 pounds.
 - b. Tolco Fig. 309 for maximum of 1140 pounds.
10. For fastening to wood ceilings, beams, or joists, furnish Grinnell Fig. 128R, Grinnell Fig. 153, Tolco 78, or equal pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2-inch by 2-inch by 1/4 inch angle clips 3 inches long, with 2, staggered 10d nails, clinched over joist.
11. Hanger rod sizes for copper, iron, or steel pipe: 3/8 inch for pipe sizes 1/2 inch through 2-inch, 1/2 inch for pipe sizes 3-inch, 4-inch and 5-inch, 5/8 inch for pipe size 6-inch, and 3/4 inch for 8-inch and 10-inch pipe.
12. Turnbuckles, if furnished, shall provide a load carrying capacity equal to that of the pipe hanger with which they are being installed.
13. Pipe hangers shall be of same size, or nearest larger manufactured size available, as pipe or tubing on which they are being installed.
14. Hangers, clamps, and guides furnished for support of non-metallic pipe shall be padded with 1/8 inch thick rubber, neoprene, or soft resilient cloth.
15. Where special pipe-supporting requirements in the Specifications conflict with any standard requirements specified herein, the Specification requirements shall govern.
16. Vertical Piping:
 - a. Vertical pipe risers shall be securely supported with riser clamps of recognized type. Risers in reinforced concrete buildings shall be

furnished with extension clamps fastened to pipe above each concrete floor slab with extended arms of clamp to rest on slab. Clamps shall be provided with lead or Teflon liners when installed on copper tubing. Clamps shall be plastic-coated when installed on non-ferrous pipe or tubing.

- b. Copper tubing in sizes 1 ½-inches and larger and steel pipelines passing up through building shall be supported at each floor of building or every 15 feet whichever is less.
- c. Copper tubing sizes 1 ¼-inches and smaller shall be supported at not intervals not more than 6 feet on center. Special provisions shall be installed for vertical lines subject to expansion and contraction caused by operating temperature differences.
- d. Vertical cast iron pipelines shall be supported from each floor and at its base. Malleable iron or steel pipe clamps with minimum thickness of 1/4 inch shall be furnished and fastened around pipe for support.

17. Horizontal Piping:

- a. Roof Mounted Piping: Pressure and non-pressure piping shall be supported from channels, stands, clamps, trapezes, rollers, or structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Block, or equal. Roller type supports shall be provided below and above pipe to prevent its dislodgement. Bottom of pipes shall clear the roof surface by 10 inches.
- b. Insulated steam and space heating hot water insulated condensate lines, insulated domestic hot water supply and return piping shall be supported with Tolco Figure 4, B-Line Figure B3140, Grinnell Figure 212, or equal, steel hangers with welded eye rods to permit hinge movement at point of attachment of hangers. Hinge movement at point of support shall be provided by welded eye linked rods Tolco Figure 101L, B-Line Figure B3211X, Grinnell Figure 278, or equal.
- c. Domestic cold water piping, water supply and return piping, condenser water piping, insulated refrigerant piping gas piping, compressed air piping, cast iron soil piping, galvanized steel vents, waste and downspout piping and glass to be supported with Tolco Figure 1, B-Line Figure B3100, Grinnell Figure 260, or equal, hangers with rods, turnbuckles and inserts suitable for above hangers.
- d. Maximum hanger and support spacing shall conform to CPC schedule for horizontal piping installed above grade.

- 18. A hanger or support shall be installed close to the point of change in direction of a pipe run, in either a horizontal or vertical plane.
- 19. When practicable, supports and hangers for cast iron soil pipe shall be installed as close as possible to joints and when hangers or supports are not located within one foot of a branch line fitting, an additional hanger or support shall be installed at fitting.
- 20. In systems where grooved piping is used, couplings shall be provided with angle pattern bolt pads to comply with support and hanging requirements of ANSI/ASME B31.1, ANSI/ASME B31.9, and NFPA Pamphlet 13.

T. Flashings:

1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.
 2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead. Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Install caps on top of heater pipes. Flanges and flashing shall be installed waterproof at point of connection with pipe or duct. No soldered joints on roof flashings will be allowed. No Stoneman lead roof flashings will be allowed.3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 8 inches.
 3. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 ½ inches. Flanges on gas-fired equipment single-wall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.
 4. Cast iron, steel, brass, and copper pipe, which terminates less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.
 5. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gas-heated sleeve type. Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of ¾ inch.
 6. Flashing and flanges on ducts shall be installed waterproof at point of connection to the duct by riveting and soldering. Storm collars shall be securely screwed and installed waterproof around appliance vent pipe immediately above flashing.
 7. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.
- U. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures per Section 23 0548 even if not indicated on Drawings.

END OF SECTION

SECTION 22 0553 - PLUMBING IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Marking and identification on mechanical piping systems, ducts, controls, valves, and apparatus.
- B. Related Requirements:
 - 1. Division 01: General Requirements
 - 3. Section 22 0513: Basic Plumbing Materials and Methods.
 - 4. Section 22 1000: Plumbing.
 - 5. Section 22 2013: Plumbing Piping.

1.02 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 22 0500: Common Work Results for Plumbing.
- B. Submit product data and installation instructions for each item specified.
- C. Submit Samples of materials.

1.03 QUALITY ASSURANCE

- A. Comply with provisions of:
 - 1. Section 22 0500: Common Work Results for Plumbing.
 - 2. ANSI/ASME A13.1: Scheme for the Identification of Piping Systems.
 - 3. APWA: Uniform Color Code.
 - 4. IAPMO: Uniform Plumbing Code (UPC)

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General: Piping systems, controls, valves, apparatus, etc., except those that are installed in inaccessible locations in partitions, walls, and floors, shall be permanently identified.

2.02 VALVES

- A. Furnish prepared chart or diagram for each piping system, indicating by identifying letter or model number of each valve in the system, its location, and function.
- B. Install charts in aluminum frame with clear glass front and secure on wall where designated by the Project Inspector.
- C. Bind copies of each chart in operating instructions manual.
- D. Provide each valve with a brass, aluminum, or plastic disc, not less than 1-1/4 inches diameter bearing engraved numbers corresponding to those indicated on chart. Fasten discs to valve with No. 14 brass wire.
- E. Provide an additional tag for safety valves and other valves that could be hazardous to safety and health of occupants. Distinguish these tags from regular valve tags by color (such as yellow with black letters and marked "Danger"); submit Sample tag to the Architect for review.

2.03 INSTRUMENTS AND CONTROLS

- A. Identify panel-mounted instruments and controls with engraved bakelite nameplates permanently affixed to panel boards.
- B. Identify alarm indicating devices and alarm reset devices by nameplates.
- C. Identify automatic valves, flow switches, and pressure switches, with embossed aluminum or plastic tape affixed to controller, indicating service and setting.

2.04 EQUIPMENT

- A. Identify each major piece of equipment with engraved bakelite nameplates permanently affixed to the equipment, indicating the room numbers it services, Equipment identification designation shall be the same to its designation indicated on the "As-Built Drawings". Room numbers in the nameplates shall correspond to the final room numbers.

2.05 ABOVE GRADE PIPE IDENTIFICATION

- A. Identify pipes by means of colored labels with directional flow arrows and identification of the pipe content, in conformance to ANSI/ASME A13.1 or the UPC.
- B. Materials: Precoiled acrylic plastic with clear polyester coating, all-temperature, self-adhering, as manufactured by Brady, Brimar Industries, Seton, Stranco, Inc., or equal.
- C. Size:

Outside Diameter of Pipe or Insulation (in inches)	Length of Color Field (in inches)	Size of Letter (in inches)
¾ to 1 ¼	8	½
1 ½ to 2	8	¾
2 ½ to 6	12	1 ¼
8 to 10	24	2 ½
over 10	32	3 ½

D. Locations:

1. On accessible piping, whether insulated or not (including mechanical rooms, attic and ceiling spaces); except that labels shall be omitted from piping where contained material is obvious due to its connection to fixtures (such as faucets, water closets, etcetera.).
2. Near each valve and branch connection in such accessible piping.
3. At each pipe passage through wall or floor.
4. At not more than 20 feet spacing on straight pipe run between bands required in 2 and 3 above.
5. At each change in direction.

E. Application: Install on clean surfaces free of dust, grease, oil, or any material that will prevent proper adhesion. Replace non-adhering or curling labels with new labels.

F. Color Schedule:

Content of Pipe	Legend	Background Color	Lettering Color
Domestic cold water	Domestic. C.W.	Green	White
Non-potable cold water	Caution: Non-potable Water Do Not Drink (1)(2)	Purple	Black
Domestic hot-water 140°F	Domestic H.W. 140°F	Blue	Black
Sanitary waste	San waste	Green	White
Sanitary vent	San vent	Green	White
Storm drain or downspout	Storm drain	Green	White
Indirect drain	Ind drain	Green	White
Sump pump discharge	Pump discharge	Green	White
Fire sprinkler supply	Fire Sprinkler supply	Red	White
Fire sprinkler drain	Sprinkler drain	Red	White

Fuel oil	Diesel oil	Yellow	Black
Gas	Gas	Yellow	White
Reclaimed Water	Caution: Reclaimed Water Do Not Drink (1)(3)	Purple	Black

H. Notes on Schedule:

- Note (1) indicates 2 ¼ inch by 1 inch yellow label with ½ inch letters reading UNSAFE WATER at one end of primary label.

Note (2) words should read “CAUTION: NONPOTABLE WATER DO NOT DRINK.” with international *do not drink* symbol.

Note (3) words should read “CAUTION: RECLAIMED WATER DO NOT DRINK.” with international *do not drink* symbol.

2.06 UNDERGROUND PIPE

A. Detectable Marking Tape:

- Provide and install detectable marking tape along buried piping. Tape shall be specifically manufactured for marking and locating underground utilities with electronic equipment. Tape shall be acid and alkali resistant, and manufactured with integral wires or foil backing, encased with protective cladding. Tape shall be a minimum of two inches in width.
- Manufacturer: Reef Industries, Inc., Advantage Brands, Inc., Northtown Company, Mutual Industries, Inc., or equal.
- Detectable marking tape shall be color-coded per APWA Color Code:
 - Yellow: Oil and gas.
 - Blue: Water, irrigation and slurry lines.
 - Green: Sewer and drain lines.

B. Tracer Wire:

- Solid copper wire type THWN, 12 AWG gauge, with heat and moisture resistant insulation.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Correct detrimental conditions prior to commencing the Work of this Section. Install markers and identification tags as specified with materials and installation procedures recommended by manufacturer.

- B. Place tracer wire on top of non-metal utility lines allowing some slack. Do not wrap tracer wire around pipe. Fasten tracer wire in place at approximately 10 feet on centers with non-metal ties.
- C. Install underground detectable pipe marking tape continuously buried 8 to 10 inches above the buried utility pipe. Wrap tape on pipe risers up to a height of 12 inches above grade.

3.02 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 22 0700 - PLUMBING INSULATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Insulation for plumbing piping.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 22 0500: Common Work Results for Plumbing.
3. Section 22 0513: Basic Plumbing Materials and Methods.
4. Section 22 0553: Plumbing Identification.
5. Section 22 1000: Plumbing.

1.02 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation.
2. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
3. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
4. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
5. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
6. ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
7. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
8. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. Underwriters Laboratories, Inc.

1. UL 723 - Test for Surface Burning Characteristics of Building Materials.

C. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

- D. California Code of Regulation Title 24.
 - 1. California Green Building Standards Code.

1.03 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 22 0500: Common Work Results for Plumbing.
 - 1. Complete material list of items to be furnished and installed under this Section.
 - 2. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements.
 - 3. Shop Drawings, catalog cuts and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.
 - 4. Display sample cutaway sections.
 - 5. Manufacturer's recommended method of installation procedures, which will become part of this Section.

1.04 QUALITY ASSURANCE

- A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 22 0500: Common Work Results for Plumbing and Section 22 0513: Basic Plumbing Materials and Methods.
- B. Insulation Work shall be in accordance with the California Building Energy Efficiency Standards, CBC, and Uniform Mechanical Code and the California Green Building Standards Code.
- C. Test Ratings:
 - 1. Comply with provisions stated under Section 22 0500 and 22 0513 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.
 - 2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.
 - 3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.
 - 4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.
- D. Regulatory Requirements: Insulation furnished and installed under this Section shall meet minimum legal requirements of the Building Energy Efficiency Standards adopted and

incorporated in the California Energy Commission, Title 24, Part 2, Chapters 2 through 53 and the California Green Building Standards Code unless otherwise noted, for the piping,

- E. Chemically based products such as sealers, primers, fillers, adhesives, etcetera must meet the California air quality regulations.

1.05 PRODUCT HANDLING

- A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 22 0500: Common Work Results for Plumbing and 22 0513: Basic Plumbing Materials and Methods.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General:
 - 1. Insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.
 - 2. Insulating material shall be furnished with thickness indicated in Table 1, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.
 - 3. Asbestos in any quantity in insulating material is not permitted.
 - 4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:
 - a. Nylon anchors for installing insulation to equipment.
 - b. Treated wood blocks.
 - 5. Flame-proofing treatments subject to moisture damage are not permitted.

TABLE 1 - MINIMUM PIPING INSULATION THICKNESS ⁽¹⁾
Insulation Thickness Required (in inches)

Piping System Type	Temp. Range (degrees F)	Runouts up to 2 (2)	1 and less	1.25 to 2	2.5 to 4	5 to 6	8 and larger
Service Water Heating Systems (recirculating, piping supply and return)							
Hot Water	Up to 180	0.5	1.0	1.0	1.5	1.5	1.5
Condensate Drain	½ inch minimum insulation thickness.	0.5	0.5	0.5	0.5	0.5	0.5

From A/C Equipment:	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5	0.5	0.5
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NOTES: (1) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.

(2) Runouts to individual terminal units, not exceeding 12 feet in length.

- B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.
- C. Canvas Jackets: Provide 6 ounce, in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.
- D. Insulation Jackets:
 - 1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16 inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.
 - 2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½ inch to 8-inch shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024 inch thickness. Insulated elbows with a nominal pipe size of 10-inch to 18-inch shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.
 - 3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.
- E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.
- F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or equal.

2.02 DOMESTIC HOT WATER PIPING SYSTEM INSULATION

- A. General: Insulate domestic hot water supply and return piping, including valves, strainers and fittings with insulation thickness as indicated on Table 1.
- B. Materials:
1. Classes of Insulation:
 - a. Class A: Glass fiber molded pipe insulation suitable for service temperatures up to 850 degrees F. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, Knauf Redi-Klad 1000, Owens Corning FIBERGLAS Pipe Insulation SSL II-ASJ, or equal.
 - b. Class B: Flexible open-cell melamine (foam insulation) suitable for service temperature -150 degrees F to 400 degrees F. Thermal conductivity at 75 degrees F, K= 0.26. Pipe insulation, one-piece pre-formed, laminated to heavy non-reinforced PVC jacket, with locking track, factory installed to jacket, to snap insulation and jacket onto pipe. Similar to TechLite 079 Series as manufactured by Accessible Products Co., or equal. Installation shall comply with manufacturers recommendations.
 - c. Class C: Mineral fiber pipe insulation suitable for service temperatures up to 1200 degrees F. Pipe insulation shall be one-piece, preformed up to 3 inches thick, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be 8 pounds in accordance with cubic foot density by Roxul Techton 1200, Fibrex COREPLUS 1200, Industrial Insulation Group, LLC (IIG) MinWool-1200, or equal.
 2. Locations and Class of Insulation Required:

TABLE 2 – LOCATIONS AND CLASS OF INSULATION REQUIRED

<u>LOCATION</u>	<u>CLASS OF INSULATION</u>
Equipment Room	A, B or C
Other Locations	A, B or C

3. Fittings on indoor piping shall be covered with flush, hand-wrapped Class A, B, or C insulation, to match the adjoining pipe insulation and covered with polyvinyl chloride fitting covers: Zeston 2000 25/50 by Johns Manville, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.
4. Adhesive: Fibrous Adhesive to bond calcium silicate to itself and non-porous surfaces.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.
- B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.
- D. Pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where firestop or firesafing materials are required.
- E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.
- F. Insulation shall not be installed in the following locations unless otherwise noted:
 - 1. On unions, flanged connections or valve handles.
 - 2. Over edges of any manhole, clean-out hole, clean-out plug, and to restrict opening or identification of access.
 - 3. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.02 INSTALLATION OF DOMESTIC HOT WATER PIPING SYSTEM INSULATION

- A. General: Domestic hot water, tempered water supply and return piping and condensate return piping, after having been tested, shall be cleaned and insulated.
- B. Application: Insulate condensate return piping, domestic hot water supply and return, including tempered supply and return piping in accordance with manufacturer's instructions and as specified herein.
 - 1. Install insulation on valve bodies up to valve bonnet. Fill void in saddles, in accordance with Section 22 0513: Basic Plumbing Materials and Methods, with insulation and seal joints.
 - 2. Install insulating material to fittings, valves, and strainers and smooth to thickness of adjacent covering. Leave strainer clean-out plugs accessible. Covers fabricated from polyvinyl chloride shall be furnished.
- C. Insulation Jackets in Exposed Indoor Locations:

1. Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams 1 1/2-inch minimum. Finish entire jacket with coating of undiluted adhesive.
 2. Equivalent factory applied pre-sized, glass fiber reinforced, or glass fiber jackets may be furnished. Seal jacket seams with adhesive in accordance with manufacturer's instructions.
 3. Johns Manville Zeston 2000, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal, fitting covers may be furnished, with molded or segmented insulation equal to specified insulation applied to fittings. Secure covers in accordance with manufacturer's instructions.
 4. In addition to above requirements, cover exposed insulated piping within a distance of 8 feet above floors with 26 gage galvanized steel jacket. Omit jacket in areas accessible only to maintenance personnel, such as mechanical equipment rooms, utility corridors, accessible pipe tunnels and manholes.
- D. Concealed Indoor Locations: Cover insulation over fittings, valves, and strainers with canvas. Provide pipe insulation with factory or field applied standard jacket of 4 ounce minimum canvas, fiberglass cloth, or glass fiber reinforced jacket. Seal jacket laps with adhesive in accordance with manufacturer's instructions.
- E. Exposed Outdoors: In addition to canvas or fiberglass cloth cover, pipe insulation exposed to weather shall be provided with an additional 0.016 inches thick aluminum jacket with 2-inch lap connected with one inch hem overlap joint located on side of pipe and turned down to shed water. Jacket shall be strapped 12 inches on center with 1/2-inch wide stainless steel strapping and wing seals. Aluminum jacket shall be mitered to fit fittings.

3.03 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.04 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 22 1000 - PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Labor, materials, tools, and equipment to install plumbing systems as indicated.
- B. Related Sections:
 - 1. Division 01 - General Requirements.
 - 2. Section 07 9200: Joint Sealants.
 - 3. Section 22 0500: Common Work Results for Plumbing.
 - 4. Section 22 0513: Basic Plumbing Materials and Methods.
 - 5. Section 22 0553: Identification for Plumbing piping and Equipment.
 - 6. Section 22 0700: Plumbing Insulation.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 22 0500: Common Work Results for Plumbing.
- B. Provide necessary documentation to Owner for processing rebates for water efficient fixtures.

1.03 QUALITY ASSURANCE

- A. Unless otherwise noted, the California Plumbing Code is hereby made part of this section.
- B. Conform to provisions of Section 22 0500: Common Work Results for Plumbing.
- C. Manufacturer of plumbing products must be third-party certified to ANSI/NSF Standard 61, Section 9 certification, and ANSI/NSF 372 to demonstrate compliance with the federal requirements for lead contribution to drinking water, the Safe Drinking Water Act SDWA, and the California Health and Safety Code Section 116875.

1.04 PRODUCT HANDLING

- A. Conform to provisions of Section 22 0513: Basic Plumbing Materials and Methods.

PART 2 - PRODUCTS

2.01 PIPING SYSTEMS

- A. Materials: Refer to Section 22 0513: Basic Plumbing Materials and Methods.
- B. Insulation for Piping: Refer to Section 23 0700: Plumbing Insulation.

2.02 FIXTURES AND DRAINS

- A. General: Fixtures specified shall be furnished complete with trim and fittings. Cast iron plumbing fixtures shall be acid resistant enamel and identified by casting letters "AR" or words "acid-resistant" into metal. Fixtures shall be white unless otherwise specified. Cast iron fixtures shall be white enamel inside and on back, rim and apron, with exposed unfinished surfaces painted white. Fixtures of same general classifications shall be of same make.
- B. Finished Brass:
 - 1. Unless otherwise specified, finished brass of a similar type shall be of same manufacturer and model throughout buildings.
 - 2. Finished and exposed brass equipment, except floor, shower and urinal drains shall be chromium-plated and polished. Floor, shower and urinal drains, unless otherwise specified, shall be nickel-bronze metal.
- C. Traps, Trap Arms and Tailpieces:
 - 1. Fixture traps shall be all cast brass, chromium-plated and polished. (No tubular traps). Exceptions as follows:
 - a. Traps that are an integral part of a fixture.
 - b. Traps concealed in floors, walls and furring.
 - c. Traps standard for service sinks and Industrial Shop equipment.
 - d. Laboratory traps and tailpieces shall be as specified in section 22-0513 "Basic Plumbing Materials and Methods".
 - 2. Concealed traps and 17 gage tailpieces may be rough brass finish, except as otherwise specified. Laboratory traps and tailpieces shall be as specified in Section 22-0513: Basic Plumbing Materials and Methods. Furnish chromium-plated and polished cast brass wall flanges with setscrews and chromium-plated and polished brass casing on discharge side of each trap.
 - 3. Tailpieces shall be not lighter than 17 gage, brass, chromium-plated, and polished. Furnish and install chromium brass plated wall flanges with set screws and chromium-plated 20 gage brass casing on discharge side of each chrome-plated all cast trap.

- D. Faucet and Shower Valve Handles: Faucet and shower valve handles shall be solid brass, chromium-plated and polished, and fastened to their stems by Allen type hollow head stainless steel set screws through the side of the handle extending into the stem. Handles with sharp edges or projections shall not be furnished. At accessible fixtures: handles shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate handles shall be 5 pounds maximum.
- E. Fixture Supplies:
1. Supplies for water heaters shall be unplated rigid copper water tube with threaded adaptors for connections to valves and other threaded connections. All other supplies shall be chromium-plated brass with hospital threads or shall be furnished with fittings and valves, which completely cover threads.
 2. Exposed supplies for showers shall be chromium-plated brass pipe up to header with hospital threads or shall be furnished with fittings and valves, which completely cover threads.
 3. Supplies to water closet tanks, lavatories, and drinking fountains shall be furnished with a NSF 372/61 threaded brass nipple. Exposed unfinished piping shall be sleeved with chrome plated brass or copper cover casing and have an appropriate escutcheon for a clean finished appearance. Angle/straight valve stops shall be female 1/2 IPS (inlet) by 3/8 compression (outlet). Fixture supplies shall be polished chrome-plated, solid supply bulbed end risers with size compatible supply nut connection to fixture and 3/8 O.D. compression nut and ferrule connection to angle stop outlet. Stainless steel flexible braided connectors with re-enforced PVC inner hose are not allowed.
 4. Hot and cold water fitting supply outlet piping serving water closets, urinals, lavatories, drinking fountains, sinks, faucets, hose bibs, and sillcocks shall be iron pipe size (IPS) brass nipple, and piped in such a manner that through wall water supply outlet piping be removable, size appropriate, and lead free. The use of copper, copper MIP sweat adapters or similar fittings, in lieu of brass nipples is not allowed. The IPS brass nipple shall be directly connected to the fixture as follows:
 - a. Control stops for water closet and urinal flush valves.
 - b. Angle stop for lavatories, sinks and drinking fountains.
 - c. Shank/arm adapters for wall mounted sink faucets.
 - d. Iron pipe size (IPS) brass nipple connection for hose bibs, sillcocks, and other plumbing related fixture and/or plumbing fitting water supply outlets.
 5. Water supply pipe that penetrates a finished surface, wall, countertop or part of a cabinet shall be appropriately sized polished chromium-plated cover casing and wall flange/escutcheon fitting tight to the brass through wall nipple and securely affixed to the finished wall surface.
 6. Water supplies of plumbing fixtures shall be protected against back-siphonage in event of a vacuum in piping system. Toilet and urinal flush valves shall be furnished with recognized atmospheric vacuum breakers, installed a minimum of 6 inches above fixture.
 7. Discharge outlets of supply faucets for lavatories and sinks shall clear top of overflow rim by at least one inch.

2.03 ACCESS PLATES (To cleanouts, valves, water hammer arrestors and hose faucets)

A. Schedule Numbers:

AP-1: Square, unless otherwise noted, steel, prime coated; frame, 18 gage minimum. Door shall be 16 gage minimum with concealed hinge or be removable, with vandal-proof lock operated by Allen wrench. (Specify for painted and stucco walls.)

SMITH	ZURN	ELMDOR	MILKOR	WATTS	MIFAB	JOSAM
Fig 4760 AK	Z-1462- VP	DW-AKL	MOR DW AK1	CO- 300-S-6	UA-A	58650-VP OR EQUAL

AP-2: Round type, stainless steel, vandal-proof, 5/16 inch No. 18 or 1/4 inch No. 20 flat-head machine screw into cleanout plug. Plate shall be prime coated minimum 18 gage steel or polished chrome-plated brass, 18-8 No. 302 stainless steel, or polished nickel bronze.

(To be specified for painted walls, screwed into cleanout plug.)

SMITH	ZURN	JOSAM	WADE	WATTS	MIFAB	OR EQUAL
4710U	Z-1469- VP	58600	8480R	CO-480- RD-6	C1400-RD-6	

AP-3: Square, polished face chrome-plated bronze, aluminum alloy or brass chrome-plated brass frame with 14 gage polished 18-8 No. 302 stainless steel or brass chrome-plated secured cover with vandal-proof screws.
(To be specified for tile walls.)

SMITH	ZURN	WADE	WATTS	MIFAB	JOSAM	OR EQUAL
4735U	Z-1460- VP	58630	CO-300- S-6	C1400-S- 3-6	58640- VP	

2.04 BACKWATER SEWER VALVE ASSEMBLY

A. Schedule Numbers:

BSV-1: Cast iron with access cover with line size gate valve upstream and downstream.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
7022-S	Z-1090	BV-200	BV-1000	67500	

2.05 CLEANOUT ASSEMBLIES

A. Cleanout plug shall be line size.

B. Schedule Numbers:

- CO-1: Iron body cleanout tee full line size up to 4 inches and round access plate, plugs shall be brass, countersunk with tapped boss for 5/16 inch No. 18 or ¼ inch No. 20 screws. (Specify for finished walls at base of waste stack, above urinal and service sink.) AB&I and TYLER may be used as iron body cleanouts. Trim and accessories shall be Smith or Zurn or equal.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4532-U	Z-1446-BP	CO-460-RD-34B	C1460-RD-6	58600-CO	

- CO-2: Iron body with approved UPC plug, top and adjustable sleeve, cut-off ferrule, polished scoriated brass nickel bronze secured cover. AB&I and TYLER may be used as iron body cleanouts. Trim and accessories shall be Smith or Zurn or equal (To be specified for finished floors inside buildings, in covered areas, and in concrete paving.)

Square:

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4053L-U-NB	ZN-1400-T	CO-200-S	C1220-S-1-6	55000-1-SQ	

Round:

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4033-L-U-NB	ZN-1400	CO-200-R	C1220-1-6	55000-1	

- CO-3: Secured cover, extra heavy-duty, adjustable sleeve, cut-off ferrule, UPC. Brass approved type plug, scoriated tractor type cover.

(To be specified for areas outside building on concrete paving.)

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4233-U	ZN-1400-HD	CO-200-RX-4	C1220-4-6	55000-22	

- CO-4: Tapped soil tee with brass plug, full line size.

(Specify for above grade, outside building at base of exposed downspout.)

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL

4512	Z-1445-BP	CO-460-34A	C1460	58910	
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CO-5: Raised threaded head brass plug.

(To be specified for yard box YB-3.)

ZURN	WATTS	SMITH	JOSAM	OR EQUAL
Z-1470-A	CO-590	4285	58540-20	

2.06 CIRCULATING PUMPS, HOT WATER HEATING SYSTEM

A. Schedule Numbers:

CPH-1: Centrifugal, single stage, close coupled with adjustable cast iron base, bronze enclosed impeller, lead-free mechanical shaft seal suitable for water temperature range from 20 degrees to 300 degrees F. Screwed or flanged connections. GPM and TDH capacities as indicated.

TACO	OR EQUAL			
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2.07 DRINKING FOUNTAINS

A. Also see Electric Water Coolers, below.

B. Drinking Fountains shall be provided with brass free waterways and lead mitigating water filtering systems (DFWF), ANSI-NSF 53 certified, to remove Lead and other contaminants having detrimental health effects.

C. Schedule Numbers:

DF-1: ADA Hi-Low pedestal drinking fountains, one wheelchair accessible and one standing person drinking fountain bowls, with an ADA accessible Bottle Filling station, free-standing 3/16" thick phosphated-steel pedestal with silver solar reflective powder-coated finish, chrome plated brass push-button operated stainless steel valves with front access to service the water control cartridge and integral water supply strainer, and front accessible flow adjustment, with polished chrome-plated solid brass drinking fountain bubbler heads with laminar .45 gpm flow to prevent splashing and integral 5/8" dia. basin shank for vandal resistance strength, 100% lead-free waterways, with polished chrome-plated vandal-resistant waste strainers, vandal-resistant access plates, with integral mounting base, and integral mounting bracket to accommodate the optional drinking water filter, 1-1/2" waste. ADA & CBC accessible, CSA Certified NSF/ANSI 61 Section 9, and NSF/ANSI 372. Basis

of Design: Haws model 3612-01-1200 (To be specified for outdoor use in remote locations ONLY.)

HAWS	OR EQUAL
3612-01-1200	

DF-2: Access compliant dual height white porcelain enamel cast iron wall-mounted drinking fountains; furnish with brass free waterways, integral basin shank vandal-resistant bubbler heads, cast brass waste strainers, stream adjustable push button operation pressure regulating valves. Bottom cover plates, low profile 1-1/4 inch cast brass traps, and stainless steel screen water supply strainer. Access compliant and certified to ANSI/NSF 61 and ANSI/NSF 372 lead free. Furnish a 3/16 inch thick steel mounting plate number 6715, which can also be installed with model No. 6800 concealed carrier steel struts for additional support where wall-mounted fountain may be subjected to excessive leverage. **(To be specified for indoor or outdoor general use.)**

HAWS	MURDOCK	HALSEY TAYLOR	OR EQUAL
1501 Mounting Plate # 6715	A152J00S	HRFG-SEBP-VR	

DF-3: ADA Hi-Low pedestal drinking fountains, one wheelchair accessible and one standing person drinking fountain bowls, free-standing 3/16" thick phosphated-steel pedestal with silver solar reflective powder-coated finish, chrome plated brass push-button operated stainless steel valves with front access to service the water control cartridge and integral water supply strainer, and front accessible flow adjustment, with polished chrome-plated solid brass drinking fountain bubbler heads with laminar .45 gpm flow to prevent splashing and integral 5/8" dia. basin shank for vandal resistance strength, 100% lead-free waterways, with polished chrome-plated vandal-resistant waste strainers, vandal-resistant access plates, with integral mounting base, and integral mounting bracket to accommodate the optional drinking water filter, 1-1/2" waste. ADA & CBC accessible, CSA Certified NSF/ANSI 61 Section 9, and NSF/ANSI 372. Basis of Design: Haws model 3612-01-1200

HAWS	OR EQUAL
3602	

2.08 DIELECTRIC UNIONS

A. Schedule Numbers:

1. Dielectric style Unions using ferrous and no-ferrous metals are prohibited. Dielectric flanges are admitted for use – see DU-2.

DU-1: Lead Free Brass union with 6-inch Lead Free Brass nipple.

DU-2: Lead Free Brass union or Lead Free Brass flanged fittings are to be used in between pipes made of dissimilar metals to prevent accelerated corrosion and deterioration in the piping systems due to galvanic and stray current.

WATTS	WILKINS	ZURN	NIBCO	OR EQUAL
LF3100M3			733-LF	

2.09 EMERGENCY EYE WASH / EMERGENCY SHOWER

(Emergency eye wash/emergency shower equipment must meet OSHA safety order requirements)

A. Schedule Numbers:

ESEW-1 Floor mounted combination emergency shower and eyewash shower: maximum output flow controlled to 20 gpm, chrome plated bronze stay-open shower control valve with stainless steel valve stem and stainless steel lever and pull rod. 1 ¼-inch galvanized pipe and fittings, with alternate 1 ¼-inch inlets and 9-inch diameter floor flange. Eye/Face Wash: Stainless steel eyewash bowl, pressure regulating flow controlled Eye/face wash with auto-open protective cover, chrome plated bronze stay-open eyewash valve with stainless steel ball and valve stem, protected by an easily serviceable in-line 50 by 50 mesh chrome plated brass strainer, large stainless steel push paddle for hand operation.

(To be specified in Pool Chlorination Rooms, Maintenance, Mechanical, or Janitorial spaces where chemicals and injurious irritants are stored or routinely used; access compliant.)

HAWS	GUARDIAN			EQUAL
8309WC	GBF1909			

2.10 FAUCETS

A. Access compliant faucets: Force to activate controls shall be no greater than 5 pounds. Self-closing metering, where specified, to remain open 10 seconds minimum when activated. Handles shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist.

B. Schedule Numbers:

F-1: Wall mounted ¾ inch hose-thread spout faucet with vacuum breaker with integral service stops and top wall brace, adjustable eccentric union inlet connections, rough chrome.

(To be specified for service sink and can wash.)

CHICAGO	AMERICAN STANDARD	ZURN	OR EQUAL
897-RCF	8344.112-RC	Z843MI-RC	

- F-2: 4-inch center set lavatory faucet self-closing metering, to remain open 10 seconds minimum when activated., Hot and cold water inlets, adjustable time cycle and chrome plated finish. Provide with copper tubing connectors. To be used with 4-inch center set Lavatory Sink.

(To be specified for Faculty restrooms - Access compliant.)

CHICAGO	ZURN	OR EQUAL
3600CR44597AB	Z86500-XL	

- F-3: Single water inlet lavatory faucet self-closing metering, to remain open 10 seconds minimum when activated. Adjustable time cycle with vandal resistant base plate and chrome plated finish.

(To be specified for student restrooms).

CHICAGO	ZURN	OR EQUAL
3400-ABCP	Z86100-XL-CP4	

- F-4: Deck mount, single hole, hot and cold faucet with copper water supply.

(To be specified for use in Multi-Purpose Rooms, Work Rooms, and in Photography Dark Rooms.)

CHICAGO	ZURN	OR EQUAL
50-E2805-5ABCP	Z826A1-XL-CST-MY	

2.11 FLOOR DRAINS

A. Schedule Numbers:

- FD-1: Cast iron body, no hub with seepage pan and flat, round nickel bronze strainers not less than 5-inch diameter for 2-inch outlet bodies, 7-inch for 3-inch outlet bodies and 8-inch for 4-inch outlet bodies, with maximum of ½ inch square holes or slots not larger than ¼ inch by 1 ¼-inch.

(To be specified for use in locations other than tile floors.)

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
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2005Y-A	ZN-415-B	FD-100-A	F1100-C-1	30000-A	
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FD-2: Cast Iron Body, No Hub connection, Heavy Duty 8" dia. Grate, Trap Primer Conn.
(Conc. Floor)

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
2120-P050	-	-	-	-	

FD-3: Back Wash Drain in Pool Equipment Room. Duco Cast Iron Body, 15" dia. Cast iron grate, Slotted Sediment Bucket, Removable type.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
2253-M					

TD-1 Trench drain stainless steel type 304, linear shower drain body with support legs. 2" wide SS light duty slotted heelproof grate. Trench has a 2" stubbed outlet in center.

Trench drain size: 72" long x 6" (Body size)

Manufacturer and Model No.: Zurn ZS880-72

2.12 FLEXIBLE HOSES

A. Schedule Numbers:

FLH-1: Braided stainless steel metal hose (for gas use). US Flex, Metraflex, Nelson Dunn or equal.

FLH-2: Braided bronze metal hose (for non-pressure condensate connection use). US Flex, Metraflex, Nelson Dunn or equal.

2.13 FLUSH VALVE ASSEMBLY

A. Valves shall be furnished so that flush remains constant and will not require any adjustment.

1. Each flush valve shall be provided with a loose key, square shank, lock shield angle service stop connected to flush valve with a union connection.
2. Provide 17 gage pressed brass escutcheons for wall and fixture. Escutcheons shall be fastened to not turn or rattle.
3. Each flush valve shall be furnished with a vacuum breaker providing one inch opening to atmosphere, which will not leak under any degree of back pressure and will not restrict rate of flow more than 10% at 10 PSI, and will operate noiselessly.
4. Tailpiece shall not be lighter than 17 gage and shall be part of flush valve assembly.
5. Exposed metal parts of flush valve assembly shall be nickel or chromium-plated on a brass or copper base.
6. Refer to 2.02.E for fixture supplies.
7. Controls for water closet flush valves shall be mounted on the wide side of toilet areas.

B. Schedule Numbers:

FLV-1: Automatic Flush Valve for Water Closets: Battery-powered, sensor-operated, 17 gage chrome-plated brass or heavier with cover and with metal cover manual override button. Shall deliver 1.28 gallon of water at each operation.

SLOAN	ZURN	OR EQUAL
Royal 111 SMO-1.28	ZER6000AV-HET-CPM	

FLV-1a: Manual Flush Valve for Water Closet: Shall deliver 1.28 gallon of water at each operation.

SLOAN	ZURN	OR EQUAL
Royal 111-1.28	Z6000AV-HET	

FLV-2: Manual Flush Valve for Urinals: shall deliver 1/8 gallon of water per flush.

SLOAN	ZURN	OR EQUAL
Royal 186-0.125-DBP	Z6003AV-ULF	

2.14 FLOOR SINKS

A. Schedule Numbers:

FS-1: 6 inches to 8 inches deep, square cast iron acid-resistant enamel, bottom aluminum dome strainer with nickel bronze rim and grate top.

(To be specified for use in Multi-Purpose Buildings, High School Cafeteria and Mechanical Equipment Rooms.)

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
3140Y 3150Y	Z-1901 ZN-1900	FS-740-1 or FS-730-1	FS1720-1, FS1730-1	49320A-NB, 49340A-NB	

2.15 HOSE BIBBS

A. Schedule Numbers:

HB-1: For brick, CMU and poured in place concrete walls, furnished with box and stop, exposed trim chrome-plated, with or without door and with vacuum breaker.

(To be specified for use in swimming pool area, outside eating and 75 feet spacing around exterior building wall.)

ACORN	WOODFORD	PRIER	OR EQUAL
8141, 8104, 8151	B75	C-633NFC	

HB-2: ASTM B 62 bronze body, rubber composition disc or renewable seat, straight nose with brass die cast or enamel iron hand wheel and with vacuum breaker. (To be specified for use at roof top AC Unit. Mechanical Equipment Room, Boiler Rooms, etc.)

ACORN	ZURN	CHAMPION	PRIER	OR EQUAL
8126-LK- RBVB	Z-1343-VB- LK	B-401 LK	C-255NP	

HB-3: Recessed hose box furnished with wall flange and built-in drip lip. Box shall be one piece construction; door shall have a recessed cam lock. Door shall remain up and out of the way when in fully opened position. Valve shall be replaceable loose key wheel handle and screwdriver stop. Install within 2 feet above finished floor. Provide vacuum breaker.

(To be specified for use in Toilet Rooms.)

ACORN	WOODFORD	PRIER	OR EQUAL
Hose box 8104 or 8151	B75	C-634BX1	

2.16 LAVATORIES

- A. Access compliant faucets for Lavatories: Force to activate controls shall be no greater than 5 pounds. Self-closing metering, when specified, to remain open 10 seconds minimum when activated.
- B. Cast Iron Lavatories shall be acid resistant enamel and shall conform to Commercial Standards CS 77.63. Unites furnished in conjunction with strainer installation or faucet installation shall be brass. Exposed brass nuts shall be chrome plated.
- C. Exposed trim shall be free from sharp edges or points. Fixture shall be furnished with other listed manufacturer specified trim. Instead of solid supply pipe, polished chrome-plated risers, 3/8 inch outside diameter with ferrule stop end and metal nosepiece may be furnished.
- D. Insulate cold water, hot water and drain lines under all access compliant lavatories with approved type insulation.

PLUMBEREX	LAV-GUARD	OR EQUAL
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Schedule Numbers:

- L-1: 20-inch by 18-inch cast iron, acid-resistant enamel punched with three holes, 4-inch on center and supplied with tempered or cold water only. Unit shall be furnished with concealed support arm hangers. Stops shall be loose key, square shank, lock shield type.

(To be specified for use in Student Toilet Rooms)

	COMMERCIAL ENAMEL	KOHLER	BRASS CRAFT	CHICAGO	ZURN OR EQUAL
Bowl	551 (3 holes)	K-2867			Z5844-CB
Faucet (See Section 2.13)	F-3	F-3	F-3	F-3	F-3
Drain				327 XCP	Z8743
Supply			HSTR 1720 A-CB-C	1017	ZH-8822-CE-LK

Note: Provide floor mounted wall support J.R. Smith 0700 (-E).

- L-2: Same as L-1, 20-inch by 18-inch cast iron, acid resistant enamel punched with three holes, 4 inches on center and supplied with tempered cold water only. Unit shall be furnished with concealed arm support hangers. Stops shall be loose key, square shank and lock shield type.

(To be specified for access compliant, student restrooms).

	COMMERCIAL ENAMEL	ZURN	KOHLER	OR EQUAL
Bowl	553 (3 holes)	Z5844	K-2867	
Faucet (See Section 2.13)	F-3	F-3	F-3	
Drain	Chicago 1-1/4-inch grid drain 327- XCP	Chicago 1-1/4 inch grid drain 327- XCP	Chicago 1-1/4-inch grid drain 327- XCP	OR EQUAL

Note: Provide floor mounted wall support J.R. Smith 0700 (-E).

- L-3: 20-inch by 18-inch cast iron, acid resistant enamel lavatory with 4-inch center set combination push button metered faucet, supplied with hot and cold water complete with concealed arm support hangers. (To be specified for access compliant installations at faculty restrooms).

	COMMERCIAL ENAMEL	ZURN	KOHLER	OR EQUAL
Bowl	553 (3 holes)	Z5844	K-2867	
Faucet (See Article 2.13)	F-2	F-2	F-2	
Drain	Chicago 1 1/4-inch grid drain 327-XCP	Chicago 1 1/4-inch grid drain 327- XCP	Chicago 1-1/4-inch grid drain 327- XCP	OR EQUAL

Note: Provide floor mounted wall support J.R. Smith 0700 (-E).

2.21 PIPE HANGERS

- A. Refer to Section 22 0513: Basic Plumbing Materials and Methods.
- B. Schedule Numbers:
- PH-1: Complete with clamps, inserts, etc.

SUPERSTRUT	UNISTRUT	TOLC O	B-LINE	OR EQUAL
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2.22 P-TRAPS

A. Schedule Numbers:

PT-1: Cast brass complete, chrome-plated.

	AB&A		OR EQUAL
	107		

2.23 PRESSURE REGULATING VALVE ASSEMBLIES

A. Schedule Numbers:

PRV-1: Furnish for sizes ½-inch to 2-inch water service, all bronze body, stainless steel seat, bronze strainer, calibrated springs, and corrosion resistant, adjustable control.

WILKINS	WATTS	OR EQUAL
500XL- YSBR-HLR	LF223S-B-HP	

PRV-2: Furnish for sizes 2 ½-inch and larger: Automatic (pressure) control valve-pilot controlled and diaphragm actuated pressure control valve, straight or angle pattern, flanged inlet and outlet connection, fusion bonded epoxy coated inside and out with stainless steel cover, stainless steel pilot, stainless steel bolts and nuts, and stainless steel flexible tubing in a compact configuration, vandal resistant bolt-on pilot controller, ¼ ball valve on all pilot control lines, and stainless steel internal parts.

WATTS	CLA-VAL	OR EQUAL
LFM115	90-01	

2.24 ROOF DRAINS

A. Schedule Numbers:

RD-1: Low profile dura-coat cast iron body dome strainer type.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
1010Y-ERC-CID	Z-100-ERC-M	RD-300-F-D-K40	R1200-EU-M	21500-22	

OD-1: Cast iron body with standpipe. (Specify for use as overflow.)

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
1080Y-ERC-CID	Z-100-89-ERC-M	RD-300-R-F-B-D-M	R1200-R-EU-M	21500-3-16-22	

SHOWER ASSEMBLIES

A. General: Shower assemblies shall be installed concealed in wall. Escutcheons are to be polished chrome plated fastened to walls with vandal proof screws. Heads shall be recessed type to cover male pipe threads or male threads shall be hospital type plated after threading and installed with not more than one thread showing. Nozzles shall be chrome-plated.

B. Schedule Numbers:

SA-1: Polished push button automatic shower limiter metering valve installed concealed in wall; polish chrome plated vandal proof screws to be used for escutcheon mounting. Shower shall be factory prepared and hydrostatically tested to 150 psi at the factory. Internal piping shall be Type L copper tubing. Fittings shall be cast bronze or copper, valves shall be tempered water and not to exceed 2.0 GPM. Flange showerhead shall be lockable universal ball joint. Exposed fasteners shall be tamper resistant. Shower station shall be 18 inches from each end and 36 inches on center and 74 inches vertical height, shower assembly shall be complete with mounting brackets and stanchions.

(To be specified for use in Secondary Schools for Boys' and Girls' group shower; P.E. Buildings)

Shower Valve	ZURN Z7530	CHICAG O 770- 665 PSH	SYMMONS 4- 420	OR EQUAL
Shower Head	ZURN 12	621	4-295 B	OR EQUAL

SA-2: Polished pressure balancing mixing valve with single blade level handle, integral volume control and chrome plated brass escutcheon with hose and spray on sliding bar.

(To be specified for access compliant use – Provide SA-4 below for hose and spray and other requirements.)

Shower Valve, Hose and Spray	ZURN Z7100 Valve Z7000 Hand-Shower	POWERS 450- 7054 E700	SYMMONS S- 96-500-4-141- H321	OR EQUAL
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SA-3: Polished pressure balancing mixing valve with single blade level handle, integral volume control and chrome plated brass escutcheon with hose and spray on sliding bar.

(To be specified for access compliant use – Provide SA-4 below for hose and spray and other requirements.)

Shower Valve, Hose and Spray	ZURN Z7100 Valve Z7000 Hand-Shower	POWERS 450- 7054 E700	SYMMONS S- 96-500-4-141- H321	OR EQUAL
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SA-4: Shower control valve requirements for Hose and Spray:

(To be specified for access compliant use.)

- a. Vacuum breaker: Exposed or concealed piping.

Exposed piping	Concealed Piping	T&S BRASS	OR EQUAL
CHCAGO 892-GABCP	ZURN Z-80000-EVB	B-0929-A	

- b. Wall spout: Wall spout with ½ inch female i.p.s. flange inlet and ½ inch male i.p.s. Outlet, chrome-plated.

CHICAGO	ZURN	T&S BRASS	OR EQUAL
892-ABCP	80000-SE	B-0968	

- c. Hose and Bar: 5-foot long reinforced white vinyl hose with 24-inch adjustable bar with hand shower slide bracket, chrome plated.
- d. Hand shower: Insulated handle with central lever stop valve, bent nozzle tube; rubber bound hose spray adapted for ½-inches hose connection.

SYMMONS	BRADLEY	ZURN	OR EQUAL
H 321	B 24	Z 7000-HW	

- e. Diverter Valve: Transfer flow between showerhead and hand held shower.

ACRON	BRADLEY	SYMMONS	OR EQUAL
DV	DV	4-458	

- f. Tempering Valve: The temperature range between 100 and 105 degrees Fahrenheit shall be background in red or red line enclosed. Valve shall be complete with fail safe feature, square shank loose key stops, checks and strainers on both hot and cold water inlets and shut-off valve on outlet to protect from scalding.

POWERS	LEONARD	LAWLER	OR EQUAL
Single Valve Hi-Lo			

2.26 SERVICE SINKS AND TRIM

- A. Schedule Numbers:

- SS-1: Cast Iron corner service sink, conforming to Commercial Standard CS 77.63 for acid-resistant enamel, 28-inch by 28-inch, coated wire rim guard, 2-inch flat strainer and

rough-plated double faucet with top brace mounted above sink back, furnished with vacuum breaker and hose end.

(To be specified for use in Custodial Rooms.)

	CECO	American Standard	KOHLER	CHICAGO	ZURN OR EQUAL
Sink	871		K-6710		Z5850
Faucet	F-1 (See Article 2.13 – Faucets)	F-1	F-1	F-1	F-1
Rim Guard	B-872		K-8940		RC
Strainer	B-71-2		K-9142		D-2

2.27 SINKS AND TRIM

- A. For classrooms, offices and dining room sinks.
- B. Access compliant faucets for sinks: Force to activate controls shall be no greater than 5 pounds. where specified self closing metering to remain open 10 seconds minimum when activated.
- C. Cast iron sinks shall be acid resistant enamel, and shall conform to Commercial Standards CS 77.63. Units furnished in conjunction with strainer installation or faucet installation shall be brass. Exposed brass nuts shall be chrome-plated. Refer to the Fixture Supplies paragraph of this section.
- D. Exposed trim shall be free from sharp edges or points. Fixture shall be furnished with other listed manufacturer specified trim. Instead of solid supply pipe, polished chrome-plated risers, 3/8-inches outside diameter with ferrule stop end and metal nose piece may be furnished.
- E. For access compliant sinks: Insulate cold water, hot water and drain pipes under sinks with district approved type insulation.

PLUMEREX	LAV GUARD	OR EQUAL
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- F. Schedule Numbers:

S-1: To be specified by the Pool Contractor.

S-2: Cast Iron, 18-inch by 12-inch – 24-inch by 18-inch or 30-inch by 18-inch or as indicated on drawings, with basket strainer, hot and cold deck mounted faucet.

(To be specified for use in Administration Offices, Conference Rooms, Teacher Workrooms, Faculty Lounge, Library and Kiln Room.)

	KOHLER	AMERICAN STANDARD	CECO	HAWS	OR EQUAL
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Sink			720C, 720G, 720I		
Faucet	F-4	F-4	F-4	F-4	
Strainer	K-8801	4331.013		6457	

2.28 SERVICE STOP GAS VALVES

A. Schedule Numbers:

SGV-1: Bronze/Brass, 3/4-inches to 2-inch IPS (WOG) water, oil, or gas – full port ball valve. CSA approved.

(To be specified for larger water heaters, small boilers, pool heaters, and A/C units on roofs.)

WATTS	NIBCO	WILKINS	OR EQUAL
LFFBV-4	F-510-CS-R-66-FS	Model 850	

SGV-3: Cast iron, 2-inch to 4-inch flanged ball valves (WOG) water, oil, or gas. CSA approved.

(To be specified for larger heating equipment.)

WILKINS	NIBCO	WATTS	OR EQUAL
Model 850	F-510-CS-R-66-FS	G4000M1	

SGV-4: Lubricated plug gas valve, 3/4-inch to 2-inch IPS valve.

(To be specified for use after gas meter headers, gas regulators, and isolation valves for building isolation, individual floor level isolation, and boiler rooms.)

NORDSTROM	WALWORTH	RESUN	OR EQUAL
142	1786	1430	

SGV-5: Lubricated plug gas valve flanged type 2 1/2-inch and larger valve.

(To be specified for use after gas meter headers, gas regulators, isolation valves for buildings isolation, individual floor level isolation and boiler rooms.)

NORDSTROM	WALWORTH	RESUN	OR EQUAL
142	1786-F	1431	

SGV-6: Bronze/Brass ½ inch to 2-inch IPS X Flare Appliance ball valves with Tee handle. Flares to be used in conjunction with corrugated flex lines.

(To be specified for clothes dryer, water heaters, unit heaters, and wall heaters up to 100,000 BTU.)

RED and WHITE	BRASSCRAFT	NIBCO	OR EQUAL
RW 5210 RW 5211 RW 5221	TBV 10-12 TBV 8-8 TBV 6-8	GBV 12 GBV 1516	

2.29 STOP VALVES

A. Stops shall be loose key type, ½-inches IPS inlet and outlet chrome-plated brass casting, except as noted.

B. Schedule Numbers:

STV-1: Angle:

CHICAGO,	BRASSCRAFT	NIBCO	OR EQUAL
442-LKABCP		77	

STV-2: Partition:

CHICAGO	T& S BRASS	OR EQUAL
1771-ABCP	B-1028	

STV-3: Straight Type, with Loose Key:

CHICAGO	BRASSCRAFT	T&S BRASS	OR EQUAL
45-LKABCP (1/2 inch)		B-O418	

2.30 THERMOSTATIC MIXING VALVE ASSEMBLIES (TMVA)

A. General: Valve bodies shall be cast brass or bronze valve assembly provided with holding bracket and shall be installed on wall bracket. Valve shall be rough brass or bronze satin sprayed finish unless otherwise noted. Assembly shall include a 3 5/8-inch diameter dial thermometer, color-coded with white face and black letters. The temperature range between 100 degrees F. and 150 degrees F. shall be background in red or red line enclosed. Valve complete with fail safe feature, square shank loose key stops, checks and strainers on both hot and cold-water inlets and shutoff valve on outlet. Valves shall be sized on a 45 psig (maximum) pressure drop at the following flow rates:

MV-1: 5 to 15 GPM.

MV-2: 5 to 15 GPM. (Point of use)

B. Manufacturers:

POWERS	T & S	LEONARD	BRADLEY	WATTS	OR EQUAL
Type 430 Series Single Valve Hi-Lo (1430 series)	Ultra-Safe	XL82LS-BDF	Navigator Series High/Low	LFMMV	

MV-2 Point of use thermostatic mixing valve Powers e480 or equal

2.31 TRAP PRIMERS

A. Schedule Numbers:

ATP-1: Automatic, multi-trap primer, cast bronze with access panel. Pressure drop of three p.s.i. shall activate trap seal primers. Manufactured by MIFAB, or equal. (Installed in accessible location.)

MIFAB	OR EQUAL
MR-500-NPB	

2.32 URINALS

A. Schedule Numbers:

U-1: Hybrid urinal, 1 gallon every 72 hours. Wall-hung vitreous china, furnish complete with hanger brackets, fasteners, and gaskets.

B. Bowl:

SLOAN	OR EQUAL
HYB-1000	

C. Wall Carrier: J.R. Smith 0635

U-2: Same as U-1 with fixture roughed-in at access compliant height. For Students and Adults.

2.33 WATER CLOSETS

A. General: Water closets shall be vitreous china with Polyvinyl chloride bolt caps. Fixtures with auto-flush valves shall be provided with manual override button.

B. Schedule Numbers:

WC-1: Wall-hung, with 1.1 gallon/per flush, flush valve and open front fire-retardant seat in white, less cover.

a. Bowl:

SLOAN	ZURN			OR EQUAL
WETS- 2451.1201	Z5615-BWL			

b. Auto-flush valve (battery): FLV-1.

c. Manual-flush valve: FLV-1a.

d. Carrier type: J.R. Smith or equal. (Refer to Architectural Floor Plans for wall type.) Option:

1. Single in metal stud wall. Jay R Smith Model 0230Y-M5854

2. Single in block wall. Jay R Smith Model 0230Y-M5854

e. Seat: White, less cover, for Students, ring thickness including bumpers shall be one inch.

OLSONITE	BEMIS	CENTOCO	OR EQUAL
1055CTFR	1955 CTFR	AMFR500STSCSS	

WC-2: Same as WC-1 with fixture roughed-in at access compliant height.

a. Manual-flush valve: FLV-1a.

b. Carrier type: Refer to WC-1, d. Option 1 and/or 2.

WC-3: Same as WC-1 with 1.28 gallon/per flush, flush valve and open front fire-retardant seat in white, less cover. For Faculty/Adult. Same as WC-1 with fixture roughed-in at access compliant height.

a. Manual-flush valve: FLV-1a.

b. Carrier: Refer to WC-1, d. Option 1 and/or 2.

2.34 WATER HEATERS / DOMESTIC BOILERS

A. Gas fired water heaters shall meet the Flammable Vapors Ignition Resistance requirements (FVIR).

- B. Gas and electric water heaters must meet NAECA energy efficiency requirements. Exceptions: Table top and point of use models (electric) less than 20 gallons. In capacity and gas models over 75,000 BTUH.
 - C. Water heaters from 75,000 BTU/hr to Boilers 2,000,000 BTU/hr shall comply with rule 1146.2 "Emission of Nitrogen from large water heaters and small boilers". Natural gas fired water heaters with heat input rates less than 75,000 Btu/hr shall comply with rule 1121.
 - D. Schedule Numbers:
- WH-1: Storage type water heaters shall be provided with a five year unconditional guarantee on tank heater and working parts. Complete guarantee for each heater shall be delivered to the Owner's Authorized Representative (OAR). Heater shall be ultra high thermal efficiency of min. 94%. Tank shall be ASME rated, NSF compliant and furnished with Neutralizer Kit, Concentric roof vent penetration pipe, metal materials.
- a. Heater shall be furnished complete with baked enamel jacket, double density insulation, heating device, energy saver thermostat, drain valve is to be a ball valve with a plug in one end, and appurtenances necessary for satisfactory operation. Proper label of approval and manufacturer name, model number, size in gallons, and rated capacity shall be permanently secured to jacket.
 - b. Heater shall be furnished with a combination pressure temperature relief valve, installed in water heater tank.
 - c. Heaters, gas and electric, shall be certified by the California Energy Commission.
 - d. Floor-mounted gas fired heaters shall be heater shall be securely strapped to structure (with 2 straps per code).
 - e. Flexible water piping connectors shall not be used.
 - f. Water heaters shall be of sizes indicated on Drawings and shall be furnished with equipment necessary to provide a complete and satisfactory piece of equipment.
 - g. Submit a complete list of boiler controls and appurtenances with wiring diagram, giving manufacturer's name, model number and, when applicable, size of each piece of equipment or appurtenance to be installed.
 - h. Pilot lines, gas valves, relays and their wiring shall be located outside boiler jacket to protect them from ambient temperature within. Flame safeguard relay shall be mounted on a control panel attached to wall at location indicated or as directed. All other controls and manual operators shall be so located as to be readily accessible when the boiler is in the installed position.
 - i. Wiring of water pump control circuit and line voltage supply to control panel is part of the Work of Division 23. All other wiring in connection with boilers is a part of the Work of this section. Wiring between boiler and wall-mounted control panel shall be installed 7 feet or more above floor level.
 - j. Gas-fired, storage type, size indicated on Drawings, with flexible venting, (Intake and Exhaust. Connectors for Gas Appliances. Connections supplying 100,000 BTUs and over shall be solid pipe. Heater shall be seismically secured with an approved restraint. HOLDRITE QS-50, QS-120.

Model No. as indicated on drawings or equal by:

BRADFORD WHITE	A.O. SMITH	RHEEM			OR EQUAL
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2.35 WATER HAMMER ARRESTORS

WHA-1: Lead Free Water Hammer Arrestor provided for Headers, Urinals and Water Closets.
For sizing purposes size according to manufacturer's recommendations.

SIOUX CHIEF	PPP	JR SMITH	WATTS	JOSAM	OR EQUAL
655 and 656 SERIES	SC SERIES	5005 TO 5050 SERIES	Series LF05 and LF15M2	75000	

2.36 YARD BOXES

A. Schedule Numbers:

YB-1 Yard Boxes: 14 3/4-inch by 20-inch by 12-inch, cast concrete, with cast iron hinged locking traffic cover marked: "WATER"

BROOKS No. 36-HFL Assembly with cast iron hinged locking cover	OR EQUAL
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YB-2: Same as YB-1, marked "WATER" (For use over water valves).

BROOKS No. 36-HFL Assembly with cast iron hinged locking cover	OR EQUAL
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YB-3: Same as YB-1, marked "SEWER"

BROOKS No. 36-HFL Assembly with cast iron hinged locking cover	OR EQUAL
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2.37 FIXTURE CONNECTIONS

A. Branches to individual fixtures shall be of the following sizes (Inches) unless larger sizes are indicated on Drawings:

Fixture	Copper, Cold (Inches)	Copper, Hot (Inches)	Trap and Connections (Inches)	Soil/ Waste (Inches)	Vent (Inches)
WC Flush Valve	1	N/A	4	4	2
Lavatories	1/2	1/2	1-1/2 by 1-1/4	2	1-1/2
Service Sink	1/2	1/2	2	2	1-1/2
Kitchen Sink	1/2	1/2	1-1/2 by 1-1/2	2	1-1/2
Classroom Sink	3/8	3/8	1-1/2 by 1-1/2	2	1-1/2
Wash Sink	3/4	1/2	1-1/2 by 1-1/2	2	1-1/2
Multiple Drinking Fountains		N/A	1-1/2 by 1-1/2	2	1-1/2
Single Drinking Fountains	3/8	N/A	1-1/2	2	1-1/2
Individual Showers		1/2	2	2	2
Standard Urinals, Wall-Hung Flush Valve:		N/A	N/A	2	1-1/2
Access Compliant Urinals, Wall-Hung Flush Valve:		N/A	N/A	2	1-1/2
Sillcocks	3/4 minimum	N/A	N/A	N/A	N/A

B. Water headers serving water closets shall be copper water tube, with following size throughout length:

1. 1-1/2 inches for 2 flush valves.
2. 2 inches for 3 to 9 flush valves.

- C. Water headers serving urinals shall be of following size throughout length:
1. 1" for 1 or 2 flush valves.
 2. 1-1/4" for 3 flush valves.
 3. 1-1/2" for 4 to 8 flush valves.
- D. Water headers serving showers shall be same as listed above for urinals.
- E. Water headers serving lavatories shall be of following size throughout length:
1. 1/2 inch for 2 lavatories.
 2. 3/4 inch for 3 and 4 lavatories.
 3. One inch for 5 and 6 lavatories.
 4. Refer to 2.02.E for fixture supplies.

2.38 HEIGHT OF FIXTURES

- A. Heights for standard fixtures.

Fixture	Adult and High School (Inches)	Secondary (Inches)	Elementary (Inches)	Kindergarten and Younger (Inches)
Toilets, height to top of seat	15 to 17	15 to 17	15	11 to 12
Lavatories, sink top height	32	32	30	25
Drinking Fountains, bubbler height.	38 to 43	40	32	30
Wash Sinks	30	30	28	24
Urinals, lip height	24	21	18	N/A
Shower Heads Male (Student and Instructor) From tip of shower head to finish floor.	72	60		
Shower Heads Female (Student and Instructor)	72	60		

From tip of shower head to finish floor.				
Shower valves	48	48		

B. Heights for access compliant fixtures.

Fixture	Adult Ages 12 and Over (Inches)	Elementary Ages 6 to 11 (Inches)	Kindergarten and Younger Ages 3 to 5 (Inches)
Toilets, center line from wall	17 to 18	15	12
Toilets, height to top of seat	17 to 19	15	11 to 12
Lavatories, sink top height	34 maximum	29 maximum	24 maximum
Lavatories, sink knee clearance	27 minimum	24 minimum	19 minimum
Urinals, lip height	17 maximum	15 maximum	13 minimum
Urinals, flush handle height	44 maximum	37 maximum	32 maximum
Drinking fountains, bubbler height.	36 maximum	32 maximum	30 maximum
Drinking fountains, knee clearance	27 minimum	24 minimum	22 minimum
Wash Sink	Per Drawings		
Shower Valves	Per CBC		
Shower Seat	Per CBC	Per CBC	Per CBC
Shower Head (adjustable) Bar	Per CBC		

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General:

1. Unless otherwise specified, plumbing fixtures, equipment and appliances that require connections to plumbing line shall be connected. This shall include fixtures specified or indicated as furnished by others, furnished by Owner, or specified in other related sections. Install supplies, stops, valves, traps, wall flanges, or pipe casing for connection of this equipment.
 2. Install equipment as indicated on reviewed and accepted Shop Drawings.
 3. Avoid interference with Work of other trades. Do not deviate from Drawings without review of the Architect.
- B. Examination: Check each piece of equipment in system for defects verifying that parts are properly furnished and installed.
- C. For piping Work, refer to Section 22 0513: Basic Plumbing Materials and Methods.
- D. Plumbing Fixture and Equipment Installation:
1. Unless otherwise indicated, fixtures shall be installed with 5/16 inch brass bolts or screws of sufficient length to securely fasten fixture to backing, wall, or closet ring.
 2. Fixtures installed against concrete or masonry walls shall have their hangers fastened with 5/16 inch brass bolts, Philip Shield type anchors, or 2 unit cinch anchors. Wood or plastic plugs are not permitted.
 3. Fixtures installed against wood or metal stud walls shall have their hangers fastened to metal backing plates with 5/16 inch brass bolts screwed into plate. Fixture hangers for urinals shall be fastened centered vertically on metal backing plate with three 5/16 brass bolts each for small individual hangers and six, for larger one piece hangers. Lavatories shall be hung with not less than four 5/16 inch brass bolts or not less than five 1/4 inch brass bolts. Each sink hanger shall be hung with not less than four 5/16 inch brass bolt or not less than five 1/4 inch brass bolts.
 4. Pan type drinking fountains shall be hung with 5/16 inch cadmium plated bolts with a bolt in each bolt opening in hanger. Hangers for pan type drinking fountains shall provide 2 inches (plus or minus 1/4 inch) between pan and wall. Spaces due to irregularities between fixtures and tile walls shall be neatly filled with white cement or silicone filler.
 5. Backing for hanging of plumbing fixtures and equipment shall be installed in supporting wall at time rough piping is installed. Backing for stud walls shall be steel plate 1/4 inch thick, not less than 4 inches wide. Backing for urinals shall be 1/4-inches thick by 6-inch wide steel plate. Steel plate shall be attached to stud at each end of plate and to each stud it crosses. Plate shall be attached to metal studs by bolting with two 1/4 inch U-bolts per stud with bolts through plate and around stud flange or by welding with a 1/8 inch fillet weld full width of stud flange, top and bottom of plate. At wood studs, plate shall be carefully recessed flush with face of stud and attached to each stud with 2 No. 14 flat-head wood screws, 2 inches in length into pre-drilled 1/8 inch holes. Backing for stud walls supporting wall-hung closets shall be as detailed.
 6. Rough-in for fixtures, equipment and appliances shall be as indicated on Drawings and as specified, including those items indicated as furnished by others, furnished by Owner, or future capacity. When connections to equipment from capped or plugged lines are required, caps or plugs shall be

removed at time equipment is set and stops or valves installed and connections provided as specified.

7. Piping materials for trap arms shall be Brass, Cast Iron or DWV copper
8. Piping shall be stubbed out to exact location of fixtures and stubs shall be installed symmetrical with fixtures. Hot and cold water supplies for center set faucets on lavatories shall be installed on 8-inch centers, unless otherwise specified or required.
9. Kitchen equipment requiring backflow protection with hot and cold water connections shall be installed with approved backflow prevention assemblies; BPV-3 and drain into floor sink with air gap.

E. Cleanouts in Drain, Waste, Vent and Sewer Lines:

1. Cleanouts shall be installed at locations stated in the California Plumbing Code and accessible at following locations:
 - a. At locations above first floor as stated on construction documents and 5 feet outside of the building.
 - b. Install an accessible main line upper terminal cleanout in all restrooms above water closet over flow. (Install above upper terminal water closet where there are more than one water closet in a restroom).
 - c. Above faucets of each sink with brass plug.
 - d. Above service sink with brass plug.
 - e. At each Drinking Fountain with brass plug.
 - f. At each urinal and locate above urinal with brass plug.
 - g. Above overflow level of pot sinks with brass plug.
 - h. In vertical line at base of each downspout connected to an underground storm drain system extend cleanout to exterior of building.
 - i. At upper end of a horizontal vent line when any part of horizontal line is below overflow level of fixture it serves.
 - j. Not to exceed 100-foot intervals in sewer and waste lines exterior of building.
 - k. At property line connection.
 - l. Where indicated on Drawings.
2. Cleanouts shall be extended to grade as follows:
 - a. Not to exceed 100-foot intervals in straight runs of pipe outside buildings.
 - b. At horizontal changes of direction in aggregate greater than 135 degrees (underground).
 - c. At property lines.
 - d. Where cleanouts occur under concrete.
 - e. Where marked for future connections.
3. Cleanouts in building shall be extended to floor level or above floor level or above floor level in walls or furring when cleanouts are not accessible or where clearance is less than 18 inches.

4. Cleanouts in finished areas in building shall be concealed except that cleanouts above service sinks in janitor's rooms or closet, and cleanouts above service sinks or in exposed piping in boiler or heater equipment rooms, may be exposed. Cleanouts for urinals shall be installed above urinal and shall terminate behind an access plate.
5. Cleanouts in floors of covered areas and those extended to grade in concrete areas shall be floor level type with extensions body brass plugs and detachable nickel-bronze or aluminum alloy scoriated.
6. Concealed cleanouts in vertical lines shall be service weight soil cleanout tees with brass plugs and round cover plates unless otherwise specified or indicated. A snug fitting sleeve of galvanized sheet metal shall be placed around hub of tee and shall extend to flush with finished soil, or cleanout shall be extended to finished wall.
7. Cleanouts extended from below floor to a wall or furring or on horizontal lines above floor that terminate at a wall or furring shall be iron body type with brass plugs and round cover plates.
8. Cover plates over cleanouts in painted walls shall be steel, bonderized and prime coated. Cover plates over cleanouts in tile walls shall be chromium-plated brass or nickel bronze. Plates shall be attached to cleanout plugs with 5/16 inch No. 18 or 1/4 inch No. 20 stainless steel vandal-proof type screws. Plates shall be one inch larger in diameter than fitting opening.
9. Cleanouts at bases of downspouts shall be tapped soil tees with brass plugs as hereinafter specified, full size of line.
10. Cleanouts extended to grade in exterior sewer lines other than floors or concrete areas shall be a cleanout assembly with secured top, extra heavy-duty, adjustable sleeve, cut-off ferrule, countersunk threaded brass plug and scoriated tractor type cover.
11. Other cleanouts shall be iron body type.
12. Cleanout extensions shall be no-hub cast iron soil pipe. Exterior cleanouts, those in concrete excepted, shall terminate in a 14-inch by 6-inch thick concrete block with cleanout assembly and top of block flush with finish grade.
13. Fittings in lines utilized as cleanouts shall be approved soil fittings including no-hub pipe. Tees and crosses in vent headers excepted.
14. Pipe joint compound shall not be installed on cleanout plug. After lines are tested and approved, each cleanout plug shall be removed, greased, and replaced.

3.03 EXCAVATION, TRENCHING AND BACKFILLING

- A. Perform trenching, excavation, and backfilling required for Work of this section as specified herein and in Section 31 2323: Excavating, Backfilling, and Compacting for Utilities.

3.04 SERVICE CONNECTIONS

- A. Determine exact location of required water, drain, and sewer connections and provide proper connections.

- B. Potable water lines shall be purged completely before connecting to sources of water for the Project. Determine quality of water supply before connection.

3.05 WATER HAMMER ARRESTORS

- A. Install water hammer arrestors indicated on Drawings and in following locations (only non-ferrous arrestors may be installed in copper water system):
 - 1. Water lines to lavatory headers, water closet and urinal headers, service sinks, kitchen sinks, wash fountains, drinking fountains, laboratories with medical type faucets and on wash sinks having three or more stations and all other quick closing fixture such as clothes washers, as close to fixture as possible.
 - 2. Between last two fixtures when three or more fixtures, other than those listed in Number 1 above, are served by a common header.
- B. When possible, arrestor shall be installed in wall or furring. When arrestor is installed in wall or furring, furnish an access plate large enough to permit removal of arrestor. Access plate shall be a minimum of 2 inches larger in each direction than the arrestor.
- C. Fixture water lines shall be provided with mechanical water arrestor hammer dampening devices. Air chambers are not approved.

3.06 CONDENSATE DRAINS - FROM AIR CONDITIONING UNITS

- A. Connect drain piping from drain pan of air conditioning unit to condensate disposal location indicated. When coil or unit housing is shock or vibration isolated, connection shall be furnished through a flexible connector not less than 10 inches long. Drain line shall pitch to flow out at not less than one inch in 8 feet. Drain line shall not be reduced smaller than unit outlet connection.
- B. Condensate drain piping installed within building whether in air conditioned space or not shall be insulated. Refer to Section 22 0700: Plumbing Insulation, for type of material required.
- C. Condensate Trap:
 - 1. A condensate trap shall be installed for each air conditioning coil. Trap shall be assembled from 2 brass unions: one between A/C unit and inlet of trap, and one at outlet of trap that connects to main drain.
 - 2. Trap configuration shall be per manufacturer's recommendations based on total unit casting static pressure (simulated plugged filter condition), but not less than 3 inch water seal.
 - 3. Running trap design is not permitted.
 - 4. Secondary drain shall not be trapped.
- D. Condensate trap shall be checked at equipment operational tests for proper water drainage flow from air conditioning unit. Cooling condensate pan shall be filled with water, filters covered with plastic (plugged filter simulated), unit panels replaced, and

unit motor running at design condition. Pan shall drain without hesitation to bottom of inlet connection. Tests are made prior to installation of ceiling.

E. Secondary Overflow Drain:

1. Drain pan installed underneath air conditioning units in concealed ceiling space or units that incorporate dam fitting shall be furnished with secondary drain piped to outside planter area with outflow location clearly visible.
2. If outside building location is not available or feasible, secondary drains shall be piped to a classroom sink, if sink is not available pipe to a room corner away from cabinets, computers, desks, door ways/entrances or stairs.
3. Secondary vertical pipe that penetrates through suspended ceiling shall be furnished with a coupling or threaded adapter so ceiling tile can be removed without damage.

3.07 CONDENSATE DRAINS - FROM WINDOW TYPE HEAT PUMP AND EXTERIOR WALL MOUNT HEAT PUMP UNITS

- A. Whether indicated on Drawings or not, window units and wall mount units without built in bottom drain pan for evaporator and condenser coils shall be provided with galvanized steel condensate pan at bottom of unit with drain line that drains into approved drywell. Install copper 1/2 inch diameter pipe for window type air conditioners and 3/4 inch diameter pipe for exterior wall-mounted heat pump units.

3.08 MAKE-UP WATER SYSTEMS

- A. Provide and connect make-up water systems for equipment in other sections.

3.09 GAS SERVICE

- A. Above Grade Service: Pipe shall be steel, hammered, free of dirt and scale, and blown out with oil-free air or nitrogen to a clean, dry condition. Piping shall not be installed in or through a ventilation duct or plenum.
- B. Underground Service, Gas approved (yellow) Polyethylene Plastic Pipe: Refer to Section 22 0513: "Basic Plumbing Materials and Methods".
1. Pipes shall be joined with polyethylene fitting and joined together by thermal fusion in accordance with procedures recommended by Polyethylene plastic pipe and fitting manufacturer.
 2. Plastic pipe shall be installed not less than 30 inches below grade.
 3. Underground Warning Tape shall be installed 12 inches above buried gas piping. Warning tape shall be yellow with caution statement as follows: "CAUTION – BURIED GAS LINE BELOW".
 4. Plastic pipe shall not be installed in or under a building or structure. Pipe shall be installed under bituminous surfacing or compacted soil area, free from large stones. Pipe may be installed under sidewalks or driveways, as long as

- no joint occurs. Pipe installed under paved covered areas wider than 40 feet shall be installed in ventilated conduits extending 2 feet past paving.
5. Pipe shall be installed on a 6 inches deep sand bed. After required pressure-leak test, pipe shall be covered with sand not less than 6 inches thick.
 6. Piping shall not support weight of valves, metal fittings or other items. Pipe shall be installed strain free.
 7. Plastic pipe fittings shall not be stored or left exposed to sunlight. Pipe in open trenches shall be shielded. A sand envelope of 6 inches minimum shall be placed around pipe, with exception of joints, until inspection by IOR is completed. Protection for pipe shall be provided when necessary to leave pipe exposed overnight.
 8. Installer of piping is required to have training and to have attained a certification. Non-trained/Non-certified installer must contact the manufacturer or manufacturer's representative to provide on-site fusion training and certification, prior to work commencement
 9. Polyethylene plastic pipe shall connect to a steel epoxy coated anodeless type riser to minimum of 6 inches above grade, when exiting the underground installation and transitioning to steel pipe connection.
 10. Where a steel pipe riser passes into a structure or building, a double swing or double-offset joint shall be furnished. Pipe shall pass into structure 6-inches above grade and through a sleeve with a minimum one inch clearance. An isolation valve is required before pipe entering the building.

3.10 CLEANING - PLUMBING PIPING SYSTEMS AND FIXTURES

- A. Plumbing lines and fixtures shall be flushed to remove dirt and foreign material until water runs clear and no foreign substance or odor is present. Strainers and screens on faucets shall be removed during this cleaning operation.
- B. After satisfactory cleaning of strainer and screen replacements has been witnessed by the Project Inspector, post and maintain signs stating: "CAUTION - Water at this construction project has not yet been certified for human consumption." Signs shall be furnished with letters at least 1/2 inch in height and shall be conspicuously posted at entrances to the Project site. Signs shall be paneled, black and yellow, in conformance with OSHA Section 1910.1455.

3.11 DISINFECTING DOMESTIC WATER PIPING SYSTEMS

- A. Newly installed or replaced piping and/or fixtures dispensing potable water, and any additional piping and/or equipment impacting the integrity of this system shall be disinfected and undergo an approved bacteriological analysis before water system is allowed for public use.
- B. Disinfection shall commence upon complete installation of all related domestic water systems including fixtures, valves, faucets, water heating systems, etc.
- C. Work shall be performed by Technicians Certified by the American Water Works Association (AWWA) and/or the State of California Department Health Services, Grade II Water Treatment Operator Certification or higher issued by the Department

of Health Services (DHS) for the State of California. Comply with Title 22, Code of Regulations Division 4, Chapter 13, and Article 2 Operator Certification Grades.

D. Method:

1. A Physical Separation of minimum 6" or Reduced Pressure Backflow assembly shall be installed to protect from cross contamination of the local water purveyor's meter service supply when at any time there is any type of water connection with the piping to be disinfected (Chlorinated) and the water meter service supply.
2. Install a Chlorination Port including a T fitting and a shut off valve to the proximity of the point of connection at the new piping system.
3. System is to be flushed to remove any materials that may have entered the system.
4. Using a chemical feed metering pump and a chlorine tank, the chlorine solution is injected into the water system.

E. Disinfection and De-chlorination procedure (24 or 3 Hour Contact Time):

1. 24-hour Test Method:

- a. Prior to disinfection, post signs on all water outlets of the system to be disinfected. Sign or tags shall read, "Water System Being Chlorinated- "Danger Do Not Drink Water" or similar warning.
- b. Piping system shall then be adequately flushed with water to remove any particles and eliminate air pockets.
- c. Using the continuous feed method, sodium hypochlorite conforming to ANSI/ AWWA B300 will be injected into the water system at a minimum of 50 PPM. A water flow meter provided by the water treatment technician will be used to determine the rate of injection and a chlorine test kit, Hach or equivalent, will be used to monitor the residual.
- d. Chlorine residual test will be taken at all appropriate points and outlets to verify 50 PPM residual levels.
- e. The chlorinated system shall be shut down for any use and the chlorinated water shall remain in the water system for retention of 24 hours.
- f. After 24 hours, chlorine residual levels will again be tested at various points throughout the system to insure a minimum of 25 PPM residual. If the system has not met the minimum of a 25 PPM residual, the above disinfection process shall be repeated.
- g. After satisfactory completion of the residual testing, flush out system until Hach or equivalent test reveal the water outlets have a free chlorine residual concentration less than 0.5 PPM. The procedure shall be in accordance with the AWWA standard C651-05.
- h. The OAR may allow temporary use of the water system for construction purposes pending results of the bacteriological test analysis. Sign or Tags shall be left on all outlets stating water system is not safe for consumption until laboratory results are complete and meet these specifications.

2. 3 Hour Test Method:

- a. If the water systems must be turned on for use as soon as possible, a 3 hours chlorine contact time to allow for disinfection is permitted with the OAR's approval.
- b. Prior to disinfection, post signs on all water outlets of the system to be disinfected. Sign or tags shall read, "Water System Being Chlorinated- "Danger Do Not Drink Water" or similar warning.
- c. Piping system shall be then adequately flushed with water to remove any particles and eliminate air pockets. Using the continuous feed method, sodium hypochlorite conforming to ANSI/ AWWA B300 will be injected into the water system at a minimum of 200 PPM. A water flow meter provided by the water treatment technician will be used to determine the rate of injection and a chlorine test kit, Hach or equivalent, will be used to monitor the residual.
- d. Chlorine residual test will be taken at all appropriate points and outlets to verify 200 PPM levels. The chlorinated system shall be shut down for any use and the chlorinated water shall remain in the water system for retention of 3 hours.
- e. After satisfactory completion of a 3 hour disinfection period, flush out system until Hach or equivalent test reveal the water outlets have a free chlorine residual concentration less than 0.5 PPM. The procedure shall be in accordance with the AWWA standard C651-05.
- f. The OAR may allow temporary use of the water system for construction purposes pending results of the bacteriological test analysis. Sign or Tags shall be left on all outlets stating water system is not safe for consumption until laboratory results are complete and meet these specifications.

F. Bacteriological Test:

1. After final flushing and satisfactory results from the residual free chlorine concentration test, Bacteriological test samples shall be collected. The intent of the following is to provide insurance for an accurate representation to a complete Bacteriological test of the water system. At least two samples shall be taken from each floor of each building.
2. Bacteriological test samples shall be delivered to a State of California Department of Health Services Certified Laboratory to perform qualitative and quantitative bacterial analyses on the water samples for the presence of any Total Coliform bacteria and Plate Count. This count must be less than 500 cfu/mL.
3. The procedure shall be repeated if it shown by bacteriological examination made by an approved agency that the level of Disinfection does not meet these specifications.
4. After satisfactory results for the bacteriological test are provided to the OAR, the physical barrier or temporary reduce pressure back flow devise shall be removed, and the new piping shall be connected to the point of connection. All the connecting piping and fittings shall be disinfected prior to installation. Chlorination Port shall be capped water tight. Warning sign or tags shall be removed.

- G. Drinking Fountain and Bottle Filler Lead Test: After installation of Drinking Fountain or Bottle Filler, and successful Bacteriological Test, shut off domestic water supply line feeding the fixture, and inform OAR. OAR will coordinate with the Drinking Water Quality Program (DWQP) Supervisor in local Project Unit and M&O's Plumbing Technical Unit Supervisor to conduct lead detection test and mitigate as necessary. Do not remove related construction warning sign and tags.

3.12 VALVES ON PLUMBING SYSTEM

- A. Furnish and install gates, ball, globes, angles, and check valves on plumbing Work at following locations whether indicated on drawings or not.
- B. Hot and cold valves shall be:
 - 1. Lead free complying with AB1953.
 - 2. Above the ground copper water system, 2-inch and larger, may utilize Victaulic butterfly valves and fittings for their connections. A 2-inch or larger Victaulic valve may be in a wall if an adequately sized access panel is provided for maintenance or removal.
- C. Valves shall be accessible and installed within an access panel approximately 3 feet above floor and no more than 7 feet above floor, or in a marked yard box to prevent tampering.
 - 1. Immediately after each water meter, in addition to any valve furnished by utility company, there shall be an accessible valve on the inlet side for a strainer assembly, dual backflow device assembly and/or possibly a dual pressure reducing valve assembly.
 - 2. A gate or ball valve on each water supply before it enters building. Valves shall be accessible from outside building and shall be installed in a marked yard box, unless otherwise indicated on drawings. Ball valves 2 ½-inch size or larger shall omit gate valve handle and furnish 2-inch square operating nut.
 - 3. At multi story buildings, provide an isolation-valve or multiple valves for both hot and cold water in access panel to isolate and control each floor level.
 - 4. For classrooms, shops, offices and boiler or mechanical room, install a gate or ball valve to control hot and cold water lines to each group of fixtures, a group of fixtures shall be considered to be 2 or more fixtures in the same room. When practical, valves shall be installed on the same wall as group of fixtures. Valves shall control only fixtures in rooms in which they are installed.
 - 5. For restrooms, a gate or ball valve shall be installed in each restroom to isolate the hot and cold water supply into a restroom regardless of the number of fixtures. These valves shall control and be accessible only from within the restroom in which fixtures are installed. Valves shall be installed on the same wall as the group of fixtures it serves. Valves shall control only fixtures in restroom in which they are installed. Back to back restrooms shall be isolated separately and individually.
 - 6. Install a gate or ball valve on each building branch line, which serves two or more fixtures, when these fixtures are not provided with a group isolation

valve as specified above. These valves shall be located approximately 3 feet but not more than 7 feet above finish floor.

7. Install a gate, ball valve or partition stop for a drinking fountain or a group of drinking fountains.
8. Install a gate, ball valve or partition stop for hot and cold water supply to plumbing fixtures with no accessible supply stops, such as wall mounted faucets.
9. Install a gate, ball valve or partition stop for stops adjacent to, and controlling water flow to each sill cock and hose bib except as follows:
 - a. A sill cock immediately below an exterior drinking fountain may be controlled by the same gate, ball valve or partition stop as drinking fountain.
 - b. Valves or stops will not be required for individual hose bibs when these hose bibs are on a branch line serving only hose bibs and branch line is furnished with a shut-off valve.
10. Install a loose key angle stop, on each exposed fixture supply, and for each flush valve unless otherwise specified,
11. Install gate or ball valve at each location where a water line is connected to a piece of equipment other than items mentioned above.
12. Install a check valve on each hot water return line where it connects to a hot water storage tank or a water heater.
13. Handles, hand wheels (including dishwasher fill valve handles) and operating nuts shall be furnished of steel, brass, or cast iron and shall be removable. Unless specified to be loose key type, handles shall be securely fastened to their stems. On exposed outdoor valves, omit operating handles and provide operating nuts.
14. Provide a handle or a key for each five, or fraction thereof, loose key valves, bibs, or stops and deliver them to the project OAR.

3.13 VALVES - GAS SERVICE

- A. A gas readily accessible shut-off stop shall be installed on each gas line entering a building immediately prior to the point it enters the building. Unless otherwise specified or indicated, shut-off valves for lines entering a permanent structure, buildings or portable buildings, shall be installed in a vertical riser above grade.
 1. Gas shut off valve for portable buildings – In addition to the gas readily accessible shut-off stop specified above, a dedicated Gas shut off valve shall be provided in a marked Yard Box, for each portable building to facilitate relocation/removal of building without the need to shut off gas to entire school.
- B. Gas Shut off valve within a building – A gas shut off valve with handles shall be accessible and serviceable within an access panel. Install valve minimum 3 feet above floor but less than 7 feet above floor.
- C. In addition to locations specified, gas shut off valve shall be installed at following locations:

1. Install a lubricated plug gas shut off valve on any line connected to gas main or header at master assembly.
 2. Install a lubricated plug gas shut off valve before entering any building or structure.
 3. Install a gas valve on each outlet, in addition to any gas stop furnished with equipment.
 4. Service to laboratory gas cocks shall be furnished with a special precision check valve, located downstream from gas stop servicing room outlet at each laboratory cock. Unless otherwise specified, 1/8-inches bore shall be provided for each outlet cock.
 5. Install a gas shut-off valve on each gas line serving 2 or more gas outlets in same room. Service stop shall be installed not more than 7 feet above floor, and shall be in the room it serves.
 6. Install a gas shut-off valve on inlet side of each gas pressure regulating valve.
 7. Gas shut-off valves to be furnished with equipment.
 8. Install gas shut-off valve at not more than 1,000 foot intervals on each gas main.
 9. At multi-story buildings, provide gas-shut off valve(s) to isolate and control each floor or level. Install valves in a concealed manner in walls with access panels.
 10. Gas shut-off valves in classrooms and locations subject to tampering shall be protected while remaining accessible.
- D. When a gas-shut off valve adjacent to gas-fired equipment is indicated in Contract Documents it shall be furnished and installed as part of Work of this section.
- E. When electrical wall switches with emergency push button are specified for controlling gas outlets at Laboratory Classrooms, provide main shut-off gas valve with normally closed electric solenoid valve within an accessible access panel.

3.14 ELECTROLYSIS PREVENTION

- A. Brass nipples, 6 inches, with recognized brass unions; flanges shall be furnished and installed at locations described herein. Flanges shall be installed with complete insulating component consisting of gasket bolt sleeves and bolt washers. Dielectric insulators shall be installed at following locations:
1. Where special applications indicated on Drawings require an insulation flange or brass union, with 6-inch brass nipple to be installed in a condensate line, or steam line, flange insulation shall be of a high temperature type, suitable for continuous operation at temperatures up to 220 degrees F. for condensate and 400 degrees F. for steam.
 2. Where steel or cast iron in ground connects to copper or brass piping above ground, transition from steel or cast iron pipe to copper or brass pipe shall be provided in an accessible location.
 3. Underground dielectric connections shall be furnished in accessible yard boxes.
 4. Above ground dielectric connections shall be exposed; or if in finished rooms shall be located in accessible access boxes.

3.15 UNDERGROUND PIPE MARKERS

- A. Pipe markers shall be furnished according to Section 22 0553: "Plumbing Identification"
- B. Underground Caution Tape shall be placed 12 to 18 inches above the utility line. The Caution Tape shall be a designated color and marked with the appropriate name for the specific type of utility pipe as follows:
 - 1. Yellow – with the words: CAUTION GAS LINE BELOW
 - 2. Blue – with the words: CAUTION WATER LINE BELOW

3.16 HOT WATER CIRCULATING PUMPS

- A. Floor-mounted pumps shall be provided with a 4-inch high concrete base with ½ inch reinforcing bars at 12-inch centers each way and doweled into concrete floor.
- B. Piping shall be supported from building structure so as to prevent any strain on pump casing.
- C. In-line pumps, unless otherwise specified, shall be centrifugal type with non-overloading characteristics and shall not overload motor above its horsepower rating under operating conditions with ratings based on continuous operation.
- D. Centrifugal water pumps shall be rated according to Hydraulic Institute Test Code for Centrifugal Pumps. Pumps shall be furnished with bronze water chamber, bronze impeller and mechanical seal. Rotating parts shall be statically and dynamically balanced.
- E. Flanged connections shall be provided on pumps with discharge connections larger than 2 inches. Smaller sizes may be threaded connections.
- F. Hot water circulating pump shall be arranged so that pump can be automatically turned off when hot water system is not in operation.

3.17 WATER TEMPERATURE CONTROLLERS

- A. Furnish and install a water temperature controller in hot water line adjacent to, and for control of, circulating pumps on hot water return lines when said pump is indicated on Drawings or herein specified. Bulb of temperature controller shall be installed so as to be directly in path of flowing water and so as not to obstruct flow of water.
- B. Furnish and install a water temperature controller in hot water storage tanks for control of circulating pump on hot water circulating line when said pump is indicated on Drawings or specified herein.

3.18 DEPTH OF SEWER LINES

- A. Minimum depth of below grade sewer lines shall be 24 inches to centerline of pipe. Sewer lines shall slope $\frac{1}{4}$ inch per foot minimum, unless otherwise indicated. Minimum depth at Owner property line shall be 6 feet, unless otherwise required.

3.19 BACKFLOW PREVENTION DEVICES

- A. Backflow Devices: Installation of backflow devices shall be tested and certified by backflow device tester before Substantial Completion. Tests shall be performed in presence of Project Inspector. Test reports shall be turned over to Project Inspector for mailing to proper agency.

3.20 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose off Project site.

3.21 PROTECTION

- A. Protect Work of this section until Substantial Completion.

END OF SECTION

SECTION 23 00 00

HEATING, VENTILATING, AND AIR CONDITIONING

PART 1 - GENERAL

- 1.1 SCOPE: Work includes but is not necessarily limited to the following:
- A. All applicable requirements of Documents 0 and Division 1 - General Requirements apply to the work of this Section.
 - B. Examine all other sections for work related to those sections which are required to be included as work of this section.
 - C. Section Includes: Heating, Ventilating and Air-Conditioning. Provide all labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work in this Section. Complete, as shown on the Drawings and/or specified herein, including but not limited to these major items:
 - 1. Split system air cooled heat pumps and exhaust fans.
 - 2. Air distribution systems for air conditioning, ventilation and exhaust. Systems to be complete with access doors, dampers, diffusers, registers, grilles and all required accessories.
 - 3. Hangers and support for ductwork and equipment.
 - 4. Automatic control systems.
 - 5. Thermal and acoustical insulation for plenums, piping, and ductwork.
 - 6. Subzone systems.
 - 7. Smoke detectors.
 - 8. Air filters.
 - 9. Vibration isolator.
 - 10. Service and equipment connections.
 - 11. Pipe hangers and supports.
 - 12. Testing and balancing of systems.
 - 13. Miscellaneous items including instruments, equipment supports, flashings, access panels, sleeves and plates, testing and adjusting, and all accessories and items required for a complete installation.
 - 14. Permit and related fees.
 - D. Related Sections: Document affecting work of this Section include, but are not necessarily limited to general conditions, supplementary conditions and Sections in Division 1 of these Specifications.
 - 1. Electric relays, switches and wiring for heating, ventilating and air conditioning

equipment except where otherwise designated on control diagrams in Division 26 - Electrical.

2. Furnishing and installing control and starting equipment, including transformers and motor starters not furnished with equipment specified in Division 26 - Electrical.
3. Condensate drain lines, including connections to equipment in Division 22 - Plumbing.
4. Access Doors and Frames - Section 08 31 16.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Without additional cost, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- C. Conform to applicable City and State Building Codes and Ordinances.

1.3 GENERAL REQUIREMENTS - See Division 1

- A. Location:

Indicated on the drawings. For purpose of clarity, the drawings are generally diagrammatic, omitting offsets and small details. Certain duct runs are shown distorted to avoid confusion. Where locations are fixed by dimension notations, follow as closely as possible consistently with proper installation.
- B. Exact Locations:

As required for proper installation avoiding interference with architectural and structural features, work of others to preserve head room and to keep openings and passageways clear. Make arrangement neat and occupy minimum space.

Install each item of equipment so as to allow for ease of maintenance and in accordance with all governmental requirements having jurisdiction.

 1. Locate ceiling diffusers symmetrical with respect to room center lines, electric lighting fixtures and acoustical tile. Arrange the exact locations in coordination with installation of lighting fixtures and acoustical tile; as indicated on the reflected ceiling plan on the drawings subject to the approval of the Architect.
- C. Openings:

Provide through walls, floors, partitions, and other construction as necessary for passage of ducts whether indicated or not on the Drawings. Seal around all penetrations.

D. Cutting and Repairing:

1. Cutting: Do not cut structural members without written authorization by the Architect.

When permitted, provide all reinforcement with repair as directed by the Architect.

Provide openings through walls, floors, partitions, and other construction as necessary for passage of pipes, conduit, and ducts whether or not such openings are shown on the Contract Drawings.

2. Repairing: By appropriate craft persons to restore construction to a condition approved by the Architect. Seal around all penetrations.

E. Protection of Work: As necessary to prevent damage of any kind to materials and installation.

F. Record Drawings: Provide accurately scaled locations, all control equipment, ducts, temperature control apparatus, volume dampers as installed, in strict accordance with provisions of Division 1 of these Specifications.

G. Submittal Shop Drawings, Manufacturer's Data and Lists of Materials, Fixtures, Equipment and Control Diagrams:

1. General:

Submit for approval, in accordance with provisions of Submittals Section of Division 1 of these Specifications, to ensure ample time for checking and processing of the submittals by the Architect; delays resulting from improper and untimely submittals shall be the responsibility of the Contractor.

2. Required List of Materials, Fixtures, and Equipment:

Complete with names and addresses of manufacturer's, catalog numbers, trade numbers, trade names, illustrations, and descriptive literature for each article proposed to be used in this project. Descriptive literature to be sufficient for complete evaluation of equality of the proposed articles. All pertinent data for each article shall be underlined in each copy of each catalog or brochure in which it is described.

3. Required Control Diagrams:

Complete ladder diagrams to show internal wiring of all major components and complete schematic control wiring diagrams, sequence of operation, and interlock of all associated equipment for each system to be drawn by Control manufacturer or A/C unit manufacturer and accompanied by a description of control sequence; to be submitted to be approved by the Architect before installation of any control wiring or equipment; without fulfillment of this requirement, control diagrams will not be approved.

4. Approval of shop drawing or other submittals will be general and shall not relieve the Contractor from the responsibility for proper fitting and construction of the

work, nor from furnishing materials and work required by the Contract which may or may not be indicated on the shop drawings when approved as specified in Subsection 1.3(G) of this Section.

5. Disapprovals:

Omit any article disapproved by the Architect not conforming to specifications or not of proper quality or grade and provide suitable article(s) in lieu thereof in conformity with the specifications. Start no construction work or purchasing related to such article(s) prior to approval.

6. Approved List:

To be used for procurement without deviation, unless otherwise authorized by the Architect.

7. Modification of Contract Drawings:

In each case where proposed substitute materials or equipment will require, for proper installation, changes to the design of the project as indicated on the Contract Drawings, appropriate proposed revision drawings shall be prepared by a licensed Architect or Engineer and shall be furnished by the Contractor for approval by the Architect. Letter of transmittal shall indicate all variations in performance, design, and installation between proposed substitutes and the specified items; each article in submittals will not be accepted unless identified with reference to Section and/or Subsection number of this Specification. Such drawings to be sufficiently complete for proper installation of the proposed substitute materials or equipment and for construction by all interested trades of the proposed revisions to the project. The cost of the drawings and of the proposed revised construction shall be borne by the Contractor. Submit any proposed substitutions and any necessary deviations or changes to control diagrams to the Architect in accordance with Division 1. Contractor shall state in writing when such item is submitted as a "substituted item."

H. Materials and Workmanship:

1. General: In conformity with City Plumbing and Mechanical Codes, Underwriters' Laboratories, CAL/OSHA Standards, SMACNA Standards, State Energy Standards Title 24, and State Fire Marshall requirements.
2. Materials: New and in perfect condition. Materials for similar uses to be same type and manufacture unless otherwise approved; sheet iron or steel and fastenings to conform to requirements specified in the Division 1 of these Specifications. All heating and cooling equipment shall be listed items by California Energy Commission.
3. Workmanship: In accordance with best trade practices and as noted in Subsection 1.2A of this Section.

I. Permits and Inspections:

1. Permits: As required by Mechanical Codes; to be obtained and paid for by the Contractor except permits and costs otherwise provided for in these Specifications.
 2. Inspections: Required of all installations prior to concealment and completion of the work; by the City Department of Building and Safety. Final Certificate of Approval required for the entire heating, ventilating, and air conditioning systems. See Division 1 for required permits.
- J. Discrepancies or Errors: Should they appear in the drawings, specifications, approved shop drawings, or in other Contract documents, the Contractor as directed in Division 1, shall immediately notify the Architect and ask for instructions.
- K. Maintenance and Operating Manuals: Provide maintenance and operating manuals for all equipment; include control diagrams with description of sequence of operation, as per provisions of Division 1 of these Specifications.
- L. Acceptance of heating, ventilating, and air conditioning system will not be considered until the Contractor has completed balance, test and adjustment of all mechanical systems and all other work as hereinafter specified, including all testing work, and has demonstrated to the Architect that all such systems operate properly in accordance with these Specifications and the standards herein referenced.
- M. Test and Supervision: As indicated in Division 1.

1.4 SUBMITTALS

- A. Comply with provisions of Division 1.
- B. Shop Drawings: Furnish detail shop drawings or catalog plates of all special equipment as required for approval. Shop drawings or catalog plates shall show sizes, sections and dimensions of equipment, methods of connection or attaching to work of other trades, and copies of all shall be furnished to other trades. Make all erection drawings necessary for the installation of the work.
- C. Material List:
1. Before entering into any Contract for purchase of materials, and before any work is started, Contractor shall submit for approval, including catalogs and descriptive matter, of the following materials and equipment he proposes to furnish and install. Materials list shall be complete and contained in the hard-bound loose-leaf notebooks. Items not contained in the submittal shall conform to design specifications as supplemental submittals will not be accepted. Submittals shall include but not limited to the following:
 - a. HVAC equipment.
 - b. Ductwork and accessories.
 - c. Each register, diffuser, and manufactured plenum with reference to schedule number.
 - d. Wiring diagrams of electrical connections required for installation of

- equipment.
 - e. Temperature control system with a detailed description of the control sequence, etc.
 - f. Certified performance curves for all fans.
 - g. Subzone systems.
 - h. Smoke detectors.
 - i. Air filters.
 - j. Insulation.
 - k. Vibration isolators.
 - l. Seismic restraints.
 - m. Exhaust fans.
 - n. Air balance procedures and forms.
- D. Wiring Diagrams: Wiring diagrams of work required for the installation of the ventilating and air conditioning equipment shall be submitted for approval. Only approved diagrams shall be used for installation purposes.
- E. Tests and Balancing:
1. One week prior to final inspection submit to the Architect bound and indexed copies of the report on system operation, including air quantities at each outlet and fan, fan speeds, pulley and motor sizes, motor loads and all other pertinent data.

1.5 CODES, ORDINANCES AND CONDITIONS

- A. All work shall conform to, and be installed in accordance with, the requirements of all laws, rules and regulations of the State, City, and County. Requirements of this Section are minimum requirements and shall govern, except that the building laws and/or the Drawings shall govern when their requirements are greater or more stringent, without added cost.
- B. Where the work as shown on the Drawings or described in the Specifications is in conflict with any of the laws, ordinances or regulations applicable to this project, the Contractor shall notify the Architect and obtain directions before installing any of the work involved with the conflict.
- C. Examine all other Sections for work related to those Sections and required to be included as work under this Section.

1.6 PRODUCT HANDLING: Comply with pertinent provisions of Division 1.

PART 2 - PRODUCTS

2.1 SHEET METAL

- A. Description: The sheet metal shall include housings, ductwork, plenums, dampers, equipment connections, etc.
- B. Materials: Sheet metal shall be fabricated of galvanized steel sheets of lock forming quality (LFQ) and shall have a galvanized coating of 1-1/4 oz. total for both sides of 1

sq. ft. of a sheet. Supports not part of ducts, bar or angle reinforcing, damper rods and items made of uncoated mild steel shall be painted with two coats of primer.

- C. Construction: Sheet metal ductwork may be of either rectangular construction (steel or aluminum) or round construction (only spiral seam steel). Gages as per local code requirements; fabrication shall be in accordance with the Sheet Metal and Air Conditioning National Association (SMACNA) HVAC Duct Construction Standards - Metal & Flexible, 3rd Edition - 2006, and as hereinafter specified.
 - D. Elbows and Tees: Shall have a center line radius of 1-1/2 times duct width, measured in plane of turn. All square elbows shall be equipped with turning vanes of double-thick metal of air foil design. Vanes shall be straight, and securely fastened to the sides. Square elbows with radius heel will not be permitted.
 - E. Extractors where Required for Proper Air Flow: Adjustable volume type with extended flexible shaft, connected to grille face or to side of duct permitting adjustment from exterior or duct.
 - F. Manually Operated Dampers or Splitters: Fabricated of 16 gauge steel, and as recommended by SMACNA Manual, equipped with Vent-Lock #637 self-locking regulator or equal on all ducts unless noted otherwise. Provide where required for air balancing, including O.S.A. intakes. Single leaf damper approved up to 36" x 12" maximum duct size, over these sizes multi-blade opposed type damper shall be used.
 - G. Joints and Seams Metal Ductwork: Seal all field joints and seams airtight with "Hardcast" or canvas and "Arabol" or approved equivalent. Ductwork exposed to weather shall have all joints sealed with canvas and "Arabol".
 - H. Kitchen Exhaust Ductwork: Ductwork shall be galvanized steel of 20 gauge. Duct shall be installed as per hood manufacturer's instructions. Connections to hood shall be by this Contractor.
 - I. Dryer Vent Duct: Ductwork for dryer vent shall be smooth, rigid galvanized 26 gauge with adjustable elbows, dirt leg and removable cap at dryer, and no screws or other extension into the air stream. Maximum 14'-0" length and two 90° elbows, for 4" round ducts. A 2' ft. long metal flexible duct connector is allowed at the dryer.
- 2.2 FLEXIBLE AIR DUCT AND CONNECTORS (MAX. 5 FT. LONG, UNLESS NOTED OTHERWISE)
- A. Flexible duct shall be factory fabricated assembly consisting of a zinc-coated spring steel helix in sealed double layer vinyl inner liner, wrapped with a nominal 1-1/2" (R-6.0) thick fiberglass insulation and sheathed in a metal foil vapor barrier jacket. The composite assembly, including insulation and vapor barrier shall meet the Class 1 requirements of flame spread of 25 or less, smoke developed of 50 or less, as set forth in NFPA Bulletin No. 90-A and be labeled by Underwriters Laboratories, Inc., as an air duct.
 - B. Flexible duct shall be maximum 5' length, sizes as required by contractor documents and have galvanized sheet metal male and female end-connectors. End-connectors

shall be attached to each other or to other sheet metal fittings with (4) No. 8, 3/8" sheet metal screws spaced approximately 90 deg. apart, or with a 1/2" wide metal band screw type clamping device. All metal fittings used with the flexible duct shall be insulated with a 2" thick, 1-1/2 lb. density flexible blanket insulation, jacketed with a foil face vapor barrier and sealed per CEC approved method to provide a continuous seal and a neat workmanlike appearance.

- C. Provide a manual damper at each take-off connector.
- D. Flexible duct shall be Thermaflex U/L Class 1 rated air duct or approved equivalent.
- E. Install in strict accordance with Code requirements and Manufacturer's instructions.

2.3 REGISTERS AND GRILLES

- A. All registers and grilles shall be furnished with finish as per architect. Extruded aluminum to be treated for painting unless otherwise specified or noted.
- B. The manufacturer shall verify that all supply and return selections shall not produce an ambient noise level in excess of NC-30. Only the self-noise of the outlet shall be considered.
- C. Shop drawings are required for each type register and manufactured plenums, with reference to schedule number.
- D. All registers and grilles shall be furnished with neoprene gaskets.
- E. Grille and Diffuser by: Titus, Krueger, Anemostat, Metalaire.
- F. Description: As per schedule on Drawings, sheet M1.105.

2.4 ACOUSTICAL AND THERMAL LINED DUCTS

- A. Material: 1" thick flexible glass fiber, 1-1/2 lbs. per cu. ft. density, blanket type duct liner. Lining must be approved by local codes and shall be approved by local codes and shall meet or exceed NFPA Standards. NRC rating shall be at least .080 at frequencies above 1000. R-6.0 minimum.
- B. Manufacturers: Johns Manville 'Line-Cooustic A' duct liner, Owens-Corning 'Aeroflex' or approved equivalent.

2.5 THERMAL INSULATION, WRAPPED (DUCTWORK)

- A. Material: Glass fiber blanket of not less than 1-1/2 lb. Per cu. ft. density. 2" thick on return and supply ducts. Duct insulation to be provided with foil face vapor barrier. R-6.0 minimum indoors.
- B. Manufacturers: Manville 'Microlite', equivalent by Owens-Corning or approved equivalent.

2.6 VIBRATION AND NOISE CONTROL

- A. All mechanical equipment shall be isolated from the structure by means of resilient vibration and noise isolators, supplied by a single manufacturer to the mechanical

contractor.

- B. Earthquake Restraints: All base mounted equipment shall be equipped with seismic snubbers.

Snubbers shall be capable of withstanding a horizontal force equal to 1 g., and a vertical force equal to ½ g.

2.7 EXHAUST FANS

- A. Ceiling or Wall Exhaust Fans:

1. Package ceiling, or roof mounted, or inline centrifugal fan complete with motor, sound insulation, housing, pre-wired outlet, box, vibration isolators and backdraft dampers. Provide roof jacks or roof caps as required.
2. Capacities as scheduled on Drawings, maximum 2.5 sone for toilets. Maximum 5.5 sone for utility areas.
3. Manufacturer: Panasonic, Air King, Cook or approved equivalent.

2.8 SPLIT SYSTEM HEAT PUMP HVAC UNITS

- A. Outdoor Heat Pump:

1. Contractor shall provide air-to-air electric, R-410A "Puron," heat pumps with built-in outdoor coil and compressor sections. Capacities shall be as required to maintain design conditions. Factory installed coil refrigerant metering device shall be mounted on liquid service valve and reversing valve. Condenser fans shall be direct-driven and arranged for horizontal air discharge. Fan motor shall be factory lubricated, inherently protected and resiliently mounted.
2. Compressor shall be hermetically sealed scroll type with internal vibration isolators and provided with sound attenuating device. Compressor motor shall include all thermal and current-sensitive overloading devices. Compressor shall be equipped with a crankcase heater and shall have internal high-pressure protection. Controls shall be factory wired in a readily accessible location.
3. Controls shall include a liquid line low pressure switch, suction line accumulator and pressure relief device. Control wiring terminal board shall be designed to match indoor unit terminal board and accessory automatic changeover thermostat terminals for standardized point-to-point connection.
4. S.E.E.R. & H.S.P.F. must comply with Title 24 requirements. See equipment schedule.
5. Accessories shall include automatic changeover thermostat, solid-state time guard, liquid line Biflow filter-dryer and solenoid and refrigerant tubing length as required. Where required, provide manufacturers stacking kits.
6. Manufacturer: Carrier Alternate manufacturers for equal capacities, weights and electrical characteristics shall be preapproved.

B. Indoor Fan Coil Unit:

1. Contractor shall provide direct expansion R-410A "Puron" heat pump fan coil units equipped with check and expansion valve kit, as shown located on floor plans and schedule. Unit shall be horizontal discharge type. Unit enclosure shall be insulated and constructed of galvanized steel, bonderized and finished with baked enamel. Service access panels shall provide access to all components. Filter rack shall be equipped with 1" thick Farr disposable MERV 8 filters that slide out for maintenance.
2. Fan shall be forward curved with double inlet, mounted on motor shaft, dynamically and statically balanced. Cooling coil shall be non-ferrous with aluminum plate fins. Coil shall have factory-installed refrigerant metering device, refrigerant line fittings which permit mechanical connections; and condensate pan with primary and secondary drain connections as well as an emergency float switch.
3. Accessories: As scheduled on drawings.
4. Manufacturer: Carrier. Alternate manufacturers for equivalent capacities, weights and electrical characteristics shall be preapproved equivalent.

The unit shall have the following functions as a minimum:

1. Selectable automatic restart, after power failure the system will restart at the same operating conditions as before the failure.
2. A timer function to provide a minimum 24-hour timer cycle for system Auto Start/Stop.
3. Temperature-sensing controls shall sense return air temperature at the unit or at the remote control
4. Indoor coil freeze protection in both cooling and heating (reversing valve failure) modes.
6. Dehumidification mode shall provide increased latent removal through total system modulation.
7. Fan-only operation to provide room air circulation when no cooling is required.
8. Diagnostics shall provide continuous checks of unit operation and warn of malfunctions. Error messages shall be displayed at the unit or the remote control.
9. Fan speed control shall be user-selectable: high, medium, low, or microprocessor determined based on the differential between the room temperature and the set point during all modes of operations.

10. Automatic changeover control shall include an adjustable dead band to prevent rapid mode cycling between heating and cooling.
11. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature in heating.
12. Cold blow prevention in heating.
13. Adjustable compensation for air stratification in heating.

2.9 REFRIGERANT PIPING AND ACCESSORIES

- A. All refrigerant piping shall be Type "L" copper.
- B. Refrigerant piping shall be made up of wrought copper or forged brass designed for refrigerant piping and for use with "Silfos" high-temperature solder. No joints are allowed in inaccessible locations.
- C. Hangers on insulated refrigerant piping shall fit outside covering and be Hydra-zorb type. Provide covering protection saddle 10" long at each hanger. Rigid insulation shall be provided at all hangers to prevent crushing.
- D. Provide Semco trisolators at all hangers of uninsulated piping.
- E. Provide vibration eliminators with braze-welded female ends, approved for refrigeration piping.
- F. Drier: Sporlan silica gel replaceable core sized for compressor capacity with bi-flow for heat pump duty, approved equivalent Henry or Alco.
- G. Liquid indicators double ported installed in lines at cooling coil inlets. Manufacturer: Henry or Alco.
- H. Shut-off valves shall be balanced action packless type for lines sized 1-1/8" O.C., or smaller, and wing cap packed bronze valves with bolted bonnets, repackable under pressure by Henry.
- I. Expansion Valves: Pilot operated piston type with manual operation stem by Henry or Alco.
- J. Solenoid valves shall be Henry or Alco.
- K. Installation: Dehydrate complete system and test thoroughly for leaks before initial charge is placed in system. Special care shall be taken for abnormally long piping runs in excess of 50 feet. Consult manufacturer of A/C equipment for installation requirements and restrictions.
- L. Refrigerant and Oil: Contractor shall furnish and charge the system with the necessary charge of refrigerant, together with all the oil necessary to operate the system. Sufficient refrigerant shall be supplied to fill the system for proper operation.

- M. Guarantee: Replace at no cost to the Owner all refrigerant and oil lost due to leaks or faulty materials and workmanship for a period of one year after date of acceptance.
- N. Insulate suction lines including fittings, with "Rubatex" flexible elastomeric tube insulation. Seal all seams and joints with Rubatex 373 adhesive, 0.25 "K" value maximum. 3/4" thick on pipe 1-1/2" and smaller. Provide UV protective coating on insulation exposed to atmosphere.
- O. The unit shall be capable of maximum line lengths from 164 to 246 ft. The maximum vertical lift or drop is 100 ft. Provide oil traps at every drop.

2.10 AIR FILTERS

- A. MERV 13 Efficient - Medium efficiency pleated disposable type, size as required by air handling unit. Filters shall be provided with media support grid, enclosing frame. Filter shall be FARR Air UL, Class 2 (30/30) or approved equivalent.
- B. Replacement Filters: All systems shall have specified filters installed prior to testing and balancing: All filters shall be replaced at the time the building is turned over to the Owner.

2.11 THERMOSTATS

- A. Shall be remote, microelectronic chronotherm heating/cooling type with separate temperature sensing elements for each system. Heating and cooling circuits shall be electrically isolated from each other. The heating side shall be provided with a factory set maximum of 75 degrees F. The thermostat shall contain or be provided with sub-base containing selector switches for cool-off heat and fan-auto-on.
- B. Low voltage digital clock type with programmable set points for automatic operation, one or more times per day.
- C. Manufacturer: Honeywell or approved equivalent.

2.12 ELECTRICAL MOTORS

- A. General: Motors rated less than 1/2 HP shall be wound for 115 or 240 volt, 60 hertz, single- phase current. Motors rated 1/2 HP and over shall be wound for 240 volt, 60 hertz, 3-phase current, unless noted otherwise. If exposed to weather or moist atmosphere, all enclosures shall be drip-proof and epoxy encapsulated unless otherwise specified.
- B. Single Phase Motors: NEMA Standard for fractional HP motors. Built-in overload and low- voltage protection with reset button on motor is required.

2.13 AUTOMATIC CONTROL DEVICES

- A. Furnish all the automatic temperature control devices.
- B. The control equipment shall be as indicated on drawings.
 - 1. Instruct the electrician, or sheet metal worker on the particular requirements of the control devices for which each is responsible.

2. Calibrate all devices and make all final settings and test out the control system under actual operating conditions for satisfactory operation.
- C. Wiring: All line voltage conduit and wiring in connection with the control system is specified under "Electrical" Section.
- D. Thermostats: Low-voltage electric type and self-generating multivolt room thermostats complete with set point adjustment. Mount 4'-0" above floor.
 1. See control diagram on drawings for fan controls.

2.14 MACHINERY GUARDS

- A. Cover all moving parts of machinery such as shaft couplings, belt drives, exposed fan intakes, etc., with removable metal guards. Provide access in guard for tachometer readings. Comply with applicable safety regulations.

PART 3 -EXECUTION

3.1 STEEL SHEET METAL WORK

- A. Sizes shall be as noted on Drawings, to provide quiet draft-free ventilation.
- B. Slope: No more than 1 to 7 on any side except where connections dictate. A maximum of 1 to 4 may be used, subject to approval.
- C. Throat: Area of the branch duct takeoff shall be in direct proportion to the volume of air to each branch.
- D. Holes: Holes in duct for damper rods and other necessary devices shall be drilled and shall be airtight. No pipes, conduits or other member may pass through any duct unless otherwise shown on the Drawings.
- E. Noise: Entire system shall prove quiet to a degree satisfactory to the Owner. Any adjustment required to produce quietness shall be made by the Contractor before work can be deemed to be finished and accepted.
- F. Isolation: Where incompatible materials come in contact, they shall be isolated from each other with rubber, neoprene, lead or material best suited for the materials to be isolated.
- G. Supports: Secure ducts against displacement and vibration. Anchor to structural parts of the buildings at intervals not greater than 10 feet. Suspend with 18 gauge straps and as recommended in the SMACNA Manual.

3.2 MECHANICAL INSULATION

- A. All ductwork, equipment and appurtenances handling air at temperatures above or below room ambient shall be insulated as generally described herein.
- B. Installation shall be neat and workmanlike in appearance and quality of workmanship. Insulation shall be neatly cut at supports, etc., and shall be first class in workmanship.

Installation shall be in direct compliance with manufacturer's recommendations for his particular materials. Care shall be taken during installation to eliminate or reduce dust and dirt to a minimum. Waste and debris shall be removed as it accumulates.

- C. Where ducts are lined on the interior, no external insulation is required.

3.3 INSTALLATION OF DUCTWORK

- A. Fabricate and install ductwork in strict accordance with Mechanical Code Chapter 6, and SMACNA standard.
- B. Sheet Metal Ductwork:
 - 1. Cross-break, or kink flat surfaces to prevent vibration.
 - 2. Wherever obstructions require a change in duct shape, maintain equivalent areas. Sizes indicated on Drawings are sheet metal sizes allowing for the lining.
 - 3. Connections:
 - a. Install and make necessary connections for the complete supply, recirculation and exhaust systems including ductwork, air distribution device, collars, intake housings, hangers, connections, fasteners, and other items required.
 - b. All air supply and return air ducts shall have their longitudinal and transverse seams tightly sealed to provide an airtight system.
- C. Provide flexible canvas connections between units and ductwork, minimum 3" wide.
- D. Volume Dampers:
 - 1. Provide adjustable volume dampers in branch supply and return ducts.
 - 2. Locate the dampers as close as possible to the main duct.
 - 3. Provide remote operators where dampers are inaccessible.
- E. Debris Protection: Prior to any interior sanding or finishing of the Apartments, provide covers for all duct inlets and outlets to prevent any debris, dust or paint from inadvertently getting into the duct system. If the systems are to be in operation during the construction, provide temporary extra high-quality filters on the systems. Remove these filters at the time of Testing & Balancing and turn them over to the Owner. Also provide protection for the HVAC equipment that is on site during the construction period.

3.4 NOT USED

3.5 FLEXIBLE AIR DUCTS

- A. Flexible duct shall be sized as required by calculations, and have galvanized sheet metal and female end connectors. End connectors shall be attached to each other or to other metal fittings with four #8, 3/8" sheet metal screws spaced approximately 90 degrees

with a 1/2" wide metal band screw type clamping device.

- B. Flexible ducts shall be installed in a fully extended condition free of sags and kinks, using the length required. Where, in the opinion of the Architect, flexible duct length is duct shall be shortened or replaced with a flexible duct of suitable length. The flexible bending radius shall not exceed the specific manufacturer's UL approval. Where support is required, flexible duct shall be suspended on 36" centers with a minimum 2" wide flat

Flex," 1-800-459-4822.

3.6 ELECTRICAL WORK

- A. Disconnect switches, line voltage wiring and all conduit (power line and low voltage) are specified in the Electrical Section of the Specifications unless otherwise specified and/or on Drawings.
- B. Wiring diagrams of electrical connections required for the installation of equipment of this Section shall be submitted to the Owner for approval. After approval, the wiring diagrams be submitted to the Electrical Contractor for use in installation.

3.7 PAINTING

- A. Painting of all apparatus, unless hereinbefore specified, shall be done under the Painting Section of the Specifications. All apparatus furnished by the Contractor shall be provided shop coat at the factory. Inside of ducts behind all air inlets and outlets in finished areas be painted two coats of dull flat black by this Contractor. Certified low V.O.C. rating.

3.8 EQUIPMENT IDENTIFICATION

- A. Identify all equipment, using brass discs or black with white engraved letters laminated Install in readily visible location, not interfering with insulation.
- B. Fans, Air Conditioning Units, Pumps, Etc.: Laminated plastic showing manufacturer, HP, capacity, static pressure and electrical characteristics.

3.9 TESTING AND BALANCING

- A. General:
 - 1. Test, balance and adjust the ventilating systems as specified herein. All work shall under direct supervision of a qualified engineer or contractor. All instruments used accurately calibrated and maintained in good working order.
 - 2. Balancing and testing shall not begin until systems have been completed and are in working order. Put all ventilating systems and equipment into full operation during working day of testing and balancing.
 - 3. Perform the following tests, compile the test data and submit 2 copies of the complete data to the Owner.
- B. Air Testing Procedure: Perform the following tests and balance system, including air devices provided by the ceiling Contractor, in accordance with the following not limited to:
 - 1. Test and adjust blower RPM to design requirements.
 - 2. Test and record motor full load amperes.
 - 3. Make pitot tube traverse of main ducts and obtain design CFM at fans.
 - 4. Test and record system static pressures, suction and discharge.

5. Test and adjust system for design recirculated air, CFM and temperature.
 6. Adjust all main supply and exhaust air ducts to proper design CFM.
 7. Test and adjust each grille and register to design CFM requirements.
 8. Manufacturer's ratings on all equipment shall be used to make required calculations.
 9. Readings and tests of grilles and registers shall include required FPM velocity and test resultant velocity, required CFM and test resultant CFM after adjustments.
 10. Make any changes in the pulleys, belts and dampers or the addition of dampers required for correct balance as recommended by the air balance agency, at no additional cost to the owner.
- C. Upon completion of the balance of the system, all the information shall be inserted on a sheet listing all items required by Specifications and be included in complete test and balance report and then shall be submitted for approval.
- D. The Owner reserves the right to request the Contractor to readjust air volume and different systems requirements to meet local conditions during the six months following, after completion of the total balancing of the systems. During this time, the Engineer, at his discretion, may request a recheck or resetting of any outlet, supply air fan, or exhaust fan or any other equipment or part of as listed in the test report. Contractor shall provide technicians to assist the Engineer in making any tests he may require during this period of time.

3.10 CLEANING

- A. Completely cover motors and other moving machinery to protect from dirt and water during construction. Cap all openings into ducts and pipes to protect from foreign matter while under construction.
- B. Thoroughly clean inside of ductwork before installing grilles.
- C. During process of work, premises shall be kept reasonably free of all debris, cuttings, and waste material resulting from work under this heading. All debris, rubbish, leftover materials, tools and equipment shall be removed from the site prior to final acceptance.
- D. Thoroughly clean all parts of apparatus and equipment. Exposed parts which will be painted shall be thoroughly cleaned of cement, plaster and other materials. All grease or oil spots shall be removed with carbon tetrachloride. Such surfaces shall be carefully brushed down with a wire brush to remove rust and other spots and left smooth and clean.
- E. Damaged factory applied finishes shall be "touched up". "Touch up" shall be accomplished with preparation, prime and finish coats applied in strict accordance with the manufacturer's recommendations.

3.11 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Complete sets of instructions containing the manufacturer's operating and maintenance instruction for each piece of equipment shall be furnished in accordance with the

general requirements to the Engineer. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers; the words "OPERATING AND MAINTENANCE INSTRUCTIONS", the name and location of the building, the name of the Contractor and the contract number.

- B. The Contractor shall incorporate, among others in the sets of operating and maintenance instructions to the Owner's representative, the following directions:
 - 1. Part numbers of all replaceable parts.
 - 2. Manufacturer's cuts and rating tables.
 - 3. Oiling, lubricating and greasing data.
 - 4. Complete electrical load data from operation tests.
 - 5. Air flow data on all fans indicated on the Drawings.
 - 6. Serial numbers of all principal pieces of equipment.
 - 7. Installing companies' names, addresses and telephone numbers.
 - 8. Control diagrams and operating sequences together with labeling of control wiring and instruments to match diagrams.
- C. After approval by the Owner, three (3) copies of this instruction and maintenance manual shall be furnished to the Owner's representative.

3.12 TEMPERATURE CONTROL SYSTEM SEQUENCE

The Contractor shall be responsible for furnishing all the automatic temperature control devices.

- A. Submit a shop drawing of the proposed temperature controls, and detailed description of the control sequence.
- B. Instruct the electrician, sheet metal worker or other specialist on the particular requirements of the control devices of which each is responsible.
- C. Calibrate all devices and make all final settings and test out the control system under actual operating conditions for satisfactory operation.
- D. Wiring: All line voltage conduit and wiring as well as low voltage conduit in connection with the control system shall be provided under the Electrical Section of the specifications.

3.13 INSTRUCTION TO PERSONNEL

- A. Upon completion of the installation of the equipment, place a competent person in charge to operate the different systems and instruct the Owner's representative in all details of operation and maintenance. Any required instructions from manufacturer's representative shall be given during this period.
- B. The Contractor shall incorporate, among others in the set of operating and maintenance instructions to the Owner, the following directions:

1. Clean and replace fan belts every two months for the first six months.
 2. Oil motor bearings every two months (give manufacturer's recommendations and type of oil) unless permanent lubricant bearings.
 3. Check and replace filters as required for proper performance. Replace air filters at completion of construction and provide two (2) extra sets to owner.
 4. Oiling, lubricating and greasing data.
 5. Belt sizes, type and lengths.
 6. Serial numbers of all principal pieces of equipment.
 7. Installing company's names, address and telephone numbers.
 8. Control diagrams.
- C. After approval by the Architect, two (2) copies of this instruction and maintenance manual shall be furnished to the Owner's representative.

3.14 GUARANTEE

- A. In addition to other guarantees required and as a condition precedent to the issuing of the final certificate for completion payment, the Contractor shall deliver to the Architect a written guarantee that all materials, apparatus and equipment furnished and installed hereunder shall be new and free from all defects. Should any trouble develop within one (1) year from date of acceptance of the building, due to faulty or inferior material and/or workmanship, the trouble shall be corrected by the Contractor without expense to the Owner. The Contractor shall guarantee all apparatus and equipment to deliver the capacities as scheduled and/or specified.

3.15 DESCRIPTIVE NAMES

- A. Selected Manufacturers: Where the name of a selected manufacturer of equipment, fixtures, or material is specified, the proposal of the Contractor shall be based on the use of the named product or equivalent product of manufacturers if such are listed. No substitutions will be permitted.

END OF SECTION

SECTION 23 05 00
COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section provides the basic mechanical requirements that apply to the Work of Division 23.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 26: Electrical.

1.02 REGULATORY REQUIREMENTS

A. Materials, fabrication, equipment, and installation shall comply with industry standards and code requirements. Where manufacturer's recommendations exceed industry standards, the manufacturer's recommendation shall establish the minimum standard. As a minimum, standards from the following organizations shall apply:

1. AMCA - Air Movement and Control Association.
2. ANSI - American National Standards Institute.
3. ASME - American Society of Mechanical Engineers.
 - a. ASME Boiler and Pressure Vessel Code.
 - b. ASME B31 - Code for Pressure Piping.
4. AHRI - Air-Conditioning, Heating, and Refrigeration Institute.
5. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers.
6. ASTM - American Society for Testing and Materials.
 - a. ASTM A53 - Specification for Welded and Seamless Pipe.
7. CSA - Canadian Standards Association.
8. FM Global - Factory Mutual Global
9. IAPMO - International Association of Plumbing and Mechanical Officials.
10. NFPA - National Fire Protection Association.
11. OSHA - Occupational Safety and Health Administration.
12. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association.
13. UL - Underwriters Laboratories Inc.
14. Intertek (ETL Certification).

B. Materials, fabrication, equipment, and installation shall comply with federal, state, and local codes including, but not limited to, the following:

1. CBC, California Building Code, and CMC, California Mechanical Code.

- a. Latest edition as adopted by the City of Coachella, and the State of California including amendments effective on the Effective Date of the Contract.
 2. California Code of Regulations, Title 8, Industrial Relations, Division 1, Chapter 4, Division of Industrial Safety.
 3. OSHA - Occupational Safety and Health Administration.
 4. CDPH – California Department of Public Health.
 5. SCAQMD - South Coast Air Quality Management District.
 - C. Specifications or Drawings shall not be construed to permit deviation from the requirements of governing codes unless approval has been obtained from legally constituted authorities having jurisdiction, and the Architect. The Contract Documents may contain more stringent requirements than those legally required.
 - D. Permits and Fees: Refer to the General and Supplementary Conditions.
- 1.03 SUBMITTALS
- A. Provide submittals in accordance with Section 01 3300: Submittal Procedures and with specific requirements of Division 23 sections, as applicable.
 - B. After Architect's approval, the above information shall become the basis for inspecting and testing materials and actual installation procedures performed in the Work.
 - C. Shop Drawings: Submit one additional copy when control diagrams having line voltage connections are indicated. Shop Drawings shall be specifically prepared for the Work of this Project. Drawings prepared in accordance with requirements of Section 01 3113: Project Coordination and Section 01 3300 may be provided by the Architect to serve as a background for the Shop Drawings. Shop Drawings shall comply with the requirements of Section 01 3113 and Section 01 3300 and shall indicate at a minimum:
 1. Complete system layout of equipment, components, ductwork, and piping, indicating service clearances, duct and pipe sizes, fitting types and sizes, top or bottom of duct and pipe elevations, distances of ducts, pipes and equipment from building reference points and hanger / support locations. All the above items shall be coordinated on the shop drawings according to the requirements of Section 01 3113.
 2. Schedule and description of equipment, ductwork, piping, fittings, valves, dampers, and controllers.
- 1.04 PROJECT RECORD DOCUMENTS
- A. Comply with provisions of Section 01 7700: Contract Closeout.
 - B. Project Record Drawings:
 1. Provide a complete set of mechanical and control system drawings in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks and plotter pen color/line thickness settings on CD-ROM. Also submit one set of full size reproducible plots on vellum and three sets of prints.
 2. Before Contract Completion, deliver corrected and completed prints to the OAR. Delivery of project record documents to the OAR does not relinquish responsibility of furnishing required information omitted from project record documents.

C. Operation and Maintenance Manuals:

1. Submit operation and maintenance manuals in required form and content. If no revisions are required, furnish one additional copy. If revisions are required, one copy shall be returned with instructions for changes; perform such changes and return manuals. Manuals shall be bound in accordance to Section 01 7700. Deliver manuals to the OAR. Submit an electronic copy of the entire manual in PDF file format.
2. Contents of Manual:
 - a. Title sheet with Project name, including names, addresses and telephone number of Contractor, installer, and related equipment suppliers.
 - b. Manufacturer's operating instructions including, but not limited to, the following:
 - 1) Identification of components and controls.
 - 2) Pre-start checklist and start-up procedures.
 - 3) Normal operation settings and checklists.
 - 4) Pre-shut down checklist and shut down procedures.
 - 5) Trouble shooting checklist and guidelines.
 - 6) Recommendations for optimum performance.
 - 7) Warnings and safety precautions on improper or hazardous operational procedures or conditions
 - c. Manufacturer's product data and parts and maintenance booklet for each item of equipment furnished under Division 23 that includes the following as a minimum:
 - 1) Manufacturer's model, identification, and serial numbers.
 - 2) Exploded view of assembly drawings identifying each component or part with the relevant part number.
 - 3) Directory of manufacturer's representatives, service contractors and part distributors.
 - 4) Maintenance and trouble-shooting instructions, including schedule for preventive maintenance, periodic inspection, and cleaning criteria.
 - d. Project Record Drawings: Complete set of mechanical and control system drawings in 50 percent reduced print format shall be furnished with the manual. Submit the above record drawings on CD-ROM in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks, and plotter pen color/line thickness settings.
 - e. Testing, Adjusting, and Balancing reports: Submit as specified in Section 01 4525.
 - f. South Coast Air Quality Management District (SCAQMD) permits to install and operate boilers, water heaters and other fuel burning

equipment and third-party source test reports as required by SCAQMD to allow start-up and operation of equipment.

- g. Riverside County industrial waste permits.
- h. Valve directory complete with location, function, size, and model of each valve with reference to the project record drawings.
- i. Equipment and component identification chart complete with location, function, size, and model of each equipment or component with reference to the project record drawings.

1.05 COORDINATION

- A. Contract Documents indicate extent and general arrangement of Work under Division 23. Contractor shall coordinate work in accordance with Section 01 3113 requirements and make adjustments as required to provide maximum headroom, a neat arrangement to keep passageways and openings clear to provide accessibility and provisions for maintenance, and to meet code requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.
- B. Do not store plastic pipe or materials in direct sunlight.

1.07 PRELIMINARY OPERATION

- A. OAR may require any portion of mechanical Work to be operated before Substantial Completion. Such operation shall be in addition to regular tests, demonstrations and instructions required under the Contract Documents, and shall be performed as required.
- B. Notify the Project Inspector at least 24 hours in advance of lighting or re-lighting pilots.

1.08 TRAINING OF OWNER PERSONNEL

- A. Training of Owner's personnel shall include:
 - 1. A minimum of 8 hours of on-site overview of the overall Mechanical System.
 - 2. Refer to Division 23 sections for specific training on each of the components of the Mechanical System.
 - 3. A minimum of 8 hours of on-site overview identifying location and function of all Control Valves and Actuator assemblies.
 - 4. A minimum of 40 hours of (in classroom) software training for a minimum of 20 PVSD personnel on EMS/BMS if such systems are utilized in the project. Training shall be conducted at control contractor training facility with computer setup for each person attending.
- B. Contract shall include the cost of training Owner operation and maintenance personnel in operating, adjusting, maintenance, trouble-shooting, and Project site repair of each component, equipment, or system provided under this Contract.
- C. Operational and maintenance training shall be conducted on the Project site, unless indicated otherwise.

- D. Upon completion of Owner training, a completion certificate indicating the nature of the training and a description of the systems, complete with equipment and component lists shall be issued to each trainee. The certificate should be issued in duplicate with one copy retained by OAR.
- E. An attendance sheet with the names and signatures of all participants attending the training shall be submitted to the OAR and kept as part of the project documents.

1.09 GUARANTEES AND DAMAGE RESPONSIBILITY

- A. Sound of water flowing in piping shall not be transmitted to building structure. Operation of mechanical system shall not produce operational sounds that can be heard outside of rooms enclosing apparatus or equipment.

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Unless otherwise specified, materials and equipment shall be new, in good and clean condition. Equipment, materials, and components shall be of the make; type and model number noted on Drawings or specified. Pieces of equipment of the same type shall be by the same manufacturer.
- B. Whenever an item is listed by a single proprietary name, with or without model number and type, it shall be for purpose of design only, to indicate characteristics and quality desired. Proprietary designation listed on Drawings, or listed first in Specifications, is used as a basis for design to establish a standard for quality and performance and space requirements.
- C. HVAC equipment products from different manufacturers are never identical. Equipment approved as being equal is interpreted as being equivalent in capacity, performance and quality. The dimensions, weight, configuration and utility requirements could be quite different from the equipment used as the basis of design. Due to these differences, additional coordination and adjustments by the Contractor are required. For the equipment to be deemed truly equal, the additional coordination and adjustments by the Contractor should not incur any additional cost to the Owner and any additional labor to the design team.
- D. Equipment and materials indicated or required to be installed outdoors shall be of the type that is designed, manufactured, listed or approved by authorities having jurisdiction for outdoor installation by being resistant to the adverse effects of weather. All the additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.
- E. For substitution of materials or products, refer to the General Conditions.

PART 3 – EXECUTION

3.01 SERVICE INTERRUPTIONS, OFF-SITE, GAS AND WATER

- A. Schedule Work so there shall be no service interruptions of existing systems or systems during normal hours of operation of affected systems and facilities.
- B. When service interruptions are mandatory, arrange in advance with the OAR as to time and date of such interruptions.

- C. Systems, which are interrupted, shall be returned back into operation in such manner that they will function as originally intended.
- 3.02 CUTTING, NOTCHING, AND BACKING
- A. Conform to California Building Code, Title 24, Part 2, for notches and bored holes in wood and for pipes and sleeves embedded in concrete and for cuts in steel, as detailed on structural Drawings.
 - B. Where pipes or ducts pass through, or are located within one inch of any construction element, install a resilient pad, 1/2 inch thick minimum, to prevent contact.
 - C. Furnish all necessary provisions for recesses, chases, and accesses and provide blocking and backing as necessary for proper reception and installation of mechanical Work.
- 3.03 LOCATION OF PIPING AND EQUIPMENT
- A. Location of piping, apparatus and equipment as indicated on Drawings is approximate and shall be altered to avoid obstructions, preserve headroom, and provide free and clear openings and passageways.
 - B. Trenches parallel to footings shall not be closer than 18 inches to the face of footings and shall not be below a plane having a downward slope of 2 horizontal to one vertical, from a line 9 inches above bottom of footing.
 - C. Pipe in tunnels shall be installed close to one side of tunnel to provide maximum space for passage. Pipe shall not be installed through crawl hole unless otherwise specified or detailed on Drawings.
 - D. Place equipment in locations and spaces indicated, disassemble and/or reassemble equipment as required by Project conditions.
- 3.04 TESTS AND TESTING
- A. Tests shall be as required under the applicable sections of Division 23, including this Section.
 - B. Tests required by other sections of the Contract Documents include the following:
 - 1. Test and balance of mechanical equipment and systems: Refer to Section 01 4525: Testing, Adjusting, and Balancing for HVAC.
 - 2. Hydrostatic test of boilers: Refer to Section 01 4525: Testing, Adjusting, and Balancing.
 - 3. Test of smoke and fire detectors: Refer to Division 26: Electrical.
 - C. Additional tests may be required in the case of products, materials, and equipment if:
 - 1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.
 - 2. Performance testing and results may also be required on certain items which are as specified, including fan, and pump performance.
 - D. Piping Tests:
 - 1. Perform tests required to demonstrate that operation of mechanical systems and their parts are in accordance with Specifications covering each item or system, and furnish materials, instruments and equipment necessary to conduct such tests. Tests shall be performed in presence of the Project Inspector, and

representatives of any governmental agency having jurisdiction. Work shall not be concealed or covered until required results are provided.

2. If required tests are not performed, Owner may provide in accordance with the Contract Documents.
3. Pressure gages furnished in testing shall comply with CPC. Air shall be bled from lines requiring hydrostatic or water tests.
4. Systems shall be pressure-tested in accordance with pipe testing schedule below. Pipe test shall indicate no loss in pressure after a minimum duration of 4 hours at test pressures indicated. Where local codes require higher test pressures than specified herein for fire sprinkler systems, local codes shall govern.
5. Fuel gas lines shall be first tested with piping exposed, before backfilling trenches or lathing; second with piping in finished arrangement, backfilled and paved where required, and walls finished.
6. Refrigerant piping may be tested with a halide detector or calibrated electronic testing equipment.
7. Piping systems may be tested as a unit or in sections, but entire system shall successfully meet requirements specified herein, before final testing by the Project Inspector.
8. Repair of damage to pipes and their appurtenances or to any other structures resulting from or caused by these tests, shall be provided.

E. Pipe Testing Schedule:

System Tested	Test Pressure (psig)	Test With:
Steam piping, hot water heating system piping and chilled water piping	150	Water
Vacuum pump or condensate pump discharge and condensate return piping	150	Water
Refrigeration piping		
R-22	400	Dry nitrogen
R-134a	300	Dry nitrogen
R-401a	300	Dry nitrogen
R-401b	300	Dry nitrogen
R-404a	500	Dry nitrogen
R-407c	500	Dry nitrogen
R-410a	600	Dry nitrogen
R-507	500	Dry nitrogen
Radiant panel piping	150	Water

F. Equipment Performance Assurance Tests:

1. Before operating any equipment or systems, a thorough check shall be performed to determine that systems have been flushed and cleaned as required and that equipment has been properly installed, aligned, lubricated, and serviced. Factory instructions shall be checked to verify installations have

been completed and recommended lubricants have been installed in bearings, gearboxes, crankcases, and similar equipment. Particular care shall be furnished in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Equipment shall also be checked for damage that may have occurred during shipment, after delivery, or during installation. Damaged equipment, products, and materials shall be replaced or repaired as required.

2. Upon completion of the above, adjust the system settings to within normal operating conditions to prevent the system from being damaged upon start-up.
3. Run-test the equipment after start-up for five consecutive days. Tests shall include operation of heating, ventilating, and air conditioning equipment and systems for a period of not less than two 8 hour periods at 90 percent of the full specified heating and cooling capacities. If equipment passes, install new filters. If equipment fails, it shall be adjusted and retested until system meets all applicable codes.
4. Equipment Start-up Reports: For each equipment or system on which start-up is performed, submit 8 copies of start-up report for review by the Architect.
 - a. The start-up report shall include the manufacturer's standard start-up form completed and signed by the start-up technician.
5. Provide, maintain, and pay costs for equipment, instruments, and operating personnel as required for specified tests.
6. Provide electric energy and fuel required for tests.
7. Final adjustment to equipment or systems shall meet specified performance requirements.
8. Equipment, systems, or Work deemed defective during testing shall be replaced or corrected as required. Test until satisfactory results are provided.

G. Specific Coordinated Plan for Test and Balance:

1. Provide a narrative of the operational intent that clearly describes the function and sequence of operation of each component, equipment, or system installed. Instruct designated Owner personnel in the operation of the installed systems.
2. Prior to final test and balance, mechanical equipment and systems shall be operated and tested as indicated in Paragraph 3.04.F above to demonstrate satisfactory overall operation of the installed systems.
3. Immediately before starting tests, air filter media shall be cleaned or renewed. Roll-type filters shall be advanced to provide new clean media. Cleanable type media shall be thoroughly cleaned and re-oiled with new, clean oil as recommended by manufacturer if they are of viscous impingement type. Disposable type filters shall be replaced with new filters. Replaceable media shall be replaced with new media.
4. An accurate means of measuring air flow and temperatures shall be furnished to balance air supply, return, and exhaust systems so uniform temperatures occur in every room and design airflow is obtained through registers, diffusers, and grilles.
5. Systems shall be adjusted to provide airflows indicated including maximum fresh air and maximum return air. Dampers shall be checked for proper settings

and operation. Air and water inlet and leaving temperatures at coils shall be checked. Complete operational data including airflows, room temperatures, fan speeds, motor currents, plenum, and duct static pressures shall be tabulated.

6. Welding performed as part of this Division may be subject to radiographic inspections at random in accordance with requirements specified in Section 23 0513: Basic HVAC Materials and Methods.

3.05 NOISE AND VIBRATION REDUCTION

- A. Correct noise or vibration caused by mechanical systems. Provide all necessary adjustments to specified and installed equipment and accessories to reduce noise to the lowest possible level
- B. Correct noise or vibration problems caused by failure to install work in accordance with Contract Documents. Include all labor and materials required as a result of such failure. Pay for re-testing of corrected noise or vibration problems by the project acoustical consultant including travel, lodging, test equipment expenses, etc.

3.06 PROTECTION, CARE AND CLEANING

- A. In addition to storage criteria of the General Conditions, and provisions under Section 01 5000: Construction Facilities and Temporary Controls, the following shall be provided:
 1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.
 2. Protect installed Work.
 3. Replacements: In case of damage, immediately provide repairs and/or replacements as required.
 4. Protect covering for bearings, open connections to tanks, pipe coils, pumps, compressors and similar equipment.
 5. Interior of ductwork shall be maintained free of dirt, grit, dust, loose insulation, and other foreign materials.
 6. Air handling equipment shall not be operated until building is cleaned and air filters are installed.
 7. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.
 8. Before initial start-up and again before Substantial Completion, piping shall be drained and flushed to completely remove grease and foreign matter. Pressure regulating assemblies, traps, strainers, boilers, flush valves, and similar items shall be thoroughly cleaned. Tag system with an information tag listing responsible party and date of element, before initial start-up and again before Substantial Completion. Compressed air, oil, and gas piping shall be blown out with oil-free compressed air or inert gas. Refrigerant piping shall be cleaned as specified.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- a. This Section includes the following hangers and supports for HVAC 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.
- b. Related Sections include the following:
 - 1) Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2) Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
 - 3) Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 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."

1.4 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.

1.5 SUBMITTALS

- a. Product Data: For the following:
 - 1) Steel pipe hangers and supports.
 - 2) Thermal-hanger shield inserts.
 - 3) Powder-actuated fastener 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.
 - 4) Equipment supports.
- c. Welding certificates.

1.6 QUALITY ASSURANCE

- a. Welding: Qualify procedures and personnel according to the following:
 - 1) AWS D1.1, "Structural Welding Code--Steel."
 - 2) AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 3) AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 4) ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- a. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1) Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPE HANGERS AND SUPPORTS

- a. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- b. Manufacturers:
 - 1) AAA Technology & Specialties Co., Inc.
 - 2) Bergen-Power Pipe Supports.
 - 3) B-Line Systems, Inc.; a division of Cooper Industries.
 - 4) Carpenter & Paterson, Inc.
 - 5) Empire Industries, Inc.
 - 6) ERICO/Michigan Hanger Co.
 - 7) Globe Pipe Hanger Products, Inc.
 - 8) Grinnell Corp.
 - 9) GS Metals Corp.
 - 10) National Pipe Hanger Corporation.
 - 11) PHD Manufacturing, Inc.
 - 12) PHS Industries, Inc.
 - 13) Piping Technology & Products, Inc.
 - 14) Tolco Inc.
- c. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- d. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- e. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- a. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- a. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- b. Manufacturers:
 - 1) B-Line Systems, Inc.; a division of Cooper Industries.
 - 2) ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - 3) GS Metals Corp.
 - 4) Power-Strut Div.; Tyco International, Ltd.
 - 5) Thomas & Betts Corporation.
 - 6) Tolco Inc.
 - 7) Unistrut Corp.; Tyco International, Ltd.
- c. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- d. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- a. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- b. Manufacturers:
 - 1) Carpenter & Paterson, Inc.
 - 2) ERICO/Michigan Hanger Co.
 - 3) PHS Industries, Inc.
 - 4) Pipe Shields, Inc.
 - 5) Rilco Manufacturing Company, Inc.
 - 6) Value Engineered Products, Inc.
- c. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

- d. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- e. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- f. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- a. **Powder-Actuated Fasteners: Threaded-steel stud**, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- 1) Manufacturers:

- a) Hilti, Inc.
- b) ITW Ramset/Red Head.
- c) Masterset Fastening Systems, Inc.
- d) MKT Fastening, LLC.
- e) Powers Fasteners.

- b. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- 1) Manufacturers:

- a) B-Line Systems, Inc.; a division of Cooper Industries.
- b) Empire Industries, Inc.
- c) Hilti, Inc.
- d) ITW Ramset/Red Head.
- e) MKT Fastening, LLC.
- f) Powers Fasteners.

2.7 MISCELLANEOUS MATERIALS

- a. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

- b. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1) Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2) Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- a. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- b. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- c. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- d. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- e. Use padded hangers for piping that is subject to scratching.
- f. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1) Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2) Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 3) Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 - 4) Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 5) Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 - 6) Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 7) Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.

- 8) Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 - 9) Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 - 10) Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 - 11) U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 - 12) Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 13) Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 14) Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 - 15) Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- g. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1) Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 2) Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
- h. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1) Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2) Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 - 3) Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4) Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

- 5) Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6) C-Clamps (MSS Type 23): For structural shapes.
 - 7) Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 8) Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 9) Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 - 10) Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 - 11) Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 - 12) Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a) Light (MSS Type 31): 750 lb.
 - b) Medium (MSS Type 32): 1500 lb.
 - c) Heavy (MSS Type 33): 3000 lb.
 - 13) Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 14) Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 - 15) Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- i. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1) Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2) Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3) Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- j. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

- 1) Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2) Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 3) Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 4) Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5) Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 - 6) Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
- k. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

3.2 HANGER AND SUPPORT INSTALLATION

- a. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- b. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1) Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2) Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- c. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- d. Fastener System Installation:
 - 1) Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

- 2) Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- e. Pipe Stand Installation:
- 1) Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2) Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- f. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- g. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- h. Install lateral bracing with pipe hangers and supports to prevent swaying.
- i. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- j. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- k. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- l. Insulated Piping: Comply with the following:
- 1) Attach clamps and spacers to piping.
 - a) Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b) Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c) Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

- 2) Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 3) Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 4) Shield Dimensions for Pipe: Not less than the following:
 - a) NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
- 5) Insert Material: Length at least as long as protective shield.
- 6) Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- a. Factory fabricated roof curbs.

3.4 METAL FABRICATIONS

- a. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- b. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- c. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and 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) Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- a. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- b. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches

3.6 PAINTING

- a. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1) Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- b. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- c. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 05 48

HVAC SOUND, VIBRATION AND SEISMIC CONTROL

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Reduction or elimination of excessive noise or vibration within building due to operation of equipment, machinery, piping, and ductwork as specified.
 - 1. Vibration isolators.
 - 2. Seismic restraint devices.
 - 3. Duct silencers.
 - 4. Acoustic housings.
 - 5. Lining and enclosing ductwork.
 - 6. Acoustic louvers.
 - 7. Sound attenuation boots at supply, return, exhaust and transfer air inlets, outlets and openings.
 - 8. Flexible ducts, conduits and piping.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 01 4525: Testing, Adjusting, and Balancing for HVAC.
 - 3. Section 23 0500: Common Work Results for HVAC.
 - 4. Section 23 2013: HVAC Piping.
 - 5. Section 23 3000: Air Distribution.
 - 6. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 GENERAL REQUIREMENTS

- A. Provide vibration isolators to eliminate or reduce the transmission of vibration noise to any part of building and mitigate vibration frequency and load imposed by equipment. Vibration isolators, base frames, inertia bases and seismic restraints shall be of sufficient size, flexibility and load distribution configuration to assure that deflection, stability and seismic restraint requirements are met without permitting excessive movement when starting. For typical units, no fewer than four isolators shall be

provided. Isolators shall be provided to deflect uniformly under operating gravity and equipment thrust loadings to within plus or minus 10 percent of specified deflection values.

- B. Static deflections specified are based on the anticipated equipment characteristics. In the event the equipment proposed by the Contractor has characteristics other than those indicated, particularly the rated rpm, the static deflection shall be re-evaluated and the proper mountings and other devices shall be provided.
- C. Where fabricated vibration isolator units are indicated, furnish manufacturer's standard catalog products with printed loading ratings or certified submittals
- D. Seismic Requirements:
 - 1. Refer to Seismic Restraint Manual: Guidelines for Mechanical Systems, published by SMACNA and approved by DSA, for minimum seismic restraints required on mechanical components design and construction details.
 - 2. Provide seismic restraints for mechanical equipment or components specified. Where equipment is specified with proprietary names, design for seismic restraints is for first proprietary name listed.
 - 3. Provide restraints, bracing and anchorage as required for the mechanical equipment, electrical equipment and components specified in the Contract Documents. Restraints, bracing and anchorage shall be installed to resist the total design earthquake or wind loads in any direction in accordance with CBC and SMACNA guidelines.
 - 4. Provide restraints, bracing, and anchorage for the mechanical equipment and components.
 - 5. For ductwork and other mechanical equipment restraints, comply with SMACNA Seismic Restraint Manual: Guidelines for Seismic Mechanical Systems and obtain approval by DSA.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01.
 - 1. Catalog cuts and data sheets on specific vibration isolators, seismic restraints, and anchors demonstrating compliance with the Specifications.
 - 2. Shop Drawings for each piece of equipment including dimensions, structural member size, support point, vibration, and seismic restraints.
 - 3. Written approval of frame design to be furnished by the equipment manufacturer.
 - 4. Drawings indicating methods for suspension, support, seismic restraints, guides, etc., for piping, ductwork, etcetera.

5. Drawings indicating methods for isolation of pipes, ducts etcetera, piercing slabs, beams, etcetera.
- B. Vibration Test Reports: At completion of installation, submit the following documents. Submission of these documents must be complete before final acceptance of vibration isolation systems is given. Assistance from the vibration isolation equipment Manufacturer may be required.
1. Complete tabulation showing for each vibration isolator:
 - a. Actual static deflection measured at the project.
 - b. Specified minimum static deflection.
 2. Report certifying:
 - a. Each piece of operative rotating mechanical equipment does not exceed the specified vibration displacement level.
 - b. Each piece of isolated equipment or equipment component (ducts, pipes, conduit, etcetera) is not short-circuited by any means.
 - c. Requirements of Part 2 are satisfied for equipment.

1.04 QUALITY ASSURANCE

- A. Standards and Codes: Comply with applicable codes and standards having jurisdiction including, but not limited to:
1. NFPA, Pamphlet 13.
 2. ASHRAE Handbook: HVAC Systems and Equipment.
 3. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems.
 4. California Building Code.
 5. VISCMA
 - a. Installing Seismic Restraints for Mechanical Equipment.
 - b. Installing Seismic Restraints for Duct and Pipe.
- B. Qualifications of Manufacturer and Installers: Comply with provisions as set forth in Section 23 0500: Common Work Results for HVAC.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Furnish and install vibration dampers, sound isolation pads, flexible connections and similar equipment required to prevent sound of water flowing in pipes, vibration of motors, and motor operated equipment from being transmitted to building structure; and, in case of fans, from being transmitted along ducts. Piping shall be isolated from vibrating equipment by furnishing required flexible connectors.
- B. Pumps and similar motor operated equipment shall be installed on anti-vibration units.
- C. Fans, except curb-mounted roof-type exhaust fans and wall mounted propeller fans, shall be installed with anti-vibration units, whether indicated on Drawings or not. Fans built into air handling units may be furnished with independent anti-vibration mountings or whole unit may be installed on an external vibration isolation system.
- D. Other equipment shall be installed on anti-vibration bases, pads, or hangers, unless specifically noted otherwise on Drawings. Package units, furnished with built in anti-vibration bases, do not require unit bases unless otherwise specified.
 - 1. Unless specified otherwise, anti-vibration bases shall be Mason Industries, M.W. Sausse & Co., the VMC Group, or equal, of the Model Number specified or indicated on the drawings. Furnished base including sub-base, shall be manufactured by same company with fan and integral motor base. Seismic restraints may be incorporated into bases or furnished separately.
 - 2. Inertia anti-vibration bases shall conform to requirements indicated.
 - 3. Unless noted otherwise, furnished anti-vibration bases, including supporting units for inertia bases, shall be of the spring type.
 - 4. Selection of bases or supporting units shall be in accordance with manufacturer's recommendations based on following installed minimum effective isolation efficiencies (where not provided with each piece of equipment):

a. Centrifugal fans, packaged fan and coil units and cooling towers, less than 800 RPM	80 percent
b. Centrifugal fans over 800 RPM	90 percent
c. Centrifugal pumps	95 percent
d. Reciprocating compressors	95 percent
- E. Flexible duct connections shall be provided at inlet and outlets of each fan or HVAC unit, except curb-mounted roof exhaust fans whether indicated on the drawings or not.
- F. Flexible pipe or conduit connections shall be provided at piping and conduit connections to HVAC units, pumps, compressors and other moving (reciprocating or rotating) mechanical or electrical equipment provided under this Section whether indicated on the drawings or not.
- G. Flexible connections for Freon piping shall be seamless flexible metal hoses of type and length recommended by manufacturer and suitable for system operating pressure.

- H. Flexible connections for all other piping shall be flexible metal hose or spool type with flanged ends, unless otherwise specified. Metal hose shall be covered with protective braiding in areas where physical abrasion may occur, or for personnel safety.
- I. Spool types shall be similar to American Rubber Co., Mercer Rubber Co., PROCO Products, Inc., or equal, and hose types shall be similar to DME, Inc., U.S. Flex, Pennflex, Anaconda Flexpipe, Keflex, or equal with any required modifications to meet specified requirements. Flanges shall be furnished with steel retaining rings. Units installed on discharge side of pumps shall be furnished for a suitable working pressure of not less than 100 psig, and those on suction side for working pressures of 50 psig or 30 inches Hg vacuum.
- J. Units installed in cold water lines (less than 125 degrees F) shall furnish a minimum temperature rating of 180 degrees F and those installed in hot water lines (above 125 degrees F) shall be constructed of special heat resistant materials and be furnished for a minimum temperature rating of 220 degrees F, continuous operation. Units shall be able to withstand a maximum lateral deflection of 3/8 inch. Temperature and pressure ratings shall be molded into body of each spool unit so they are easily identified. Spool types shall be for straight in flow only.
- K. Spool type units shall be furnished with control units comprised of a minimum of two tie-rods and anchor plates or internal guide sleeves to prevent excessive elongation or misalignment. Rubber washers shall be provided under bolt heads and rubber grommets in bolt holes to prevent any metal to metal contact between bolts and flanges.
- L. Where hose type units are furnished, restraining anchors or braces shall be provided if excessive or undesirable pipe movement occurs when system is operated.

2.02 GENERAL PROPERTIES OF VIBRATION ISOLATORS.

- A. Shall be provided with markings so that, after adjustment, when carrying their load, deflection under load can be verified; thus determining that load is within proper range of device and that correct degree of vibration isolation is being provided according to the design.
- B. Isolators to operate in direct proportion to their load versus deflection curve. Load versus deflection curves shall be furnished by manufacturer and must be linear over a deflection range of 50 percent above design deflection.
- C. Wave motion through isolator shall be reduced to following extent: Isolation above resonant frequency shall follow theoretical prediction based upon an un-dampened single degree of freedom system with a minimum isolation of 50 decibels above 150 cycles per second.
- D. Vibration isolator spring diameters shall be no less than their deflected height. Furnish spring with a 50 percent overload safety factor.
- E. Unless otherwise indicated, equipment installed on vibration bases shall provide a minimum operating clearance of one inch between structural steel base and floor or

support base. Provide flexible connectors in piping and flexible conduit in power wiring to minimize transmission of vibration.

- F. Isolators and springs exposed to weather shall be hot-dipped galvanized or powder coated after fabrication and before installation. Hot-dipped zinc coating shall be not less than two ounces per square foot by weight complying with ASTM A123. In addition, provide limit stops to resist wind velocity.
- G. Where indicated, provide structural steel bases with height saving brackets, and minimum of three points of support. Isolators shall be furnished with a method for leveling.
- H. Design isolators and seismic restraints for positive anchorage against uplift and overturning.
- I. Provide and install, under this Section of the Specifications, structural steel required to properly support equipment and steel required to support horizontal thrust arrestors.

2.03 ISOLATOR TYPES

- A. Type A: Steel Spring Isolators: Un-housed steel spring isolators, laterally stable and unrestrained. Design springs so that ratio of horizontal to vertical spring (stiffness) constant is between 0.9 and 1.3. Natural frequency of isolator must be 1/3 to 1/4 of driving frequency that is to be controlled. Isolators to provide a minimum additional travel to solid equal to 50 percent of rated deflection. Isolators shall be furnished with built-in leveling bolts complete with sound isolation pads type B. Static deflection as specified.
- B. Type B: Sound Isolation Pad: Provide under each spring isolator a sound isolation pad, utilizing high quality durable neoprene pad material, loaded to 40 psi. Build sound pad up to 2 layers of 1/4 inch thick neoprene material; separate layers with a 16 gage galvanized sheet metal plate. Top layer shall provide a hardness of 40 durometers and the bottom layer shall be 40 durometers. Cold bond sound pads together and to isolator baseplate.
- C. Type C: Neoprene-in-Shear Isolators: Isolator shall be neoprene-in-shear type as recommended by manufacturer. Isolator shall provide a static deflection under rated load at 1/4 inch.

2.04 EQUIPMENT FRAMES

- A. Provide mounting frames and brackets to carry load of equipment without causing mechanical distortion or stress to the equipment.
- B. Type A Frame: Wide flange members, rigidized structural steel frame with brackets. Maximum allowable deflection at any point on load frame relative to unloaded frame shall be 0.005 inch. Members to be constructed of wide flange beams, with a depth of not less than 1/10 of length of span between isolators. Frame shall be M.W. Sausse & Co. type RMSB-W, as basis of design, or Mason Industries, Caldyn, or equal.

- C. Type B Frame: Channel members, rigidized structural steel frame with brackets. Frame to be constructed of channel steel with section depth equal to 1/10th length of longest structural member. Frame shall be M.W. Sausse & Co. type RMSB-C, as basis of design, or Mason Industries, Caldyn, or equal.
- D. Type C Frame: Steel gusset or bracket welded or bolted directly to machine frame in order to accommodate isolator. Frame shall be M.W. Sausse & Co. type RMSG, as basis of design, or Mason Industries, Caldyn, or equal.
- E. Type D Frame: Fabricated of rectangular channel steel forms for floating foundations to be filled with concrete on the Project site. Channel depth to be a minimum of 1/12th of longest dimension, but in no case less than 6 inches. Form shall include 1/2 inch reinforcing bars installed each way in a layer 1 1/2 inches above bottom and drilled steel members with sleeves mounted below holes to receive equipment anchor bolts. Weight of concrete and frame shall be two times or more than the weight of the unit it supports. Frame shall be M.W. Sausse & Co. type RMSBI, as basis of design, or Mason Industries, Caldyn, or equal.

2.05 MATERIALS AND CONSTRUCTION

- A. Duct Silencers: Provide factory fabricated duct silencers of tubular or rectangular type, for low or medium velocity service, with arrangements, sizes, and capacities as indicated on the Drawings.

1. Construction:

- a. Fabricate silencers of galvanized steel with casing seams sealed or welded to be airtight at a pressure differential of 8 inches water gage between inside and outside of unit, and stiffen or brace as necessary to prevent structural failure or deformation at same condition, or audible vibration during normal operation. Outer casings of rectangular silencer modules shall be made of 22 gage galvanized steel in accordance with ASHRAE Guide of recommended construction for high-pressure rectangular ductwork. Seams shall be lock formed and mastic filled. Outer casings of tubular silencers shall be made of galvanized steel in 18 to 22 gage. Internal acoustic elements of rectangular silencers shall incorporate integral die formed entry and exit to minimize pressure drop and self-noise. Interior partitions for rectangular silencers shall be fabricated of not less than 26 gage galvanized perforated steel. Interior construction of tubular silencers shall be compatible with the outside casings.
- b. Filler material shall comply with the following:
 - 1) Fire Safety Standards: NFPA 90A and NFPA 90B.
 - 2) Temperature: ASTM C411.
 - 3) Air velocity: ASTM C1071, UL 181.

- 4) Fire Hazard Classification: ASTM E84, UL 723-Class 1, NFPA 255.
 - 5) Corrosion Resistance: ASTM C739, C665.
 - 6) Fungi Resistance: ASTM G21.
 - 7) Water Vapor Sorption: ASTM C1104, less than 1 percent by weight.
 - 8) Formaldehyde, Phenolic Resins or other Volatile Organic Compounds: 0 percent.
- c. Airtight construction shall be provided by furnishing a duct sealing compound installed on the Project site. Silencers shall not fail structurally when subjected to a differential air pressure of 8 inches w.g. inside to outside of casing.
2. Acoustic Performance: Silencer ratings shall be determined in a duct-to-reverberant room test facility, which provides for airflow in both directions through the test silencer in accordance with ASTM Standard E477. The test facility shall be accredited by the National Voluntary Laboratory Accredited Program for the ASTM E477 test standard. Data from a non-accredited laboratory is not permitted. The test set-up and procedure shall eliminate effects due to end reflection, directivity, flanking transmission, standing waves, and test chamber sound absorption. Acoustic ratings shall include dynamic insertion loss (DIL) and self-noise (SN) power levels both for forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions). Data shall be for test silencers no smaller than the following cross-sections:

Rectangular, inches - 24 by 24, 24 by 30, or 24 by 36
Tubular, inches - 12, 24, 36, and 48

 - a. Noise reduction values (dynamic insertion loss) in decibels reference 10-12 watts, shall not be less than (of the model, size and length) indicated on Drawings.
 - b. Self generated noise in decibels reference 10 to 12 watts, shall not be more than of the model, size and length indicated on Drawings.
3. Aerodynamic performance: Airflow measurements shall be performed in accordance with ASTM specification E477 and applicable portions of ASME, Air Movement and Control Association (AMCA), and Air Diffusion Council (ADC) airflow test codes. Tests shall be reported on the identical units for which acoustic data is presented. Air pressure drops shall not exceed those (of the model, size and length) indicated on Drawings.
4. Certification: With submittals, provide certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance for reverse and forward flow test conditions. Test data shall be for a standard product.

Rating tests shall be conducted in the same facility, shall utilize the same silencer, and shall be open to inspection if required by the Architect.

5. Rectangular silencers shall be Industrial Acoustics Company of the model number indicated on the drawing, as basis of design, or Vibro-Acoustics, Dynasonics, SEMCO Silentair, TranSonics, Inc., or equal.
- B. Duct Liner: As indicated in Section 23 0700: HVAC Insulation.
- C. Flexible Ducts: As indicated in Section 23 0700: HVAC Insulation.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Provide isolators, flexible pipe connectors, flexible electrical conduit and flexible duct connectors at all moving mechanical system components to prevent transmission of vibration noise to any part of building whether indicated on the drawings or not.
- B. Install isolators to suit imposed load and the vibration frequency to be absorbed. Isolator units shall furnish adequate strength and flexibility to exhibit proper resiliency under machine load and impact without permitting excessive movement when starting.
- C. Where commercial vibration isolator and seismic restraint units are specified, furnish manufacturer's standard catalog products with printed loading ratings, or provide substantiating calculations.
- D. Install vibration isolators and seismic restraints in accordance with manufacturer's printed installation instructions.
- E. Where equipment is belt driven and motor is not installed on equipment, install motor and driven equipment on unitized support, and install entire support isolators. Unitized support to be provided with adjustable slide rails sized for motor weight and frequency. Support shall be Mason Industries type WF, M.W. Sausse & Co., type RMSF, Caldyn, or equal.
- F. Do not install any equipment, piping, conduit, ductwork, etc., that makes rigid contact with building or its structural members, unless reviewed by the Architect.
 1. Coordinate Work with other trades to avoid rigid contact with building.
 2. Correct, before installation, any conflict with other Work that would result in solid contact to equipment or piping due to inadequate space.
 3. Obtain inspection from the Project Inspector for concealed Work before enclosure.
 4. Notify manufacturer before installation of vibration isolation devices so that manufacturer may instruct and demonstrate technique for proper installation.

- G. The furnishing or installation of vibration isolators must not cause any change of position or alignment of equipment, ductwork, or piping, resulting in stresses in piping or ductwork, connections, or misalignment of shafts or bearings. Equipment, piping, and ductwork shall be maintained in a rigid position during installation. Load shall not be transferred to isolator until installation is complete and under full operational load.
- H. Air Compressors, Water Chillers, Pumps, Boilers with Integral Combustion Fans and Miscellaneous Equipment, mounted on roof or raised floors: Install each unit with its motor on a vibration isolated base utilizing type B frames, except where a type D frame is indicated on Drawings. Install steel support frame furnished by equipment manufacturer, utilizing equipment anchor bolt templates and isolator height saving brackets. Provide springs as specified for type "A" isolator; static deflection shall be a minimum of 2 inches.
- I. Fans (2000 rpm or higher) Air Compressors and Miscellaneous Equipment, mounted on grade: As specified for grade mounted boilers except furnish type C isolators.
- J. Boilers mounted on grade: Install each unit on concrete housekeeping pad with sound isolation pad designed for applicable equipment loading. Unit shall be fastened to housekeeping pad to prevent any movement.
- K. Air Handling, Air Conditioning Units, Floor Mounted Fans, and Cabinet-Installed Fans: Install entire casing including filters, mixing box, fan section, coil sections, etc., on a continuous, integral, structural steel base, as indicated. Furnish type A, B, or C frames, reinforced as necessary to prevent distortion of frame. Furnish isolator type A; static deflection shall be a minimum of 1 ½ inches.
- L. Suspended Fans and Air Conditioning Unit Fan Coils and Unit Ventilators: Suspend each integral unit from overhead structure on steel spring and elastomer hanger isolators. Support deflection under rated load of 3/8 inch. Provide spring static deflection as follows:

Fan RPM	Min. Deflection
200 – 400	3 inches
400 – 700	2 inches
Above 700	1 inches

- M. Pipe Isolation: Where indicated and as required, furnish and support each pipe from an isolator. Isolator for the first five support locations away from vibrating equipment shall have the same deflection as the equipment isolators. After that, isolators shall be a neoprene-in-shear type of size as recommended by manufacturer; except where indicated on Drawings, pipe hanger rod shall be furnished with a steel spring isolator and elastomeric element, with lower rod capable of 30 degrees total misalignment without contact on spring housing.
- N. Seismic Restraints: Floor or pad mounted equipment that do not require vibration isolators, shall be bolted to floor or other support. Floor mounted equipment with vibration isolators shall be provided with lateral and vertical restraining devices on all sides of base to restrict displacement of equipment. On all sides of suspended

equipment, provide bracing for rigid supports and provide aircraft cable restraints for resiliently supported equipment.

- O. Ductwork, duct acoustical lining, manual volume dampers and flexible ducts: Do not reduce length of duct runs, duct acoustical lining, manual volume dampers and flexible ducts for economy.
- P. Installation of flexible ducts at air inlets and outlets: Do not attach flexible ducts directly to air inlets and outlets unless a straight, smooth and uniform air flow can be achieved with sufficient space to make an elbow with a radius of at least three times the diameter of the duct. If sufficient space is not available to make such an elbow, provide a rigid elbow or a lined plenum.
- Q. Placement of Air Devices: Do not relocate air devices without the Architect's approval.

3.02 EXAMINATION

- A. Arrange for the services of a certified representative of isolation manufacturer to visit the Project site for inspecting installation of devices. In the event the isolators do not meet specified requirements perform necessary revisions. Submit a written report to the Architect, signed by above representative, indicating all devices are properly installed and are operating as specified or required by isolation manufacturer.

END OF SECTION

SECTION 23 05 53
HVAC IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Marking and identification required on mechanical piping systems, ducts, controls, valves, apparatus, etcetera.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 23 0900: HVAC Instrumentation and Controls.
 - 3. Section 23 3000: Air Distribution.
 - 4. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. Submit product data and installation instructions for each item specified.
- C. Submit Samples of materials.

1.03 QUALITY ASSURANCE

- A. Comply with provisions of:
 - 1. Section 23 0500: Common Work Results for HVAC.
 - 2. ANSI/ASME A13.1: Scheme for the Identification of Piping Systems.
 - 3. APWA: Uniform Color Code.

Or

 - 4. IAPMO: Uniform Plumbing Code (UPC).

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General: Piping systems, controls, valves, apparatus, etc., except those that are installed in inaccessible locations in partitions, walls, and floors, shall be permanently identified.

2.02 VALVES

- A. Furnish prepared chart or diagram for each piping system, indicating by identifying letter or model number of each valve in the system, its location, and function.
- B. Install charts in aluminum frame with clear glass front and secure on wall where designated by the Project Inspector.
- C. Bind copies of each chart in operating instructions manual.
- D. Provide each valve with a brass, aluminum, or plastic disc, not less than 1-1/4 inches diameter bearing engraved numbers corresponding to those indicated on chart. Fasten discs to valve with No. 14 brass wire.
- E. Provide an additional tag for safety valves and other valves that could be hazardous to safety and health of occupants. Distinguish these tags from regular valve tags by color (such as yellow with black letters, and marked "Danger"); submit Sample tag to the Architect for review.

2.03 INSTRUMENTS AND CONTROLS

- A. Identify panel-mounted instruments and controls with engraved bakelite nameplates permanently affixed to panel boards.
- B. Identify alarm indicating devices and alarm reset devices by nameplates.
- C. Identify damper motors and automatic valves, flow switches, pressure switches, etc., with embossed aluminum or plastic tape affixed to controller, indicating service and setting.

2.04 EQUIPMENT

- A. Identify each major piece of equipment with engraved bakelite nameplates permanently affixed to the equipment, indicating the room numbers it services, Equipment identification designation shall be the same to its designation indicated on the "As-Built Drawings". Room numbers in the nameplates shall correspond to the final room numbers.

2.05 ABOVE GRADE PIPE IDENTIFICATION

- A. Identify pipes by means of colored labels with directional flow arrows and identification of the pipe content, in conformance to ANSI/ASME A13.1 or the UPC.
- B. Materials: Precoiled acrylic plastic with clear polyester coating, all-temperature, self-adhering, as manufactured by Brady, Brimar Industries, Seton, Stranco, Inc., or equal.
- C. Size:

Outside Diameter of Pipe or Insulation	Length of Color Field	Size of Letter
¾ to 1 ¼-inch	8-inch	½-inch
1 ½ to 2-inch	8-inch	¾-inch
2 ½ to 6-inch	12-inch	1 ¼-inch"
8 to 10-inch	24-inch	2 ½-inch"
over 10-inch	32-inch	3 ½-inch

D. Colors: As indicated in schedule.

E. Locations:

1. On accessible piping, whether insulated or not (including mechanical rooms, attic and ceiling spaces); except that labels shall be omitted from piping where contained material is obvious due to its connection to fixtures (such as faucets, water closets, etc.).
2. Near each valve and branch connection in such accessible piping.
3. At each pipe passage through wall or floor.
4. At not more than 20 feet spacing on straight pipe run between bands required in 2 and 3 above.
5. At each change in direction.

F. Application: Install on clean surfaces free of dust, grease, oil, or any material that will prevent proper adhesion. Replace non-adhering or curling labels with new labels, as required by the Project Inspector.

G. Schedule:

Content of Pipe	Legend	Background Color	Lettering Color
Air conditioning condensation drain	A/C condensate drain	Green	White

2.06 IDENTIFICATION OF AIR CONDITIONING EQUIPMENT

- A. Provide identification markers to locate air conditioning equipment above T-bar ceilings. Install 3/4 inch to one inch diameter colored self-adhesive dots to T-bar ceiling grid indicating point of access. The following identification markers shall be recorded on the project record documents:

1. Fire Damper and Combination Fire/Smoke Fire Damper: Red.
2. Manual Volume Dampers, Relief Dampers, Motorized Volume Dampers: Blue.
 - a. Supply air: Full dot.
 - b. Return air: Half dot.
3. Fan coil unit: Green.
4. Filter Location if separate from fan coil: Yellow.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Correct detrimental conditions prior to commencing the Work of this Section. Install markers and identification tags as specified with materials and installation procedures recommended by manufacturer.
- B. Place tracer wire on top of non-metal utility lines allowing some slack. Do not wrap tracer wire around pipe. Fasten tracer wire in place at approximately 10 feet on centers with non-metal ties.
- C. Install underground detectable pipe marking tape continuously buried 8 to 10 inches above the buried utility pipe. Wrap tape on pipe risers up to a height of 12 inches above grade.

3.02 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- a. This Section includes TAB to produce design objectives for the following:
 - 1) Vibration measuring.
 - 2) Verifying that automatic control devices are functioning properly.
 - 3) Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

- a. Adjust: To regulate air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- b. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- c. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- d. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- e. NC: Noise criteria.
- f. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- g. RC: Room criteria.
- h. Report Forms: Test data sheets for recording test data in logical order.
- i. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

- j. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- k. TAB: Testing, adjusting, and balancing.
- l. Terminal: A point where the controlled medium, such as air, fluid or energy, enters or leaves the distribution system.
- m. Test: A procedure to determine quantitative performance of systems or equipment.
- n. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

- a. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- b. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of the Contract Documents review report as specified in Part 3.
- c. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- d. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- e. Sample Report Forms: Submit two sets of sample TAB report forms.
- f. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

- a. TAB Firm Qualifications: Engage a TAB firm certified by AABC.
- b. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
 - 1) Agenda Items: Include at least the following:
 - a) Submittal distribution requirements.

- b) The Contract Documents examination report.
 - c) TAB plan.
 - d) Work schedule and Project-site access requirements.
 - e) Coordination and cooperation of trades and subcontractors.
 - f) Coordination of documentation and communication flow.
- c. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1) Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2) Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- d. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."
- e. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."
- f. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 - 1) Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 PROJECT CONDITIONS

- a. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- a. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- b. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- c. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- a. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1) The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2) Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 EXAMINATION

- a. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1) Contract Documents are defined in the General and Supplementary Conditions of Contract.
 - 2) Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- b. Examine approved submittal data of HVAC systems and equipment.
- c. Examine Project Record Documents described in Division 01 Section "Project Record Documents."
- d. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- e. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems,"

Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

- f. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- g. Examine system and equipment test reports.
- h. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- i. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- j. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- k. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- l. Examine equipment for installation and for properly operating safety interlocks and controls.
- m. Examine automatic temperature system components to verify the following:
 - 1) Dampers, and other controlled devices are operated by the intended controller.
 - 2) Dampers are in the position indicated by the controller.
 - 3) Integrity of dampers for free and full operation and for tightness of fully closed and fully open positions.
 - 4) Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 5) Sensors are located to sense only the intended conditions.
 - 6) Sequence of operation for control modes is according to the Contract Documents.
 - 7) Controller set points are set at indicated values.
 - 8) Interlocked systems are operating.

- 9) Changeover from heating to cooling mode occurs according to indicated values.
- n. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- a. Prepare a TAB plan that includes strategies and step-by-step procedures.
- b. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1) Permanent electrical power wiring is complete.
 - 2) Automatic temperature-control systems are operational.
 - 3) Equipment and duct access doors are securely closed.
 - 4) Balance, smoke, and fire dampers are open.
 - 5) Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 6) Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- a. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" and this Section.
- b. Cut insulation, ducts, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- c. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- d. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 PROCEDURES FOR MOTORS

- a. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1) Manufacturer, model, and serial numbers.
 - 2) Motor horsepower rating.
 - 3) Motor rpm.
 - 4) Efficiency rating.
 - 5) Nameplate and measured voltage, each phase.
 - 6) Nameplate and measured amperage, each phase.
 - 7) Starter thermal-protection-element rating.
- b. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.5 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- a. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- b. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- c. Measure outside-air, wet- and dry-bulb temperatures.

3.6 PROCEDURES FOR VIBRATION MEASUREMENTS

- a. Use a vibration meter meeting the following criteria:
 - 1) Solid-state circuitry with a piezoelectric accelerometer.
 - 2) Velocity range of 0.1 to 10 inches per second.
 - 3) Displacement range of 1 to 100 mils.
 - 4) Frequency range of at least 0 to 1000 Hz.
 - 5) Capable of filtering unwanted frequencies.
- b. Calibrate the vibration meter before each day of testing.

- 1) Use a calibrator provided with the vibration meter.
- 2) Follow vibration meter and calibrator manufacturer's calibration procedures.
- c. Perform vibration measurements when other building and outdoor vibration sources are at a minimum level and will not influence measurements of equipment being tested.
 - 1) Turn off equipment in the building that might interfere with testing.
 - 2) Clear the space of people.
- d. Perform vibration measurements after air and water balancing and equipment testing is complete.
- e. Clean equipment surfaces in contact with the vibration transducer.
- f. Position the vibration transducer according to manufacturer's written instructions and to avoid interference with the operation of the equipment being tested.
- g. Measure and record vibration on rotating equipment over 3 hp.
- h. For equipment with vibration isolation, take floor measurements with the vibration isolation blocked solid to the floor and with the vibration isolation floating. Calculate and report the differences.
- i. Inspect, measure, and record vibration isolation.
 - 1) Verify that vibration isolation is installed in the required locations.
 - 2) Verify that installation is level and plumb.
 - 3) Verify that isolators are properly anchored.
 - 4) For spring isolators, measure the compressed spring height, the spring OD, and the travel-to-solid distance.

3.7 TEMPERATURE-CONTROL VERIFICATION

- a. Verify that controllers are calibrated and commissioned.
- b. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- c. Record controller settings and note variances between set points and actual measurements.
- d. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

- e. Check free travel and proper operation of control devices such as damper and valve operators.
- f. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- g. Check the interaction of electrically operated switch transducers.
- h. Check the interaction of interlock and lockout systems.
- i. Check main control supply-air pressure and observe compressor and dryer operations.
- j. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or non-grounded power supply.
- k. Note operation of electric actuators using spring return for proper fail-safe operations.

3.8 TOLERANCES

- a. Set HVAC system airflow rates within the following tolerances:
 - 1) Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 - 2) Air Outlets and Inlets: 0 to minus 10 percent.

3.9 REPORTING

- a. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- b. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.10 FINAL REPORT

- a. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

- b. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1) Include a list of instruments used for procedures, along with proof of calibration.
- c. Final Report Contents: In addition to certified field report data, include the following:
 - 1) Manufacturers' test data.
 - 2) Field test reports prepared by system and equipment installers.
 - 3) Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- d. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1) Title page.
 - 2) Name and address of TAB firm.
 - 3) Project name.
 - 4) Project location.
 - 5) Architect's name and address.
 - 6) Engineer's name and address.
 - 7) Contractor's name and address.
 - 8) Report date.
 - 9) Signature of TAB firm who certifies the report.
 - 10) Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11) Summary of contents including the following:
 - a) Indicated versus final performance.
 - b) Notable characteristics of systems.
 - c) Description of system operation sequence if it varies from the Contract Documents.
 - 12) Nomenclature sheets for each item of equipment.
 - 13)

- 14) Notes to explain why certain final data in the body of reports varies from indicated values.
 - 15) Test conditions for fans and pump performance forms including the following:
 - a) Settings for outside-, return-, and relief-air dampers.
 - b) Conditions of filters.
 - c) Cooling coil, wet- and dry-bulb conditions.
 - d) Fan drive settings including settings and percentage of maximum pitch diameter.
 - e)
 - f) Settings for supply-air, static-pressure controller.
 - g) Other system operating conditions that affect performance.
- e. Vibration Measurement Reports:
- 1) Date and time of test.
 - 2) Vibration meter manufacturer, model number, and serial number.
 - 3) Equipment designation, location, equipment, speed, motor speed, and motor horsepower.
 - 4) Diagram of equipment showing the vibration measurement locations.
 - 5) Measurement readings for each measurement location.
 - 6) Calculate isolator efficiency using measurements taken.
 - 7) Description of predominant vibration source.
- f. Instrument Calibration Reports:
- 1) Report Data:
 - a) Instrument type and make.
 - b) Serial number.
 - c) Application.
 - d) Dates of use.
 - e) Dates of calibration.

3.11 INSPECTIONS

a. Initial Inspection:

- 1) After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
- 2) Randomly check the following for each system:
 - a) Measure airflow of at least 10 percent of air outlets.
 - b)
 - c) Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d) Measure sound levels at two locations.
 - e) Measure space pressure of at least 10 percent of locations.
 - f) Verify that balancing devices are marked with final balance position.
 - g) Note deviations to the Contract Documents in the Final Report.

b. Final Inspection:

- 1) After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner.
- 2) TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.
- 3) Owner shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
- 4) If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- 5) If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

- 6) TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
- 7) Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Condensate drain piping from air conditioning equipment.
2. Refrigerant piping.
3. Supply and return air ducts for heating and cooling systems air ducts.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 23 0500: Common Work Results for HVAC.
3. Section 23 0553: Mechanical Identification.
4. Section 23 3000: Air Distribution.
5. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. ASTM C167 - Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
2. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board.
3. ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation.
4. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
5. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
6. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

7. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 8. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
 9. ASTM D5116 - Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.
 10. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 11. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
 12. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 13. ASTM G22 - Standard Practice for Determining Resistance of Plastics to Bacteria.
- B. Underwriters Laboratories Inc.:
1. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.
 2. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.
- C. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems .
 2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 3. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
1. Complete material list of items to be furnished and installed under this Section.
 2. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements.

3. Shop Drawings, catalog cuts and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.
4. Display sample cutaway sections.
5. Manufacturer's recommended method of installation procedures, which will become part of this Section.

1.04 QUALITY ASSURANCE

- A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 23 0500: Common Work Results for HVAC and Section 23 0513: Basic HVAC Materials and Methods.
- B. Test Ratings:
 1. Comply with provisions stated under Section 23 0500 and 23 0513 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.
 2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.
 3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.
 4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.
- C. Regulatory Requirements: Insulation furnished and installed under this Section shall conform to the requirements of the California Building Code Parts 4, Mechanical Code, Part 5, Plumbing Code and Part 6, Energy Code.
- D. All chemically based products such as sealers, primers, fillers, adhesives, etc. shall meet the California air quality regulations.

1.05 PRODUCT HANDLING

- A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 23 0500: Common Work Results for HVAC and 23 0513: Basic HVAC Materials and Methods.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General:

1. Piping insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.
2. Piping insulating material shall be furnished with thickness indicated in Table 1, unless otherwise noted on the drawings, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.
3. Asbestos in any quantity in insulating material is not permitted.
4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:
 - a. Nylon anchors for installing insulation to ducts or equipment.
 - b. Treated wood blocks.
5. Flame-proofing treatments subject to moisture damage are not permitted.

TABLE 1 - MINIMUM PIPING INSULATION THICKNESS (1)

Insulation Thickness Required (in inches)
Space Heating Systems (Steam, Steam Condensate and Hot Water)

Piping System Type	Temp. Range (degrees F)	Run-outs up to 2 (2)	1 and less	1.25 to 2	2.5 to 4	5 to 6	8 and larger
Hi Pres Temp	Above 350	1.5	2.5	2.5	3.0	3.5	3.5
Med Pres Temp	251 to 305	1.5	2.0	2.5	2.5	3.5	3.5
Low Pres Temp	201 to 250	1.0	1.5	1.5	2.0	2.0	3.5
Hot Water	Up to 200	0.5	1.5	1.5	1.5	1.5	1.5
Steam Cond.	-	0.5	1.0	1.0	1.0	1.5	1.5

Service Water Heating Systems (recirculating, piping supply and return)

Hot Water	Up to 180	0.5	1.0	1.0	1.5	1.5	1.5
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Space Cooling Systems (Chilled water, Brine and Refrigerant)

Chilled Water	40-60	0.5	0.5	0.75	1.0	1.0	1.0
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Refrigerant/Brine	Below 40	1.0	1.0	1.5	1.5	1.5	1.5
Condensate Drain	½-inch Minimum insulation thickness.	0.5	0.5	0.5	0.5	0.5	0.5
From Air Conditioning Equipment:	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5	0.5	0.5

NOTES:

- (1) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.
 - (2) Run-outs to individual terminal units, not exceeding 12 feet in length.
- B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.
- C. Canvas Jackets: Furnish 6 ounce in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.
- D. Insulation Jackets:
1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16-inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.
 2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½-inch to 8-inch shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024-inch thickness. Insulated elbows with a nominal pipe size of 10 inches to 18 inches shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.
 3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation

Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.

- E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.
- F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or equal.

2.02 COOLING PIPING SYSTEM INSULATION

- A. General: Insulate chilled water supply and return piping and refrigerant piping.
- B. Materials:
 - 1. Classes of Insulation:
 - a. Class A: Expanded polystyrene pipe insulation, self-extinguishing type, either molded or extruded; Dow Chemical Co. STYROFOAM, ITW Insulation Systems XPS PIB, Foam-Control EPS, or equal.
 - b. Class B: Glass fiber molded pipe insulation ASTM C547. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, CertainTeed Snap-On, Owens Corning FIBERGLAS SSL II-ASJ, or equal.
 - c. Class C: Expanded (foamed) urethane (polyurethane) or polyisocyanurate pipe insulation of self-extinguishing type molded or fabricated, Dyplast Products, LLC ISO-C1/2.0, ITW Trymer, Specialty Products & Insulation Co. Polyisocyanurate Pipe Insulation, Armacell Armalok, or equal.
 - d. Class D: Foamed plastic pipe insulation, self-extinguishing type, ASTM C534 Type 1 - tubular. Pipe insulation shall be one-piece preformed, flexible tubing type and provide a maximum K factor of 0.28 at 75 degrees F mean temperature. Pipe insulation shall be Armacell Armaflex, Aeroflex Aerocel, Rubatex INSUL-TUBE 180, or equal.
 - 2. Locations and Class of Insulation Required: For thickness required, refer to Table 1 of this Section.

TABLE 3 – SERVICE, LOCATION AND CLASS OF INSULATION REQUIRED

<u>SERVICE</u>	<u>LOCATION</u>	<u>CLASS OF INSULATION</u>
Condensate drains from air conditioning equipment	Indoors at all locations including above ceilings and between stud walls	D
Refrigerant suction Liquid line as required	All locations except underground	D
All other piping, except underground	All locations except underground	A, B, C

3. Adhesives:

- a. Polystyrene adhesives: Synthetic rubber and resin adhesives specifically designed to adhere extruded and expanded rigid polystyrene and urethane insulation to themselves and to other porous and non-porous substrates.
- b. Vapor barrier laps and penetrations: Furnish protective coating and lagging adhesive on butt joints of foil-faced vapor barriers, and where pins and staples puncture facings.

2.03 DUCTWORK AND PLENUM INSULATION

- A. General: Insulate ductwork and plenums with not less than the amount of insulation tabulated in Table 4, unless noted otherwise on the drawings. Insulation may be omitted under the following conditions:
 1. Exposed return air ductwork in conditioned space.
 2. Return air ductwork between wall studs inside an interior wall.

TABLE 4 - INSULATION OF DUCTS AND PLENUM

<u>Duct Location</u>	<u>Insulation Type</u>
Exposed interior round and oval supply air ductwork located at Gyms and MPR Stages	DW-1
Exposed interior rectangular supply air ductwork located at Gyms and MPR Stages	L-1
In walls, within floor/ ceiling spaces	F-1 or L-1 See note 3
Hot and cold plenums	F-2, DW-1 or L-2 See note 3
Attics, Garages, and Crawl Spaces, within unconditioned space or in basement	F-3 or L-2 See note 3

B. Insulation Types:

1. DW-1: 1-inch thick insulation sandwiched inside double-wall type ducts and fittings.
2. DW-2: 2-inch thick insulation sandwiched inside double-wall type ducts and fittings. Duct joints shall be waterproofed.
3. F-1: 1½-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
4. F-2: 2-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
5. F-3: 3-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
6. L-1: 1½-inch Internal duct lining.
7. L-2: 2-inch Internal duct lining.

C. Notes:

1. Minimum insulation provided shall be as required by the current California Mechanical Code Title 24 for the most restrictive condition.
2. Refer to the materials indicated in this section for external insulation & Internal Lining.
3. External insulation shall be replaced with internal duct lining (of equivalent thermal resistance value unless noted otherwise) where indicated on the drawings or specified elsewhere for sound attenuation.

4. Provide internal duct lining (1 ½-inch unless noted otherwise) where indicated on the drawings or specified elsewhere for sound attenuation.
5. All exterior insulated ductworks shall be water proofed at joints, seams and duct penetrations.

D. Materials:

1. Fire-Resistive Insulation Materials and Coatings: Submit State Fire Marshal pre-approved materials only.
2. Adhesives: See Paragraph 2.01.E for applicable products.
3. External Insulation: Provide glass fiber blankets that are factory-laminated with Foil Reinforced Kraft (FRK) vapor barrier facing; Johns Manville Microlite, Owens-Corning SOFTR Duct Wrap, Knauf Insulation Friendly Feel Duct Wrap, or equal. Provide a minimum installed R value as required by the CEC Building Energy Efficiency Standards; but not less than scheduled on Table 5:

TABLE 5
INSULATION OF DUCTS AND PLENUM INSTALLED
THERMAL RESISTANCE "R" VALUES

Type	Labeled Thickness (in inches)	Installed R Value (hr.ft ² .°F/Btu)
F-1	1 ½	4.2
F-2	2	5.6
F-3	3	8.3
DW-1	1	4.2
DW-2	2	5.6
L1	1 ½	6.0
L2	2	8.0

4. Internal Lining: Internal Lining shall be of the type that inhibits the growth of mold, mildew and fungi and shall not contain harmful VOC's or contain glass fiber. Approved Material:
 - a. Polyester Duct Liner:
 - 1) Polyester duct liner shall be an engineered nonwoven, thermally bonded Polyester with a smooth and durable FSK facing.
 - 2) Polyester duct liner must be able to withstand a constant internal temperature up to 250°F must be compliant with Greenguard Environmental Institute and contain zero VOCs per ASTM D5116. Liner must comply with all

applicable standards including ASTM E84, ASTM C411, ASTM C518, ASTM G21, NFPA 90A and 90B, and UL 181.

- 3) Approved Manufacturer: Ductmate Industries "PolyArmor" duct liner or approved equal.
- b. Elastomeric duct liner:
- 1) Closed-cell, sponge- or expanded-rubber materials. Elastomeric liner must be able to withstand a constant internal temperature up to 300°F and must comply with all applicable standards including ASTM E84, ASTM E96, ASTM C209, ASTM C534 - Type II sheet materials, ASTM C411, ASTM C518, ASTM G21, ASTM G22, NFPA 90A and 90B, and UL 181.
 - 2) Approved Manufacturer: Armacell LLC "AP Armaflex FS" duct liner or approved equal.
- c. Duct liner must be attached per manufacturer's requirements using a non-flammable, low VOC water-based adhesive. When applicable, apply a non-flammable, low VOC water-based lagging adhesive to the exposed leading edge of the insulation. Install fasteners per SMACNA HVAC Duct Liner installation instructions.
- d. Duct liner must be installed per SMACNA Manual, "HVAC Duct Construction Standards, Metal and Flexible," Third Edition unless otherwise specified.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.
- B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.
- D. Pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where fire-stop or fire-safing materials are required.

- E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.
- F. Insulation shall not be installed in the following locations unless otherwise noted:
 - 1. On vacuum return lines less than 50 feet long.
 - 2. On unions, flanged connections or valve handles.
 - 3. Over edges of any manhole, clean-out hole, clean-out plug, access door or opening to a fire damper, so as to restrict opening or identification of access.
 - 4. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.02 INSTALLATION OF HEATING PIPING SYSTEM INSULATION

- A. General: Space heating hot water, domestic hot water, tempered water supply and return piping and condensate return piping, after having been tested, shall be cleaned and insulated.
- B. Application: Insulate condensate return piping, hot water heating supply and return piping, steam and steam condensate piping, domestic hot water supply and return, including tempered supply and return piping in accordance with manufacturer's instructions and as specified herein.
 - 1. Install insulation on valve bodies up to valve bonnet. Fill void in saddles, in accordance with Section 23 0513: Basic HVAC Materials and Methods, with insulation and seal joints.
 - 2. Install insulating material to fittings, valves, and strainers and smooth to thickness of adjacent covering. Leave strainer clean-out plugs accessible. Covers fabricated from polyvinyl chloride shall be furnished.
- C. Insulation Jackets in Exposed Indoor Locations:
 - 1. Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams 1-1/2-inch minimum. Finish entire jacket with coating of undiluted adhesive.
 - 2. Equivalent factory applied pre-sized, glass fiber reinforced, or glass fiber jackets may be furnished. Seal jacket seams with adhesive in accordance with manufacturer's instructions.
 - 3. Johns Manville Zeston 2000, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal, fitting covers may be furnished,

with molded or segmented insulation equal to specified insulation applied to fittings. Secure covers in accordance with manufacturer's instructions.

4. In addition to above requirements, cover exposed insulated piping within a distance of 8 feet above floors with 26 gage galvanized steel jacket. Omit jacket in areas accessible only to maintenance personnel, such as mechanical equipment rooms, utility corridors, accessible pipe tunnels and manholes.
- D. Concealed Indoor Locations: Cover insulation over fittings, valves, and strainers with canvas. Provide pipe insulation with factory or field applied standard jacket of 4-ounce minimum canvas, fiberglass cloth, or glass fiber reinforced jacket. Seal jacket laps with adhesive in accordance with manufacturer's instructions.
- E. Exposed Outdoors: In addition to canvas or fiberglass cloth cover, pipe insulation exposed to weather shall be provided with an additional 0.016-inch thick aluminum jacket with 2-inches lap connected with 1-inch hem overlap joint located on side of pipe and turned down to shed water. Jacket shall be strapped 12-inch on center with ½-inch wide stainless-steel strapping and wing seals. Aluminum jacket shall be mitered to fit fittings.

3.03 INSTALLATION OF COOLING PIPING SYSTEM INSULATION

- A. General: Chilled water supply and return piping, refrigerant piping and condensate drain lines, after having been tested, shall be cleaned and insulated.
- B. Application: Insulation on chilled water lines, refrigerant suction lines and liquid lines, if indicated, and air conditioner interior drain lines shall be jacketed with fire-resistant vapor barrier of laminated aluminum foil consisting of 2 plies with glass-yarn reinforcing. Jacket joints shall be lapped and sealed with an approved adhesive. Insulation shall be secured with aluminum bands not less than 0.005-inch thick by ¾-inches wide, spaced not over 12-inch on centers, or as recommended by manufacturer.
1. Longitudinal Seams: Butt hinged sections of covering tightly together and seal down jacket flap with adhesive, or with factory-applied, self-sealing lap with pressure-sensitive sealer protected with release paper.
 2. End Joints: Wrap joint with a 3-inch wide (minimum) self-sealing tape.
 3. Fittings and Valves: Fittings and valves shall be covered with same material of same thickness as pipe insulation, sealed with an approved, vapor-sealing tape or compound and covered with Johns Manville Zeston polyvinyl-chloride cover, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.
 4. Pipe hangers shall be insulated or attached to pipe by an insulating insert, butted between adjoining insulation sections.
- C. Additional Jackets:

1. Exposed Indoor Insulation: Cover with 26 gage galvanized sheet metal jacket to 8 feet above floors, except in mechanical equipment rooms and accessible pipe tunnels.
2. Exposed Outdoor Insulation: In addition to canvas or fiberglass cloth cover, provide 0.016-inch thick aluminum jacket with 1-inch wide aluminum bands and seals. Install appropriate jackets on valves and fittings.

3.04 INSTALLATION OF HIGH TEMPERATURE EQUIPMENT INSULATION

- A. General: Provide insulation over parts of heat exchangers and similar equipment requiring insulation having removable head or sections.
- B. Application:
 1. Equipment: Securely tie insulation on with copper clad wire. Install tack coat weather barrier coating at a thickness specified by manufacturer. While tack coat is still wet, a layer of 10 open weave glass cloth membrane shall be embedded with fabric seams overlapped a minimum of 2-inch. Install a finish coat fully covering membrane at coverage rate specified by manufacturer.
 2. Boiler Breechings: Wire securely V-rib wire lath, 3/4-inch minimum depth to boiler breechings, connections and stacks inside boiler rooms, and cover with insulation and jacket as specified above.
 3. Manholes and Hand Holes: Maintain accessible by beveling off permanent insulation around manhole and cover manhole plate with removable blanket.

3.05 INSTALLATION OF DUCTWORK AND PLENUM INSULATION

- A. External Covering:
 1. Before installing duct insulation, sheet metal ducts shall be clean, dry, and tightly sealed at joints and seams, inspected pressure tested, and accepted by OAR/ Inspector.
 2. Duct exterior insulation shall be firmly wrapped around ductwork with joints lapped a minimum of 2-inch. Insulation shall be securely fastened with 18 gage copper-lined steel wire, or 16 gage soft-annealed galvanized wire spaced approximately 12-inch on centers and at loose ends, presenting a neat and workmanlike appearance. Where duct width is such that wiring will not fasten insulation firmly against duct an adhesive shall be furnished to fasten insulation to duct with wiring being installed at ends of insulation segment.

3. Insulation on ductwork transporting conditioned air, both supply and return, and outside air intake ducts when pre-conditioned, shall be furnished with a factory-applied, fire-resistant vapor barrier.
4. Exposed Ducts or Plenum:
 - a. Install insulation to ducts or plenum furnished with butt joints, without voids and with adhesive over entire surface of duct. Cover insulation with canvas jacket, fastened tightly to insulation with lagging adhesive. Install 2 finish coats of undiluted adhesive.
 - b. When installing jacket, finished covering shall be even and level, without humps, with constant diameters on round ducts maintained.

B. Interior insulation - lining:

1. Dimensions of ducts indicated are net inside dimensions and must include thickness of duct liners to obtain the required duct size.
2. Install insulation in square turns, where required, to cover interior surfaces before duct turns are installed.
3. Install lining material during fabrication of duct with sealed face only exposed to air stream.
4. Interior insulation in ducts or plenums shall not have exposed edges. Edges open to entering or leaving air streams shall be covered, secured in place and sealed with approved duct liner edge sealers.
5. Insulation shall be fastened to sheet metal with an approved fire-retardant adhesive, with minimum 90 percent coverage and edges firmly adhered.
6. Mechanical fasteners shall supplement the adhesive on top sections of ducts more than 12-inch wide and on sides of ducts more than 24-inch high and shall be spaced on 16-inch centers maximum. Fastener posts shall be cut off approximately 1/4-inch from metal disc.

3.06 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.07 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 08 00
HVAC SYSTEMS COMMISSIONING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for Commissioning (Cx) of HVAC systems and equipment including installation, start-up, testing, documentation, and training according to the Construction Documents.
2. Standard procedures for the execution of commissioning work shall be in conformance with Division 01, Section 01 9113: General Commissioning Requirements. Coordinate work with the Commissioning Services Provider (CxSP).

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 01 4523: Testing and Inspection.
3. Section 01 4525: Testing, Adjusting, and Balancing for HVAC.
4. Section 01 7900: Maintenance and Operations Staff Demonstration and Training.
5. Section 01 9113: General Commissioning Requirements.
6. Section 23 0500: Common Work Results for HVAC.
7. Section 23 3000: Air Distribution.
8. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.
9. Section 26 0500: Common Work Results for Electrical.
10. Section 26 0513: Basic Electrical Materials and Methods.
11. Section 26 0519: Low Voltage Wires (600 Volt AC).
12. Section 26 0526: Grounding and Bonding.
13. Section 28 3149: Carbon Monoxide Detection and Alarm Systems.
14. Section 26 0586: Motors and Drives.
15. Section 26 0800: Electrical Systems Commissioning.
16. Section 26 2913: Adjustable Frequency Drives.
17. Project Commissioning Plan (CxP).

1.02 REFERENCES

A. Applicable codes, standards, and references: inspections and tests shall be in accordance with the following applicable codes and standards:

1. InterNational Electrical Testing Association – NETA.

2. National Electrical Manufacturers Association – NEMA.
3. American Society for Testing and Materials – ASTM.
4. Institute of Electrical and Electronics Engineers – IEEE.
5. American National Standards Institute – ANSI.
6. National Electrical Safety Code – NESC.
7. California Building Code – CBC.
8. California Electrical Code – CEC.
9. California Mechanical Code – CMC.
10. Insulated Cables Engineers Association – ICEA.
11. Occupational Safety and Health Administration – OSHA.
12. National Institute of Standards and Technology – NIST.
13. National Fire Protection Association – NFPA.
14. American Society of Heating and Air-Conditioning Engineers – ASHRAE
(The HVAC Commissioning Process, ASHRAE Guideline).
15. Associated Air Balance Council – AABC (National Standards for Total System Balance).

1.03 SUBMITTALS

- A. Submittals package shall include the following:
 1. Commissioning required submittals in accordance with Division 01 Specification Sections.
 2. Copy of the Architect's reviewed and accepted submittals to the CxSP via the OAR.
 3. List of team members who will represent the Contractor in the Pre-functional Equipment Checks (PEC) and Functional Performance Tests (FPT), at least six weeks prior to the start of Pre-functional Equipment Checks.
 4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, a copy of full details of Owner-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of Owner to keep Warranty in force clearly defined.
 5. Installation and checklist documentation shipped with equipment and field checklist forms to be used by factory or field technicians.
 6. Detailed manufacturer's recommended procedures and schedules for PECs, supplemented by Contractor's specific procedures, and FPTs, at least four weeks prior to the start of PEC.

1.04 MEETINGS, SEQUENCING AND SCHEDULING

- A. Meetings: Attend the Cx meetings as required under Section 01 9113 and Cx Plan.

- B. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Divisions 23 and 26 Sections has been successfully completed and tests, inspection reports, and Operation and Maintenance manuals required have been submitted and accepted. The start-up and PEC shall be completed and submitted to the Owner at least two weeks prior to beginning FPT.
 - 1. Coordinate HVAC work with the work of other trades prior to scheduling of any Cx procedures.
 - 2. Coordinate the completion of HVAC testing, inspection, and calibration prior to start of Cx activities.

1.05 QUALITY CONTROL

- A. Comply with Division 01 quality control specifications.
- B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this Section.
- C. Comply with Section 01 4525: Testing, Adjusting, and Balancing for HVAC.

1.06 EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

- A. Split Systems.
- B. Fan Coil Units.
- C. Single Package Gas Heating Electric Cooling Units.
- D. Variable Volume and Temperature System.
- E. Exhaust Fans.
- F. Ventilators.
- G. Water Heaters, Gas and Electric.
- H. Air Conditioning Units.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

- A. Equipment to be utilized in the commissioning process shall meet the following requirements:
 - 1. Provide test equipment as necessary for the testing of the equipment and systems to be commissioned.
 - 2. Provide testing equipment and accessories that are free of defects and certified for use.
 - 3. Provide testing equipment with current calibration labels as per NIST Standards.
 - 4. Equipment shall be calibrated on the manufacturer's recommended intervals with calibration tags affixed to the instrument. In the absence of calibration tags, calibration documentation shall be submitted to the CxSP

at least thirty days prior to use; this documentation shall include description and serial number of instrument and calibration data and date.

5. Testing equipment shall be maintained in good operating condition for the duration of the project.

PART 3 – EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

- A. Work to be performed prior to commissioning:
 1. Complete phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.
 2. If modifications or corrections to the installed system(s) are required to bring the system(s) to acceptance levels due to Contractor's incorrect installation or defective materials, such modifications shall be made at no additional cost to the Owner.
 3. Normal start-up services required to bring each system into full operational state:
 - a. Testing, motor rotation check, control sequences of operation, full and part load performance.
 - b. Commissioning shall not start until each system is complete and start-up has been performed.
- B. Pre-Commissioning responsibilities:
 1. Inspection, calibration and testing of the equipment required to commission the following systems:
 - a. HVAC System(s).
- C. Commissioning Process Requirements:
 1. Refer to Section 01 9113: General Commissioning Requirements and related Sections for information on meetings, start-up plans, Pre-Functional and FPT, operations and maintenance data, training requirements, and other Cx activities.

3.02 PREPARATION

- A. Provide certified HVAC technicians as required, with tools and equipment necessary to perform Cx activities specified.
- B. Provide certified testing agency personnel and equipment factory representatives as require in the Cx plan and other related Sections.
- C. Verify that work required in this Section and in Section 01 9113 is complete prior to starting of FPT.
- D. Verify that complete operational manuals have been reviewed and accepted by the CxSP as specified before starting FPT.

3.03 TESTING

- A. Testing procedures shall include the following minimum information:
1. Test number.
 2. Equipment used for the test, with manufacturer and model number and date of last calibration.
 3. Date and time of the test.
 4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
 5. Identification of the system, subsystem, assembly, or equipment.
 6. Conditions under which the test was conducted, including (as applicable); ambient conditions, set points, override conditions, status, and operating conditions that impact the results of the test.
 7. Systems and assemblies test results and performance and compliance with contract requirements.
 8. Issue number, if any, generated as the result of the test.
 9. Name(s) and signature(s) of witnesses and the person(s) performing the test.
- B. Contractor shall participate and perform Cx related testing requirements as specified.
- C. General Requirements for Mechanical, Controls, and Testing and Balance:
1. Construction and Acceptance Phases:
 - a. Provide assistance to CxSP in preparing FPT procedures specified. Sample test forms are included in the project Cx Plan.
 - b. Develop full startup and initial checkout plan using manufacturer's start-up procedures and Cx checklists for commissioned equipment. Submit to CxSP for review and approval prior to startup.
 - c. During startup and initial checkout process, execute mechanical-related portions of PEC for the equipment and systems to be commissioned.
 - d. Perform and clearly document completed startup and system operational checkout procedure. Providing four copies of the results to the Owner.
 - e. Resolve any open punch list items before FPT. Air testing and balance shall be completed with discrepancies and problems remedied before FPT of respective air -related systems.
 - f. Provide skilled technicians to execute starting of equipment and to execute PFT. Ensure that technicians are available and present during agreed upon schedules and for sufficient duration to complete necessary tests, adjustments, and solutions to identified problems.

- g. Maintain a log of events and issues of tests and related Cx activities. Submit handwritten reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests, and lists of completed tests as specified.
- h. Correct open issues and re-test as needed to prove compliance with system operational standards.
- i. Prepare Operation and Maintenance Manuals and provide training for the Owner maintenance personnel and end-users per Section 01 7900.
- j. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of Warranty and notify the Owner.
- k. Execute simulated seasonal FPT, witnessed by the Owner and the CxSP, as specified. Document results and perform corrections as needed for system acceptance and make necessary adjustments to Maintenance and Operations Manuals and Record Drawings.

3.04 SENSOR CALIBRATION

- A. Field-installed temperature, relative humidity, CO₂, pressure sensors, pressure gages, and actuators (dampers and valves) shall be calibrated using the methods described below. Calibration procedures shall be documented during execution of the Start-up and the PEC. Alternate methods may be used, if approved by the CxSP.
- B. Test instruments shall have had a NIST certified calibration within the last 12 months. Sensors installed in the unit at the factory with provided calibration certification need not be field calibrated.
- C. Sensors:
 - 1. Verify that sensor locations are appropriate and away from causes of erratic operation.
 - 2. Verify that sensors with shielded cable are grounded only at one end.
 - 3. For sensor pairs that determine a temperature difference, make sure they are reading within 0.2 degrees F of each other.
 - 4. For sensor pairs that determine a pressure difference, make sure they are reading within 2 percent of each other.
 - 5. Calibration: Put the equipment in operation. Make a reading with a calibrated test instrument within six inches of the site sensor. Verify that the sensor reading (via the permanent thermostat or gage) is within the tolerance listed in the table below of the instrument-measured value. If not, calibrate or replace sensor.
 - 6. Tolerances:

Sensor

Required Tolerance (+/-)

AHU wet bulb or dew point	2.0 degrees F
Outside air, space air, duct air temps	0.4 degrees F
Watt-hour, voltage, and amperage	1 percent of design
Pressures, air, water and gas	3 percent of sensor range (inc. design value)
Flow rates, air	10 percent of sensor range (inc. design value)
Flow rates, natural gas	5 percent of sensor range (inc. design value)
Relative humidity	4 percent
CO ₂ monitor	100 ppm
Sound level	5 db - Type 1 meter (Per Calibrator Mfg.)
Domestic Hot Water Temperature	1.5 degrees F
Domestic Hot Water Pressures Water and Gas	3 percent of sensor range (inc. design value)
Flow Rates, Domestic Water	4 percent of sensor range (inc. design value)
Flow Rates	5 percent of sensor range (inc. design value)

3.05 ADJUSTING

- A. Perform work required to rectify installations not meeting contract requirements at no additional cost to the Owner.
- B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.
- C. If systems' Cx deadline, as defined in the Project Schedule, goes beyond the scheduled completion without resolution of the problem(s), the Owner reserves the right to obtain supplementary services or equipment to resolve the problem.

3.06

TRAINING

- A. Provide training plan for systems to be commissioned as required in applicable Division 23 specification sections and Section 01 7900.

END OF SECTION

SECTION 23 09 00

HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Temperature controls for air conditioning, heating, and ventilating systems as indicated. Work includes, but is not be limited to, the following:
 - 1. Automatic control valves and automatically operated dampers.
 - 2. Electric relays (magnetic starters excluded), electric or mechanical linkages, duct sensors, thermostats, dampers and motorized valves, and appurtenances and accessories.
 - 3. Wiring outlet boxes and conduits for control systems, including wiring to connect magnetic starters to control systems.
 - 4. Testing and adjusting temperature control system.
 - 5. Furnishing record drawings and operational data of systems as installed and finally adjusted.
 - 6. Formal instruction of Owner personnel in operation of equipment.
- B. Following items are specified in other Sections:
 - 1. Magnetic starters, contacts, power relays and variable resistors or controllers for motors, and other electrical devices.
 - 2. Load carrying wiring for above listed devices and wiring for starting switches not interconnected with temperature control system. (Division 26: Electrical).
 - 3. Electrical power to control panels and other equipment. (Division 26: Electrical).
 - 4. Installing automatic valves in pipelines.
 - 5. Installing automatic dampers.
 - 6. Automatic controls and valves not connected with comfort heating, ventilating, and air conditioning systems.
 - 7. Packaged self contained equipment specified complete with temperature controls.
 - 8. DDC control equipment Environmental Control and Energy Management Systems.
- C. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Division 26: Electrical.
 - 3. Section 23 0500: Common Work Results for HVAC.
 - 4. Section 23 0800: HVAC Systems Commissioning.
 - 5. Section 23 3000: Air Distribution.
 - 6. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.2 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.

1. Complete list of items proposed to be furnished and installed under this Section.
 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements.
 3. Manufacturer's printed installation procedures.
- B. Shop Drawings: Provide Shop Drawings, in the same size as the Drawings, prepared, signed and sealed by a mechanical engineer licensed in the State of California. Shop Drawings shall indicate temperature control diagrams, complete with equipment appurtenances required for system. Include sequence of operation description for each system. Submit in accordance with of Division 01.
- C. Sequence of Operation: Provide complete, detailed, step-by-step sequence of operation for each item of equipment.
- D. Operating Instructions: Comply with provisions of Section 23 0500: Common Work Results for HVAC. Explain and demonstrate operation of system to Owner representatives as required.
- E. Guarantee: Refer to Section 23 0500: Common Work Results for HVAC.

1.3 QUALITY ASSURANCE

- A. Manufacturer and Installer Qualifications: Comply with provisions stated under Section 23 0500: Common Work Results for HVAC.

1.4 PRODUCT HANDLING

- A. Production, Replacement, Delivery and Storage: Refer to Section 23 0500: Common Work Results for HVAC and Section 23 0513: Basic HVAC Materials and Methods.

PART 2 - PRODUCTS

2.1 TEMPERATURE CONTROLS

- A. Provide temperature controls of pneumatic, electric, electronic microprocessor - DDC type, or a combination thereof, as indicated on Drawings, to provide required sequences or operational control.

2.2 MANUFACTURERS

- A. Equipment in system shall be of same manufacturer or their standard furnished items. Testing, initial start-up, and adjusting of control system shall be under continuous observation of the mechanical engineer responsible for Shop Drawing preparation.
- B. Electric, electronic, or direct digital microprocessor based control equipment shall be one of following manufacturers, unless otherwise noted:
1. Honeywell, Inc.
 2. Johnson Controls, Inc.
 3. Invensys.
 4. Equal.
 5. Carrier.

2.3 ELECTRIC EQUIPMENT AND ACCESSORIES

- A. Electric control equipment and accessories include, but are not limited to, the following:
 - 1. Electric control devices as indicated on Drawings and described herein, including thermostats, temperature controllers, valve and damper operators, switches, relays, and control panels for instruments as required to provide a complete and operable system.
 - 2. Wiring and conduit, unless otherwise noted, or control systems including wiring required, to connect magnetic starters, specified in other sections, to control systems.
- B. Room Thermostats:
 - 1. Thermostats for unitary air conditioning units shall be as specified in Section 23 8000: Heating, Ventilating and Air Conditioning Equipment. Thermostats located on outside walls shall be installed on insulated backplates or as specified by unit manufacturer.
 - 2. Provide the following room thermostats for each specific application as follows, where manufacturer's thermostats are not specified in Section 23 8000:
 - a. Honeywell, Johnson Controls, Invensys, Carrier, or equal, for heating only; Honeywell, Johnson Controls, Invensys, Carrier, or equal, for cooling only.
 - b. Honeywell, Johnson Controls, Invensys, Carrier, or equal, microelectronic commercial thermostat with sub-base for electronic control of 18 to 30 VAC single zone HVAC equipment. Thermostat is either stand alone or arranged in a temperature averaging network consisting of 2, 3, 4, 5, or 9 sensors for corresponding rooms or zones.
 - c. Honeywell, Johnson Controls, Invensys, Carrier, or equal, proportional thermostat, low-voltage, 3-wire controller for valve, damper motors and balancing relays. Unit manufacturer may specify or recommend optional thermostat.
 - d. Provide tamper-proof locking thermostat guards for items specified above. Covers shall be opaque beige plastic in student occupied areas, clear plastic cover in administrative areas. Provide Honeywell, Johnson Controls, Invensys, Carrier, or equal, universal thermostat guards or as recommended by thermostat manufacturer.
- C. Duct-Mounted Thermostats: Duct-mounted thermostats shall be modulating or 2-position as required to accomplish sequence of operation.
- D. Valve and Damper Motors: Damper motors shall be furnished with oil-immersed gear trains and ample capacity to handle required loads under normal operating conditions. Where indicated, spring return type motors are to be provided. Valve motors to be 2-position or proportional, spring return or now spring return.
- E. Wiring: Wiring in connection with control systems regardless of voltage, except power supply circuits, is part of the Work of this Section. Wiring shall comply with Division 26: Electrical.
- F. See Section 23 0923 for DDC/Electronic controls.

PART 3 - EXECUTION

3.1 TEMPERATURE CONTROL SYSTEM INSTALLATION

- A. Control system shall be installed in accordance with control manufacturer's instructions and reviewed Shop Drawings.

3.2 CONTROL PANELS OR CABINETS

- A. Switches, clocks, temperature control instruments, and remote bulb thermometers, whose capillary tubes are less than 25 feet in length, shall be mounted in control panels with required wiring, piping, and tubing behind panel. Control panels shall be galvanized steel sheet metal, with light gray hammertone enamel finish, not lighter than 14 gage. Control panels shall be UL Listed. Panels shall be attached to wall at locations indicated, or as required. Adjustable apparatus shall be provided with P-Touch, or equal, labels to indicate function. A clear space of 30 inches in front shall be maintained.
- B. Control cabinets shall be provided with door locks. Door locks shall be the flush type, latched, 5/8 inch for metal door, keyed to a Corbin Cat. No. 60 key. Cabinet shall be prime coated and finish painted as specified in Section 09 9000: Painting and Coating. Cabinet shall be flush mounted.

3.3 ROOM THERMOSTAT

- A. Room thermostats shall be wall mounted at a height of approximately 4 feet. Room thermostats are not permitted on outside walls, at marker boards, between shelving, in recesses or above heat producing equipment. Units shall be installed as close to edge of tack board as possible. Room thermostats shall be furnished with tamperproof cover. Thermostats shall be furnished with set point windows and integral thermometers. Office thermostats shall be furnished with extended adjustment knobs; others shall have key adjustments. Room thermostats shall be furnished with non-switching sub-bases.

3.4 COORDINATION

- A. Coordinate this Work with other aspects of system balancing to obtain a complete operating mechanical system in accordance with design intent, including coordinating with balancing of the system.
- B. Coordinate this Work with all aspects of alarm, fire alarm, and smoke detector, specified in Division 26: Electrical.

3.5 SEQUENCE OF OPERATION

- A. Each system, electric, electronic, or direct digital control shall operate as graphically and described on Drawings and in accordance with reviewed sequence of operation.

3.6 CONTROL SYSTEM ADJUSTMENTS

- A. Perform adjustments under operating conditions to provide sequence of operation for controls indicated. If required operating conditions cannot be obtained before Substantial Completion, due to outdoor seasonal temperatures, return to the Project site when requested by the Owner and readjust control system when outdoor temperatures will permit proper operating conditions. Start readjustment within seven calendar days after notification. Final settings of controls and pressure ranges indicated by gages shall be indicated on project record documents.

3.7 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

3.8 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 23 30 00

AIR DISTRIBUTION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Ductwork and appurtenances required for a complete air transmission and distribution system for the heating, ventilating, and air conditioning systems indicated on Drawings and as specified.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 09 9000: Painting and Coating.
 - 3. Section 23 0500: Common Work Results for HVAC.
 - 4. Section 23 0800: HVAC Systems Commissioning.
 - 5. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
 - 6. Section 23 0700: HVAC Insulation.
 - 7. Section 23 0900: HVAC Instrumentation and Controls.
 - 8. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. Manufacturer's Data:
 - 1. Complete list of items to be furnished and installed under this Section. Material lists that do not require performance data shall include manufacturer names, types and model numbers.
 - 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements.
 - 3. Literature shall include descriptions of equipment, types, models, sizes, capacity tables or curves marked to indicate performance characteristics, electrical requirements, options selected, space requirements, including allowances for servicing, and other data. Data shall include name and address of nearest service and maintenance organization that regularly stocks repair parts.

Listings of items that function as parts of an integrated system shall be furnished at one time.

4. Submit complete acoustical test reports showing that proposed products have been tested in accordance with latest editions of relevant ASHRAE and AHRI Standards (ANSI/ASHRAE Standard 70 for air inlets and outlets; ANSI/ASHRAE Standard 130 and AHRI 880 for terminal units) and will be suitable for operation in Project spaces with specified maximum noise criteria (NC) requirements. The results of all testing shall be certified by an independent testing agency and submitted to the ARCHITECT for approval. The submittal shall include a complete description of the test conditions, methods and procedures.
5. Submittals shall include a tabulation of proposed products, identification of Project spaces where proposed products are to be installed, maximum allowable NC for all Project spaces, and product NC (at specific design air volume) for all Project spaces.
6. Shop Drawings: Shop Drawings indicating methods of installation of equipment and materials, sizes and gages of ducts, and details of supports. Items to be covered shall include but not be limited to following:
 - a. Layout of ductwork and equipment drawn to scale to establish that equipment will fit into allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment, anchoring to, and hanging from structural framing of building. Indicate vibration isolation units, foundations, supports, and openings for passage of pipes and ducts.
 - b. Drawings indicating locations and sizes of sleeves and prepared openings for pipes and ducts.
 - c. Typical details of supports for equipment and ductwork.

1.03 QUALITY ASSURANCE

- A. Installer's and Manufacturer's Qualifications: Comply with provisions stated under Section 23 0500: Common Work Results for HVAC.
- B. Sound power level measurements and Manufacturers' NC value calculations shall be conducted in complete accordance with the latest version of ANSI/ASHRAE Standards 70 and 130 and AHRI 880.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Comply with provisions stated in Section 23 0500: Common Work Results for HVAC.
- B. Ensure ducts are clean and free of dirt, dust, moisture, oils and other contaminants that can lead to poor air quality. Cover openings of ductwork with a self-adhering protective

film. Film shall not leave a residue on metal after removal, and shall be highly resistant to tears and punctures.

1.05 COORDINATION

- A. Coordinate activities in accordance with provisions of Section 23 0500: Common Work Results for HVAC.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Unless otherwise noted, provisions, including amendments thereto, of the latest edition of the HVAC Duct Construction Standards of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) and the California Mechanical Code (CMC), are hereby made part of this Section.
- B. Rectangular, round and flat oval ducts shall be manufactured and installed in accordance with requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA.
- C. Sheet metal ducts shall be fabricated from galvanized steel, aluminum or stainless steel.
- D. Galvanized steel ducts shall be fabricated of galvanized steel sheet, lock forming grade, conforming to ASTM A653 and A924.
- E. Galvanized steel ducts gage thickness and permissible joints and seams of ductwork shall conform to requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA and the CMC unless noted otherwise on the drawings. The more stringent requirements shall prevail.
- F. Button punch snap-lock seams, using Lockformer or equal, shall be permitted only in concealed areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.
- G. Ducts shall be reinforced in accordance with the latest edition of the SMACNA HVAC Duct Construction Standards: Cross-braced Duct: Duct sizes 19 inches wide and larger which have more than 10 square feet of unbraced panel shall be beaded or cross-braced. This requirement is applicable to 20 gage or less thickness and 3 inches w.g. or less pressure. For details, refer to SMACNA manual.
- H. Round and Oval Galvanized Steel and Aluminum Ducts:
 - 1. Round Spiral Ducts and Fittings: Fabricated from galvanized sheet steel shall be machine-formed spiral pipe with sealed spiral locking joints. Fittings shall be furnished with continuous corrosion-resistant welds. Provide gages of ducts and fittings recommended by manufacturer.

2. Details of seams and transverse joints for round duct and fittings shall conform to SMACNA standards.
3. Flat oval ducts shall be provided as indicated on the Drawings. Reference standard details in SMACNA manual.
4. Minimum duct wall thickness, and permissible joints and seams of ductwork for flat oval duct construction shall conform to requirements in the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA and the CMC. The more stringent requirements shall prevail.
5. These provisions apply for ducts furnished for indoor comfort heating, ventilating and air conditioning service only.

I. Flexible Ducts

1. Flexible duct shall be non-metallic, insulated for conditioned air supply and return. The flexible ducts shall be factory fabricated with exterior reinforced laminated vapor barrier, 1 ½-inch thick fiber glass insulation (K = 0.25 at 75 degrees F), encapsulated zinc-coated spring steel wire helix and impervious, smooth, non-perforated interior vinyl liner and factory fabricated steel connection collars. For the composite assembly, including insulation and vapor barrier, comply with NFPA Standard 90A or 90B and tested in accordance with UL Standard, UL 181. Non-insulated metallic ducts shall be provided for exhaust only.
2. Methods of installations, standards for joining and attaching, and supporting flexible duct shall conform to applicable provisions of SMACNA manual.
3. Specifications herein shall not supersede installation requirements by flexible duct manufacturer if those are more stringent.

J. Aluminum Ducts:

1. Material for aluminum duct shall be of 3003-H14 alloy aluminum sheets, with such designation embossed or stenciled on each sheet. Minimum tensile strength shall be 19,000 psi.
2. Aluminum duct thickness and permissible joint and seams shall conform to requirements of the latest edition of the HVAC Duct Construction Standards- Metal and Flexible of SMACNA, and CMC.
3. Aluminum ductwork shall be furnished to transport moisture-laden air from shower rooms, shower drying rooms, dishwashers and discharge ducts from evaporative condenser and cooling towers.
4. Unless otherwise noted, follow SMACNA Duct Construction Details for steel construction standards as indicated for unreinforced duct, reinforced duct, or cross-broken duct.
5. Button punch snap-lock seams on aluminum ducts are not permitted.

K. Stainless Steel Duct:

1. Materials for stainless steel duct shall be stainless steel conforming to ASTM A167 and A480.
2. Stainless steel ducts shall be provided as required and indicated on the Drawings.
3. Fume hood exhaust shall be stainless steel Type 304.
4. Kitchen exhaust duct system shall be stainless steel Type 304.
5. Stainless steel ducts shall be constructed with welded joints except for connections to equipment which shall be flanged joints with gaskets.
6. Entire stainless steel duct systems shall comply with current CMC requirements for product conveying ducts except where the requirements of this Section are more stringent.

L. Fittings and Other Construction Details: Details of fittings such as elbows, turning vanes, branch take-off and connections, duct access doors, connections for grilles, registers and ceiling diffusers, flexible connector at fan, etcetera, shall conform to applicable provisions of this Section or SMACNA manual.

M. Duct Seam and Joint Sealant: Provide sealant for metal ducts at duct joints which are defined as transverse joints between duct sections including girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections, access doors and frames, and abutments to building structure. Also provide the same at duct seams which are defined as longitudinal joint between duct sections. Spiral lock seams in factory fabricated round or oval ducts are excluded.

1. Sealant for low-pressure ducts shall be: Design Polymerics DP1010 or DP1020, Childers CP-145A/CP-146 Chil-Flex, Foster's 32-19 Duct-Fas, Miracle-Kingco Glenkote Seal-Flex, Ductmate Industries PROseal or FIBERseal, or equal.
2. Provide sealing material for medium-pressure ducts as described in the SMACNA manual for those pressures.
3. Sealant materials shall comply with the flame spread and smoke developed rating of current CMC when tested in accordance with ASTM E84.
4. Sealant for exposed to weather ducts shall pass the Weather Resistance Test per ASTM G154 at 2000 hours QUV.

N. Restrictions:

1. Zinc-coated steel duct shall not be installed for ductwork transporting moisture-laden air. Flexible duct may only be furnished where specifically indicated on Drawings. Aluminum ducts shall not be installed for internal pressures above 2 inches of water.

2. Fiberglass duct is not permitted as a substitute for sheet metal duct.

2.02 DAMPERS

A. Manually Operated Volume Control Dampers:

1. VD-1, Rectangular: Multi-blade type, opposed blade operation, 16 gage galvanized steel blades; center pivoted on 3/8 inch diameter steel trunnions; interlocking edges; dampers shall be in own angle frame, full duct size as indicated on Drawings; frame of minimum 16 gage steel channel construction. Provide with damper operator and axles positively locked to blade. Ruskin MD35, Pottorff MD-42, Greenheck MBD-15 or equal.
2. VD-2, Round: Frame shall be constructed of not less than 20 gage galvanized steel, blades of not less than 20 gage galvanized steel channel construction with factory neoprene seals, 1/2 inch diameter axle shafts and locking hand quadrant. Ruskin MDRS25, Greenheck MBDR-50, or equal.
3. VD-3, Oval: Frame shall be constructed of not less than 14 gage galvanized steel channels with factory blade seals of not less than 12 gage galvanized steel with not less than 1/2 inch diameter axle shafts. Provide Ruskin standard construction for frame, blade and axle size, thickness and material variation. Provide adjustable locking hand quadrant. Ruskin CDO25, or equal.

B. Motorized Volume Control Dampers:

1. MVD-1, Rectangular: Multi-blade type opposed blade operation, 16 gage minimum steel channel frame construction; 16 gage galvanized steel blades center pivoted on 1/2 inch diameter steel trunnions. Interlocking edges. Dampers shall be in own angle frame. Full duct size as indicated on the Drawings. Provide with matching two position motorized actuator with linkages, 24VAC by Belimo, Honeywell, Invensys, or equal. Ruskin CD35, Pottorff CD-42, Greenheck VCD Series, or equal.
2. MVD-2, Round: Butterfly type constructed with minimum 20 gage galvanized steel frame with steel angle reinforcement on above 20-inch diameter. Blade shall be 14 gage minimum thickness. Neoprene seal to ensure air tightness in closed position. Furnish with matching two position motorized actuator with linkage 24 VAC by Belimo, Honeywell, Invensys, or equal. Ruskin CDRS25, American Warming and Ventilating (AMV) VC-25, Air Balance, Inc. AC530, or equal.
3. Electronic Damper Actuators: Belimo, Honeywell, Invensys, or equal.
 - a. Sized for torque required for damper seal at load conditions.
 - b. Coupling: V-bolt dual nut clamp with a V-shaped toothed cradle. Aluminum clamps or set screws are not acceptable.
 - c. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is

reached. Actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.

- d. Power Requirements: As indicated on Drawings.
- e. Actuator Timing: Shall meet 15 seconds.
- f. Temperature Rating: Actuator shall have a UL 555S listing by damper manufacturer for 350 F.
- g. Auxiliary Switches: Provide for signaling, fan control, and position indications.

C. Automatic Fire Dampers:

1. FD, Fire Dampers: Shall conform to requirements of and be listed by State of California Fire Marshal and NFPA 90A. Dampers shall provide airflow resistance not to exceed 0.05 inch water gage static pressure at 900 fpm or 0.25 inch water gage at 2,000 fpm. Dampers shall be installed in required steel sleeve at each penetration of a rated partition.
 - a. Vertical-mounted fire dampers: Fire damper shall be curtain type with blades removed from the air stream to allow for maximum free area. Dampers will be provided in factory sleeves as tested and listed by manufacturer. Dampers shall be rated for 1 ½ hours for installation in one or 2-hour partitions. Provide UL listed fusible links of adequate size and temperature rating. Dampers will be installed according to the manufacturer's recommended installation instructions provided with units. Provide suitable access for inspection and servicing of each damper. Pottorff VFD-10/VFD-10D Series, Ruskin IBD/DIBD Series, Greenheck FD/DFD Series, or equal.
 - b. Combination fire and smoke dampers: Combination fire and smoke dampers shall be louver bladed type. Units shall be tested and listed under UL 555 and UL 555S. Rating 1 ½ hours for installation in one or 2-hour partitions. The seals shall be non-degradable steel to steel. Leakage shall not exceed 15 cfm/sq. ft. at one inch w.g. and shall be tested at 850 degrees F. Dampers shall be capable of being remotely controlled and reset for pressurization and smoke evacuation. Fire-releasing device shall be UL 33 listed melting fusible links. Dampers shall be provided in sleeves with pre-mounted non-stall motor actuators and dual-position indicators for remote annunciation, if required. The complete assembly shall be factory cycled and tested prior to shipment. Provide suitable access for inspection and servicing of each damper. Pottorff FSD-141 with non-stall motor, Ruskin FSD37 or FSD60 with electric fuse link Model EFL 200, with electric non-stall motor, Greenheck FSD Series, with non-stall motor, or equal.
2. Electronic Damper Actuators: Refer to Sub-paragraph 2.04.B.3.

- D. Relief Dampers: Parallel multi-blade, counter balanced type with adjustable counter weights. Constructed of 20 gage galvanized sheet steel or extruded aluminum with solid stops all around. Bearings shall be dust proof, ball bearings. Damper shall open on a positive pressure of 0.01 inch within space and close to a backdraft. Interlocking edges shall prevent dust infiltration when closed. Air Balance, Inc., Pottorff, Ruskin, Metal Form Manufacturing Co. Inc., or equal.
- E. Duct Access Panels: Provide factory fabricated access panels in ducts where required for servicing fire or smoke dampers, and at other locations as specified in this Section. Units shall consist of removable panel, gasketed and pressure sealed by controlled spring tension locks. Construct unit, including interior parts, of same material as duct. Units shall be constructed to be suitable for installation in systems of up to 5 inches water gage static pressure.

2.03 AIR DISTRIBUTION DEVICES

A. General:

1. Grilles, registers, diffusers and appurtenances shall conform to requirements specified herein and shall be of type and sizes as specified and indicated on Drawings. Performance shall be in accordance with ANSI/ASHRAE Standard 70 including airflow velocity, pressure, temperature, and sound measurements.
2. Sponge neoprene, rubber, vinyl or felt border gaskets shall be provided for surface-mounted registers, grilles or diffusers.
3. The noise generating characteristics of all specified grilles, registers, and diffusers shall be tested to, and comply with, all requirements of this specification. Representative samples shall be subjected to tests in accordance with applicable standards and procedures in order to demonstrate such compliance. A special test for this project is not required if the manufacturer has previous certified test results that can be made applicable to this project. Maximum Sound Levels of diffusers, grilles and registers shall be as follows:

Administrative office area: NC 30
4. Provide suitable frame types to match the ceiling types as specified or indicated on the Architectural Drawings.
5. Ceiling diffusers shall be provided with equalizing grids.
6. Ceiling mounted grilles, registers and diffusers shall be provided with a factory applied, baked enamel, dull finish, bone white to match acoustical ceiling tile.
7. Grilles or registers mounted on painted walls or other surfaces shall be furnished with a baked prime coat and finish painted in accordance with Section 09 9000: Painting and Coating.
8. Diffusers, registers and grilles indicated or scheduled on the drawings to comply with special requirements shall take precedence over the standard items specified.

B. Ceiling Diffusers - Round, Square, Rectangular:

1. CD-1 For less than 10 feet ceiling height only. Units shall be square or rectangular modular core type as indicated on the drawings. Anemostat QC Series, Krueger Model 1240, Price SMCD Series, or equal.
2. CD-2 Units shall be square plaque type. Anemostat PG Series, Krueger Model PLQ, Price SPD Series, or equal. The horizontal air discharge pattern shall be 360-degree radial type with factory installed blank-offs for three way, two way corner, two way opposite, or one way discharge pattern.
3. CD-3 For areas of higher than 10 feet ceiling height. Units shall be square or rectangular louver faced type. Anemostat D Series, Krueger Model SH, Price SMD/AMD Series, or equal.
4. CD-4: Units shall be round, adjustable pattern, and surface-mounted type. Anemostat C-27, Krueger RM Series, Price RCDE Series, or equal.
5. CD-5: Units shall be adjustable linear slot type. Anemostat SLAD Series, Krueger Model 1900, Price AS Series, or equal.

C. Grilles - Return, Exhaust, Ceiling, Square, Rectangular:

1. GR-1 Acoustical Tile on Plaster Ceiling: Return and exhaust grilles shall be single deflection type with horizontal fixed face bars set at straight or 45 degree angle, ½ inch spacing and flush and flanged for surface mounting. Anemostat S3HD Series, Krueger Model S80/S85, Price 500/600 Series, or equal.
2. GR-2 Prefabricated Acoustical Tile Ceiling with Inverted Exposed T-Bars: Return and exhaust grilles shall be with single deflection horizontal fixed face bars, set at straight or 45 degree angle, ½ inch spacing and flush, lay-in panel type with nominal overall dimension of 24-inch by 24-inch. Anemostat Type SAC3L Series, Krueger Model S80/S85, Price 500/600 Series, or equal.

D. Registers, Supply, Return, Wall:

1. WR-1: Sidewall supply register shall be double deflecting type with loose key-operated opposed blade volume control. Anemostat S2 Series, Krueger Model 80/880, Price 500/600 Series, or equal.
2. WR-2: Sidewall return register shall be single deflecting type with horizontal fixed face bars set at 45 degree angle flush and flanged for surface mounting and complete with loose key-operated opposed blade volume control. Anemostat S3 Series, Krueger Model S80/S85, Price 500/600 Series, or equal.

2.04 SOUND ATTENUATING EQUIPMENT - DUCT SILENCERS

- A. Provide factory fabricated duct silencers of tubular or rectangular type, for high or low velocity service, with arrangements, sizes and capacities as indicated on Drawings. Construct silencers of galvanized steel with casing seams sealed or welded to be airtight at a pressure differential of 8 inches water gage between inside and outside of unit, and stiffen or brace as required to prevent structural failure or deformation at same condition, or audible vibration during normal operation. Filler material shall comply with the following:
- | | |
|--|---|
| Fire Safety Standards: | NFPA 90A and 90B |
| Temperature: | ASTM C411 |
| Air velocity: | ASTM C1071, UL 181 |
| Fire Hazard Classification: | ASTM E84, UL 723-Class 1, NFPA 255 |
| Corrosion Resistance: | ASTM C739, C665 |
| Fungi Resistance: | ASTM G21 |
| Water Vapor Sorption: | ASTM C1104, less than 1 percent by weight |
| Formaldehyde, Phenoloc Resins or other Volatile Organic compounds: | 0 percent. |
- B. Select and provide silencers from acoustical and aerodynamic rating tables based on actual test readings or interpolated values of such readings obtained from tests made by recognized independent laboratories. Tests shall be in accordance with ASTM E477.
- C. Select and provide silencers for air pressure drops not exceeding those indicated on Drawings, and of types, sizes and models for which noise reduction values, dynamic insertion loss, in decibels reference 10 to 12 watts, are not less than indicated on Drawings.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 DUCTWORK

- A. Construct ductwork according to details of fabrication and methods of support, as indicated in the SMACNA manuals and CMC, unless specified or indicated otherwise in this Section or on Drawings. In event of conflict, the most stringent requirement shall be provided.
- B. Unless otherwise required, construct ducts to conform accurately to dimensions indicated and to be straight and smooth on inside, with joints neatly finished.
- C. Duct dimensions indicated are net inside dimensions.
- D. Where aluminum is welded, provide a minimum thickness of 16 gage, and use gas inert tungsten process of welding.

- E. Anchor ducts to building structural slab, framing and roof decking and detail method of anchoring and fastening if not indicated on Drawings. Supports shall be seismically constructed as required by the latest edition of the SMACNA guidelines.
- F. Construct and install ducts to be completely free from vibration under operating conditions.
- G. Indicate on layout drawing, required for suspended ductwork, location of supports, loads imposed on each fastening or anchor, typical details for anchorage, and details for special anchorage for supports attached to metal roof decking.
- H. Attach supports only to building structural framing members and concrete slabs.
- I. Where supports are required between structural framing members, detail and install suitable intermediate metal framing.
- J. Ducts transporting air-conditioned or heated supply air shall be insulated in accordance with requirements of Section 23 0700: HVAC Insulation.
 - 1. Ducts exposed to weather shall be prefabricated double wall type from HVAC equipment through building envelope.
- K. Ferrous angles and structural members and joining collars specified for construction and support of ductwork and plenums shall be primed with one heavy coat of required asphaltic aluminum paint before installation or fabrication. Metal surfaces shall be thoroughly cleaned before installation of paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls are not required to be primed or painted.
- L. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

3.03 DUCT CONSTRUCTION

- A. Minimum ductwork gages, joints, reinforcing, and bracing of ductwork shall conform to SMACNA and CMC. The most stringent standards shall prevail. Additional bracing shall be provided to prevent objectionable panel vibration.
- B. Button punch snap-lock seams, using Lock-former or equal, shall be permitted only in non-accessible areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.
- C. Provide longitudinal seams of the grooved snap lock, or Pittsburgh and standing, sealed spiral or continuously welded.
- D. Ferrous angles and structural members and joining collars specified for the construction and support of ductwork and plenums shall be primed with one heavy coat of asphalt aluminum paint before installation or fabrication. The metal surface shall be thoroughly cleaned before application of the paint. Galvanizing may be provided instead

of painting. Installed duct hanger rods concealed in furred ceilings and walls is not required to be primed or painted.

- E. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.
- F. S-type or drive-slip type girths or longitudinal seams shall not be furnished for ductwork installed outdoors or mounted on roofs.
- G. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

3.04 DUCT ELBOWS AND TURNING VANES

- A. Duct elbows, including supply, exhaust, and return, shall be provided with a centerline radius of 1.5 times duct width parallel to radius whenever possible; centerline radius shall not be less than width of duct parallel to radius.
- B. Where space does not permit above radius, or where square elbows are indicated on Drawings, turning vanes shall be installed whether indicated on Drawings or not.
- C. Turning vanes shall conform to SMACNA and CMC.

3.05 DUCT JOINTS AND SEAMS

- A. Conditioned air supply ducts shall be furnished with joints and seams sealed, welded for air tightness, except spiral seam factory machine formed duct components. Spiral seam is exempted. Joints between slip-fit components may be assembled with all seams and joint connections fastened with screws.
- B. Other ducts shall be furnished with joints and seams sealed by using sealant, taping, soldering, or welding. Ducts for grease hood exhaust shall be furnished with grease-tight welding or brazing on external surface for joints and seams. Fiberglass ducts shall be provided with a thermally activated closure system, Johns Manville Fortifiber Therm-Lock with Automatic Bond Indicator dots, or equal.
- C. S-slip or drive-slip type girths or longitudinal seams are not permitted on exterior or exposed rooftop mounted ductwork.
- D. Caulking, taping, or other joint or seam treatment shall be provided in accordance with recognized standards.
- E. Seams around fan, coil housing and plenums shall be sealed with gaskets or sealing compound to provide an airtight assembly.
- F. Stainless steel ductwork connected to range hoods and fume hoods shall be provided with grease-tight, gas tight welded seams, and shall be constructed and installed so that grease or other material cannot become pocketed in any portion thereof, and system shall slope downward toward hood not less than 1/4 inch per lineal foot. Gasketed flanged joints with sealing compound shall be used only at fan and fume hood connections.

- G. Alternative duct connectors such as Ductmate Industries, Mez Industries, or equal may be used if the following conditions are met:
 - 1. One of the specifically listed connectors is submitted and approved by the ARCHITECT and OAR.
 - 2. The correct size connector, application, and gage of material conform to SMACNA Standards.
 - 3. The connector is installed per manufacturer's specifications.

3.06 DUCT TRANSITION

- A. Slopes in sides of transition pieces shall be no greater than 1 to 5. Abrupt changes or offsets in duct system are not permitted, except when reviewed by the ARCHITECT.

3.07 DUCT TEST HOLES

- A. Holes in ducts and plenums shall be provided for pilot or static tubes for obtaining air measurements to balance or check air systems. Holes shall be covered with neoprene gasketed sheet metal cover or plugged with a fitted neoprene plug chained to duct.

3.08 SOUND ATTENUATING EQUIPMENT

- A. Install sound attenuators where required and indicated on Drawings. Refer to manufacturer's instructions for required installation.

3.09 FLEXIBLE CONNECTIONS

- A. At points where sheet metal connections are installed to fans or air handling units, or where ducts of dissimilar metals are connected, a flexible connection of commercial grade, Duro Dyne Durolon, Ventfabrics Ventglas, Ductmate Industries Proflex, or equal, non-combustible material shall be installed and securely fastened by zinc-coated steel clinch-type bands or a flange type connection. Inlet and outlet openings shall be axially in-line, maximum deviation of centerline shall be less than 5 percent of diameter or shortest dimension of a rectangular inlet of fan or air handling unit, with system at rest. Duct end of connection shall be seismically restrained if more than 4 feet from last support.

3.10 AIR TERMINAL DEVICES

- A. General: Install supply devices after ducts, plenums, and casings have been cleaned and blown free of small particles, as specified. Devices shall be aligned to be parallel to ceiling construction or walls and ceiling surfaces, and shall be pulled tightly to compress gaskets and to fit neatly against surfaces.
- B. Diffusers: Support surface mounted ceiling diffusers from angles or channels resting on and fastened to ceiling construction. Do not support from ducts. Install lay-in diffusers on T-bar ceilings with hanger wires from each corner and not supported by

ceiling structure. Provide sheet metal adaptor box above each diffuser to allow space for volume controller with round collars for connection to round ducts where indicated on Drawings. Fasten duct-mounted diffusers to duct collars.

C. Registers and Grilles:

1. Install wall supply registers at least 6 inches below ceiling, unless otherwise indicated. Locate return and exhaust registers 6 inches below ceiling unless otherwise indicated.
2. Support ceiling diffuser type inlets, registers, and grilles as required above for ceiling diffusers.
3. Fasten wall mounted and duct mounted registers and grilles to flanges of duct collars.

3.11 DAMPERS

A. Manually operated dampers, gravity dampers, fire dampers, and motor operated dampers shall be furnished and installed as specified and indicated. Upon completion of installation, dampers shall be checked, lubricated, and adjusted so that they operate freely, without binding. Dampers shall be of standard commercial manufacture, complete with damper frame. Where painting is required, they shall be shop finished unless otherwise noted.

1. Provide and install manual volume dampers per SMACNA standards to allow balancing per AABC, NEBB or TABB Procedures and Standards whether indicated on the drawings or not.
2. Balancing dampers shall be installed in main supply ducts from fan discharge plenums, where two or more ducts are connected to each plenum, although such balancing dampers may not be indicated. Each zone shall be provided with a manual volume damper. Sheet metal screws shall be installed through handles and into ducts to lock damper in place after test and balance.
3. Each supply, return, and exhaust branch shall be provided with manual volume dampers.
4. Do not provide opposed blade dampers at air inlets and outlets.
5. Each supply, return, and exhaust inlet or outlet shall be provided with a manual volume damper. This damper shall be a minimum of 5 feet upstream of the air outlet and inlets. An acoustic flexible duct should be provided between the outlet and inlet and the damper for concealed ducts.
6. Dampers installed in accessible locations shall be provided with locking and indicating quadrants. Ventfabrics Ventlok, Duro Dyne, Young Regulator Co., or equal.
7. Dampers installed in ductwork in furred ceiling spaces or in roof spaces with less than 30 inches of clearance below beams, joists, or other construction, and

where access panels are not provided shall be furnished with damper rods extended below ceiling and terminated with a concealed damper regulation. Ventfabrics Ventlok, Young Regulator Co., Duro Dyne, or equal.

8. Dampers not identified as splitter, extractor, or butterfly dampers shall be of multi-louver type arranged for opposed blade operation. Damper shall be same dimension as adjoining duct and be tight closing. Blades shall not be greater than 9 inches. Dampers shall be not less than 18 gage steel.
9. Motor operated dampers shall be furnished by temperature control manufacturer as part of temperature control equipment and shall conform to requirements of Section 23 0900: HVAC Instrumentation and Controls.
10. Dampers shall be provided with accessible operating mechanisms. Where operators are exposed in finished portions of building, operators shall be chromium-plated with exposed edges rounded. Splitter dampers are not permitted unless specified and reviewed by the ARCHITECT.
11. Dampers shall not be installed in combustion air ducts.
12. Access panels shall be installed for access at each damper's operating mechanism.

3.12 FIRE AND SMOKE DAMPERS

- A. Fire dampers or combination fire and smoke dampers shall be installed and accessible at duct penetrations of rated walls and partitions and as required by State Fire Marshal and NFPA 90A, 92A, 92B, and 101.
- B. Fire dampers shall be sized, and adjoining duct enlarged, to assure full size air passage of connecting ductwork.
- C. Install smoke dampers as indicated on Drawings and as required in ducts penetrating smoke isolation separations.
- D. Fire dampers or combination fire and smoke dampers shall be electrically actuated, power open-fail close type, UL 555 and UL 555S classified for 1-1/2 hours.
- E. Provide a service disconnect switch for each and every combination smoke and fire damper.

3.13 DETECTORS

- A. Smoke detectors shall be installed in accordance with requirements of the California Mechanical Code.
- B. Smoke detectors shall be installed in systems of over 2000 CFM capacity to detect presence of smoke and automatically shut down air handling units or fans unless it has been verified with the electrical installer that Exception 1 to CMC 609.0: Automatic Shutoffs, regarding automatic shutdown of systems with total coverage smoke detection systems is applied.

- C. Smoke detectors shall be installed in supply system downstream of filters.

3.14 BACKDRAFT DAMPERS

- A. Backdraft dampers shall be installed at locations indicated in accordance with the State of California Building Energy Efficiency Standards, Title 24, CCR.

3.15 DUCT SLEEVES AND PREPARED OPENINGS

- A. Furnish duct sleeves for 15-inch diameter ducts or less passing through floors, walls, ceilings, or roof and install during construction of the floor, wall, ceiling, or roof. Install round ducts larger than 15 inches diameter and square and rectangular ducts passing through floors, walls, ceilings or roof through prepared openings. Provide duct sleeves and prepared openings for duct mains and duct branches.
- B. Provide one inch clearance between duct and sleeve or between insulation and sleeves for insulated ducts, except at grilles, registers and diffusers.
- C. Provide prepared openings for round ducts larger than 15 inches in diameter and for square and rectangular ducts with one inch clearance between duct and openings or between insulation and opening for insulated ducts, except at grilles, registers and diffusers.
- D. Provide closure collar of galvanized sheet metal not less than 4 inches wide unless otherwise indicated on Drawings on each side of walls or floors where sleeves or prepared openings are provided except where grilles or diffusers are installed. Install collar tight against surface. Fit sharp edges of collar installed around insulated duct to preclude tearing or puncturing insulation covering vapor barrier. Fabricate collars from round ducts in steel. Provide not less than 4 nails to attach collar where openings are 12 inches in diameter or less and not less than 8 nails where openings are 20 inches in diameter or less.
- E. Pack space between sleeve or opening and duct or duct insulation with commercial grade packing yarn.

3.16 FLEXIBLE DUCT RUNOUTS

- A. Runouts from branches, risers or mains to air terminal units and outlets may be pre-insulated, factory fabricated flexible ducts complying with NFPA 90A. Flexible ductwork shall not exceed 7 feet in length. When required to suspend flexible ducts, furnish hangers of type recommended by manufacturers of pre-insulated flexible duct and install at intervals recommended. Method of attachment to other components of air distribution system for a vapor-tight joint shall be in accordance with printed instructions of flexible duct manufacturer. Bend radius shall be 1-1/2 times diameter of duct, measured from centerline. Bends greater than 90-degree angle are not permitted. Non-metallic flexible duct shall be permitted only in T-bar suspended ceilings.

3.17 DUCT HANGERS AND SUPPORTS

- A. Exposed or easily accessible ductwork: All exposed ducts shall be supported by all-thread Rod as a single hanger and or a trapeze support for rectangular duct work in accordance with requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA.
- B. Non-accessible ductwork: Non-exposed and hidden from sight during regular school operations ductwork, rigid round, rectangular, and flat oval metal ducts, shall be installed with support systems conforming to SMACNA Standards.
- C. Where ducts are installed one above the other, they shall be individually supported on a trapeze of steel angles with 3/8 inch supporting steel rods securely fastened to overhead construction. A minimum distance of 3 inches shall be maintained between ducts wherever possible, but in no event shall distance be less than 2 inches. Minimum sizes of steel angles shall be 1 ½-inch by 1 ½-inch by 1/8 inch for duct sizes through 60 inches in greatest dimension, 2-inch by 2-inch by 1/8 inch for duct sizes 61 inches through 84 inches, 2-inch by 2-inch by 3/16 inch for duct sizes 85 inches through 96 inches, and 2-inch by 2-inch by 1/4 inch for duct sizes over 97 inches.
- D. Ducts six square feet area and greater and or minimum 28" round or greater shall be seismically restrained. Refer to Section 23 0548: HVAC Sound, Vibration and Seismic Control.
- E. Hangers shall not be supported by, or fastened to, non-structural members including blocking. Toggle or Molly type bolts are not permitted.
- F. Vertical ducts shall be supported with suitable angles on each side of each duct located at each floor and at intervals not to exceed 8 feet. Angles shall be sized and installed according to SMACNA Standards for required span so that they will be rigid, without bending or sagging.
- G. Roof-mounted ductwork shall be installed a minimum 12 inches above roof and shall be supported by galvanized welded pipe, one on each side, fastened to roof structure, flashed and sealed to roof membrane. Install supports at each turn, unit connections, and each penetration, and space at maximum 6 feet off-center in general. Pitch pockets are not allowed.

3.18 ACCESS PLATES AND DOORS

- A. Access plates and doors shall be furnished and installed where stops, valves, fire dampers, fusible links, coils, damper operating mechanism, control equipment, lubrication fittings, air filters, air handling equipment and similar items normally requiring adjustment or servicing are installed in concealed spaces.
- B. Access plates and doors shall be located to permit convenient access to equipment sized to permit removal of equipment for servicing. Access plates shall be no less than 12-inch by 12-inch in clear opening. Proper servicing of equipment requires adequate access for maintenance personnel. Access doors shall not be less than 24-inches by 24-inch, unless otherwise detailed. Two or more valves shall not be located in same access area unless sufficient clearance is provided for operation, servicing and removal of each valve.

- C. Openings in ducts or plenums whose longer dimension does not exceed 12 inches may be covered by a plate of same material as duct, gasketed and fastened to duct or plenum with sheet metal screws.
- D. Access plates in floors shall not be less than 8-inch by 8-inch and shall be carborundum surface brass with cast brass frames anchored into concrete. Access plates in tile walls shall be chromium plated brass and polished. Serrated plates furnished as part of a clean-out assembly are permitted in floors instead of a separate plate.
- E. Access plates and doors in walls and ceilings of finished rooms and in locations normally accessible to students shall be furnished with continuous piano hinges, unless otherwise specified, and a special flush type spring-loaded latch requiring an Allen wrench to operate. Access devices shall be installed after plastering in plaster ground openings.
- F. Access panels or doors penetrating one-hour fire resistive ceilings shall meet code requirements for such openings.
- G. Access panels shall be fire-rated; Milcor, or equal. Access doors shall be as required for installation in openings penetrating one-hour fire resistive ceilings. Access doors shall be furnished with a flush, key-operated cylinder lock, furnished with two keys each, instead of Allen headlock for non-rated ceilings.
- H. Access panels that are part of an integrated ceiling are specified in Section 09 8433: Cementitious Wood Fiber Acoustical Units. Identification markers shall be affixed to adjacent supports, under this portion of Work, to indicate location and type of mechanical device to be serviced.
- I. Access panels installed in ducts or plenums located in heater or equipment rooms containing gas-fired equipment shall be furnished with heavy-duty spring closing hinges and refrigerator door type catches unless otherwise required. When these panels are intended for maintenance personnel access, catches shall be operable from both interior and exterior.
- J. Other access panels, except those specified above, shall be furnished with suitable hinges and one or more sash fasteners.
- K. Panels located in ducts and plenums shall be installed with gaskets made of synthetic rubber, felt, or similar material to provide an airtight installation. Panels shall be constructed and reinforced to prevent vibration.
- L. Label the words "FIRE DAMPERS" on panels over fire dampers and words "DO NOT OPEN - HEATER IS OPERATING" on panels located in heater or equipment rooms. Letters shall be approximately 3 inches high, if space is available.
- M. Furnish a key to operate latch access plates, one for each access plate, but not to exceed five keys for any one Project.

- N. Access plates and panels shall be furnished with manufacturer's name or trade mark and model number cast or stamped thereon, or upon a label permanently affixed thereon.
- O. Provide duct through roof flashing as detailed in the SMACNA standards or as indicated on Drawings.
- P. Refer to SMACNA for access plate and door construction.

3.19 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose off the Project site.

3.20 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- a. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
- b. Related Sections include the following:
 - 1) Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2) Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

- a. Product Data: For each product indicated, include the following:
 - 1) Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2) Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.
- b. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1) Ceiling suspension assembly members.
 - 2) Method of attaching hangers to building structure.
 - 3) Size and location of initial access modules for acoustical tile.
 - 4) Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

- 5) Duct access panels.
- c. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- d. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

PART 2 PRODUCTS

2.1 AIR DISTRIBUTION DEVICES

- 1. Grilles, registers, diffusers and appurtenances shall conform to requirements specified herein and shall be of type and sizes as specified and indicated on Drawings. Performance shall be in accordance with ANSI/ASHRAE Standard 70 including airflow velocity, pressure, temperature, and sound measurements.
- 2. Sponge neoprene, rubber, vinyl or felt border gaskets shall be provided for surface-mounted registers, grilles or diffusers.
- 3. Provide suitable frame types to match the ceiling types as specified or indicated on the Architectural Drawings.
- 4. Ceiling diffusers shall be provided with equalizing grids.
- 5. Ceiling mounted grilles, registers and diffusers shall be provided with a factory applied, baked enamel, dull finish, bone white to match acoustical ceiling tile.
- 6. Grilles or registers mounted on painted walls or other surfaces shall be furnished with a baked prime coat and finish painted in accordance with Section 09 9000: Painting and Coating.
- 7. Do not provide opposed blade dampers at diffusers and registers to balance the airflow, as they tend to create noise. Provide a manual volume damper at each branch take-off and also at branch duct to each diffuser and register upstream of the flexible duct connections. Air throw patterns shall be as indicated on the drawings.
- 8. Diffusers, registers and grilles indicated or scheduled on the drawings to comply with special requirements shall take precedence over the standard items specified.

2.2 MANUFACTURERS

- a. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1) Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

- 2) Products: Subject to compliance with requirements, provide one of the products specified.
- 3) Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
- 4) Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.3 GRILLES AND REGISTERS

a. Adjustable Bar Grille:

- 1) Manufacturers:
 - a) Anemostat (see schedule for model)
 - b) Krueger.
 - c) Price Industries.
 - d) Titus.
- 2) Material: Steel
- 3) Finish: Baked enamel, color selected by Architect
- 4) Face Blade Arrangement: Fixed horizontal spaced 1/2 inch apart.

b. Fixed Face Grille:

- 1) Manufacturers:
 - a) Anemostat (see schedule for model)
 - b) Krueger.
 - c) Price Industries.
 - d) Titus.
- 2) Material: Steel.
- 3) Finish: Baked enamel, color selected by Architect.

2.4 CEILING DIFFUSER OUTLETS

a. Louver Face Diffuser:

- 1) Manufacturers:

- a) Anemostat (see schedule for model)
- b) Krueger
- c) Price Industries.
- d) Titus.
- 2) Material: Steel.
- 3) Finish: Baked enamel, color selected by Architect.
- 4) Mounting: Surface.
- 5) Pattern: Four-way core style.
- 6) Dampers: Radial opposed blade.
- 7) Accessories:
 - a) Square to round neck adaptor.
 - b) Adjustable pattern vanes.
 - c) Plaster ring.
 - d) Safety chain.
 - e) Wire guard.

2.5 SOURCE QUALITY CONTROL

- a. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 EXECUTION

3.1 EXAMINATION

- a. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- b. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- a. Install diffusers, registers, and grilles level and plumb.

- b. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- c. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- a. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 80 00

HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Air conditioning and air handling equipment including but not limited to:
 - 1. Single Packaged Air Conditioning Units.
 - 2. Split System Air Conditioning Units.
 - 3. Split System Heat Pump Units.
 - 4. Fans.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 07 6000: Flashing and Sheet Metal.
 - 3. Section 22 1000: Plumbing.
 - 4. Section 23 0500: Common Work Results for HVAC.
 - 5. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
 - 6. Section 23 0900: HVAC Instrumentation and Controls.
 - 7. Section 23 3000: Air Distribution.

1.2 DESIGN REQUIREMENTS

- A. Work of this Section is based on HVAC equipment units indicated as Basis of Design. Products from different HVAC equipment manufacturers listed are never identical, although equivalent in capacity, performance, and quality. In the cases where dimensions, weight, configuration and utility requirements differ from the products used as a basis of design, the Contractor, at no additional cost to the Owner, shall coordinate and submit, for Architect review, revisions to the design.

1.3 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. For products listed that are not the basis of design, submit the following in addition to above requirements:
 - 1. Title 24 Calculations: Replace HVAC unit values in calculation files provided by the Architect and submit for review.

1.4 QUALITY ASSURANCE

- A. Provide submittals in accordance with Section 23 0500: Common Work Results for HVAC.

1.5 PROJECT RECORD DOCUMENTS

- A. Provide Owner instructions on equipment operation and maintenance procedures, as indicated in Section 23 0500: Common Work Results for HVAC.

1.6 WARRANTY

- A. Compressors shall be provided with manufacturer's five year warranty, replacement only.
- B. Manufacturer shall warrant parts, except heat exchangers, for a period of five years.
- C. Heat exchangers shall be provided with manufacturer's ten year warranty, replacement only.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Capacities of air conditioning equipment indicated on Drawings are net capacities actually required. Standard catalog ratings shall be adjusted to actual Project site environmental conditions.

2.2 AIR CONDITIONING UNITS - AHU

- A. Manufacturers: Carrier, Trane, York, or equal.
 - 1. Basis of Design: [Carrier]
- B. Furnish packaged air conditioning unit with gas heating for indoor installation. Unit shall be self-contained, completely factory assembled, with complete internal wiring and controls. Unit shall be field configurable for horizontal discharge. Heating capacities, electrical characteristics, and operating conditions shall be as indicated on Drawings.
- C. Quality Assurance:
 - 1. Units shall be CSA certified for indoor installation.
 - 2. Unit shall be UL listed and designed to conform to ANSI Z21.47-2016/CSA 2.3-2016 Gas
 - 3. ANSI/NFPA 70: National Electrical Code.
 - 4. Unit heating efficiencies AFUE ratings shall comply with current CCR, Title 24, Building Energy Efficiency Standards for Residential and Nonresidential Buildings, and shall not be less than ratings indicated on drawings.
 - 5. Unit shall comply with California Maximum Oxides of Nitrogen (NOX) Emission Regulations and current SCAQMD regulations.
 - 6. Insulation and adhesive shall meet NFPA 90A and 90B requirements for flame spread and smoke generation.
 - 7. Each unit shall be run tested at factory per ANSI/ASHRAE 37 and provided with a certificate indicating tested pressures, amperages, dates, and inspector.
- D. Unit Cabinet:

1. Galvanized steel with baked enamel finish on external surfaces that are exposed to weather.
2. Interior surfaces exposed to conditioned and return air streams shall be insulated with a minimum ½-inch thick, 1 pound density foil-faced cleanable insulation.
3. Cabinet top cover shall be of one piece construction or where seams exist, shall be double hemmed and gasket sealed.
4. Cabinet panels shall be hinged access panels for filter, fan, control box and heat section areas. Each panel shall use multiple quarter-turn latches. Each major external hinged access panel shall be permanently attached to unit. Panels shall also include tiebacks.
5. Return air filters shall be accessible through a hinged access panel and be on a slide-out track using standard size filters.
6. Holes shall be provided in base rails (minimum 16 gage) for rigging shackles and level travel and movement during overhead rigging operations.

E. Fans and Motors:

1. Fan shall be a dynamically balanced, double width, double inlet, forward curved centrifugal type, fabricated of steel with a corrosion resistant finish that was tested and rated in accordance with AMCA requirements.
2. Fans shall be direct-driven.
3. Direct drive fans shall be provided with ECM motor.
4. Blower and motor shall have permanently lubricated, factory-sealed ball bearings and automatic-reset thermal overload protection.

F. Controls, Safeties and Diagnostic Points:

1. Unit Controls: Unit shall be furnished with self-contained, network capable and ready direct digital controls.
 - a. Controls shall be factory-installed.
 - b. Controls shall operate with zone control systems.
 - c. Controls shall furnish built-in diagnostics for thermostat commands for staged heating and cooling, evaporator-fan operation, and economizer operation.
 - d. Controls shall be furnished with a 5-minute time delay between modes of operation.
 - e. Control circuit shall be protected by a fuse on 24-V transformer side.
 - f. Control shall incorporate passive infrared detection for sensing occupancy in space serve.
2. Operating Characteristics:
 - a. Unit shall be capable of meeting maximum load criteria of AHRI Standard 210/240 or 360 at plus or minus 10 percent voltage.
3. EMS Diagnostic Points: Provide diagnostic points for units, including those at projects with no EMS.
 - a. Supply air temperature.
 - b. Space temperature.
 - c. Outdoor air temperature.

- d. Filter status.
- e. Fan status.
- f. Other diagnostic point required by current Title 24, automated fault detection and diagnostics (FDD).

G. Filter Section:

- 1. Provide filter section with factory-installed low-velocity, throwaway 4" 2-inch thick high capacity, MERV 13, or equal, filters of commercially available sizes unless noted otherwise on the drawings.
- 2. Filter face velocity shall not exceed 300 fpm at nominal airflows.
- 3. Filter section shall allow installation of standard size air filter.

H. 100 Percent Outdoor Air Unit:

Approved manufacturers are:

- iAire
- Desert-Aire
- Aeon

- 1. Provide 100 percent packaged DX outdoor air unit as indicated on drawings, with integral compressor(s), and evaporator coil located within the weather-tight unit housing. The packaged DX system shall be controlled by as onboard microprocessor based digital controller (DDC) that indicates both owner-supplied setting, unit status and fault conditions that may occur. The DDC shall be programmed for space control.
- 2. Low-leakage dampers not to exceed 3 percent leakage, at one inch wg pressure differential (variable sliding economizer).
- 3. Dampers Using Electronic Actuators:
 - a. Manufacturer: Belimo, Honeywell, Invensys, Johnson Controls, or equal.
 - b. Size for torque required for damper seal at load conditions.
 - c. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.
 - d. Overload Protection: Electronic overload or digital rotation-sensing circuitry without the use of end switches to prevent damage to the actuator during a stall condition.
 - e. Fail-Safe Operation: Mechanical, spring-return mechanism.
 - f. Power Requirements: Maximum of 10 VA at 24 VAC or 8 W at 24 VDC.
 - g. Proportional Actuators shall be fully programmable. Control input, position feedback and running time shall be factory or field programmable by use of external computer software. Diagnostic feedback shall provide indications of hunting or oscillation, mechanical overload and mechanical travel. Programming shall be through EEPROM without the use of actuator mounted switches.
 - h. Actuators shall be listed by ISO 9001, ULC, and CSA C22.2.

- I. Parts Availability: Submit proof in writing that majority (minimum 80 percent) of the replacements parts are commonly available and not proprietary. Also, submit proof in writing that a local parts sales and service facility exists, where replacement parts will be warehoused in quantity. Guarantee timely availability for parts that are proprietary.

- J. Units Controls

The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats, and sensors. The units shall have factory installed variable frequency drive for modulation of supply air blower assembly if needed. The VFD shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.

2.3 FAN COIL UNITS AND CONDENSING UNITS

- A. Manufacturer: Carrier, Trane, York, or-equal.

- B. Basis of Design: [Carrier]

- C. FCU and CU: Furnish fan coil unit (FCU) and condensing unit (CU), split type, air-cooled, roof or ground for ducted connections or free blow. Units shall be air-cooled condensing unit/direct expansion fan coil combinations. Condensing unit outdoor section shall be factory assembled with a direct-drive condenser fans with horizontal or vertical air discharge, scroll-type compressor, refrigerant coil, fan motors, pre-wired control panel and a holding charge of a non-ozone depleting refrigerant. Contractor shall provide additional refrigerant for extended lines. Indoor fan coil unit shall be furnished with horizontal discharge and will include evaporator coil, fan and motor, condensate pan with drain, thermal expansion valve, pre-wired control panel and remote thermostat control. Unit shall provide an EER/SEER complying with CCR, Title 24, Building Energy Efficiency Standards for Residential and Nonresidential Buildings. UL listed and rated at AHRI Standard 210/240.

- D. Nominal unit cooling, heating capacities, electrical characteristics, and operating conditions shall be as indicated on Drawings.

- E. Condenser coils:

- 1. Acceptable Condenser Coils:

- a. Copper-tube, aluminum-fin coil, with liquid subcooler. Internally enhanced 3/8-inch outside diameter, seamless copper tubing mechanically bonded to aluminum fins with a factory applied Corrosion-Resistant Epoxy Coating. Provide Protective Hail Guard.
 - b. Spine Fin™ condenser coil shall be continuously wrapped, corrosion resistant aluminum with minimum brazed joints. This coil is 3/8 inch outside diameter seamless aluminum tubing glued to a continuous aluminum fin. Coils are lab tested to withstand 2,000 pounds of pressure per square inch. The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on four sides by louvered panels.
 - c. Coil shall be air-cooled Micro-Channel heat exchanger technology (MCHX) and shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a two-pass arrangement. Coil construction shall consist of

aluminum alloys for fins, tubes, and manifolds in combination with a factory applied Corrosion-Resistant Epoxy Coating. Provide Protective Hail Guard.

- F. Condenser Coils shall be furnished with copper plate fins mechanically bonded to enhanced copper tubes with copper tube sheets and brazed joints. Coated coils are not acceptable.
- G. Evaporator coils:
 - 1. Aluminum plate fins mechanically bonded to enhanced copper tubes with joints brazed.
 - 2. Tube sheet openings shall be belled to prevent tube wear.
 - 3. Evaporator coil shall be of full-face active design. Dual circuit models shall have face-split type evaporator coil.
- H. Evaporator Coils at locations within two miles from ocean shall be furnished with copper plate fins mechanically bonded to enhanced copper tubes with copper tube sheets and brazed joints. Coated coils are not acceptable.
- I. Condenser Fan and Motors: Condenser fan shall be a dynamically balanced, propeller type, fabricated of aluminum blades riveted to corrosion resistant steel spiders and direct-driven by a totally enclosed motor. Condenser air shall be discharged horizontally or vertically. Condenser fan motors shall be high efficiency or ECM type motor.
- J. Cabinets: Fabricated of galvanized steel, bonderized and finished with baked enamel.
- K. Compressor shall be serviceable two stage or variable speed type hermetic scroll. Compressor shall be furnished with access valves and shall be installed on rubber isolators to reduce sound vibration. It shall be furnished with high and low-pressure protection. Each horizontal discharge condensing unit shall be furnished with a factory installed suction accumulator. Field installed accumulators are not permitted. It shall be furnished with high and low-pressure protection, brass external vapor supply line service valves, vapor return line service valves with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps, filter drier, pressure relief, liquid line solenoid valves, thermostatic expansion valves, and a holding charge of refrigerant.
- L. Controls: Compressor motor assembly shall be protected with high and low-pressure switches, internal overloads, internal thermostat, internal relief valve, and anti-recycle relay, or time cycle device to prevent rapid cycling of compressor after any off cycle. Unit shall incorporate an automatic relay for indoor circulating air blower. Control panel shall be pre-wired in unit casing. The control circuit shall incorporate a manual reset safety circuit to render refrigerant system (compressor and outdoor air motor) inoperative should there be a loss of airflow or refrigerant. Units shall also be furnished with automatic condenser-fan motor protection, high condensing temperature protection, compressor motor current and temperature overload protection, high pressure relief, and condenser fan failure protection.
- M. EMS Diagnostic Points:
 - 1. Supply air temperature.
 - 2. Return air temperature.

3. Space temperature.
 4. Filter status.
 5. Fan status.
 6. Compressor status.
 7. Other diagnostic point required by current Title 24, automated fault detection and diagnostics (FDD).
- N. Low Ambient Operation: Head pressure control shall be provided for operation at outside air temperature below 45 degrees F.
- O. Filters: Filters shall be 2-inch standard size high capacity replaceable media type MERV 13, or equal, installed in an external 2-inch rack filter section and complete with an access door.
- P. An in-line filter-drier shall be provided with equipment and shall be installed at Project site.
- Q. Economizer: Provide on units with capacities equal to, or larger than 4.5 tons nominal capacity, when the Prescriptive Compliance approach is utilized to comply with Energy Efficiency Standards. Economizer shall be manufacturer's standard; factory furnished and field installed. Economizer control shall maintain a fixed supply air temperature during free cooling operation by providing full modulation of operable outside and return air dampers.

2.4 HEAT PUMP AND FAN COIL UNITS

- A. Manufacturer: Carrier, Trane, York, or equal.
1. Basis of Design: [Carrier]
- B. HP and matching indoor fan coil unit and condenser unit: Furnish heat pump, split type, air-cooled, roof or ground installation with ducted connections or free blow. Units shall be air-cooled heat pump/direct expansion fan coil combinations. Heat pump outdoor section shall be factory assembled and furnished with direct-drive condenser fans with horizontal or vertical air discharge, scroll type compressor, refrigerant coil, fan motors, pre-wired control panel. Unit shall also be provided with a fully piped refrigerant circuit, fully charged with an environmentally friendly refrigerant that is not scheduled for phase out. Provide additional refrigerant for extended lines. Indoor fan coil unit shall be furnished with horizontal discharge and will include evaporator coil, fan and motor, condensate pan with drain, thermal expansion valve, pre-wired control panel and remote thermostat control. Nominal unit cooling, heating capacities, electrical characteristics, and operating conditions shall be as indicated on Drawings.
- C. Quality Assurance:
1. Cooling capacity rated in accordance with current AHRI Standard 210/240 and 270. Units shall be listed in AHRI.
 2. Unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with NEC.
 3. Units shall be constructed in accordance with UL standards and shall carry UL label of approval. Units shall have CSA approval.

4. Units shall be listed in CEC directory.
 5. Unit shall provide an EER/SEER/COP complying with CCR, Title 24, Building Energy Efficiency Standards and per the drawings.
- D. Evaporator and condenser coils: Evaporator and condenser coils shall be copper with mechanically bonded, smooth aluminum plate fins. Tube joints shall be brazed with copper or silver alloy. Coils shall be pressure-tested at factory. Protective metal guard for inlet and outlet of outdoor coil.
- E. Evaporator and Condenser Coils at locations within two miles from ocean shall be furnished with copper plate fins mechanically bonded to enhanced copper tubes with copper tube sheets and brazed joints. Coated coils are not acceptable.
- F. Fans:
1. Condenser Fan and Motors: Condenser fan shall be ECM type motor direct driven, propeller type arranged for horizontal or vertical discharge. Condenser fan motors shall be furnished with inherent protection, and shall be permanently lubricated type, resiliently mounted for quiet operation. Each fan shall be furnished with a safety guard.
 2. Evaporator fan section shall be furnished with ECM type motor centrifugal, forward curved, double width, double inlet fan or fans installed on a solid shaft. Fan shall be statically and dynamically balanced and shall rotate on permanently lubricated bearings.
- G. Unit Cabinets:
1. Cabinets shall be fabricated of galvanized steel, bonderized and finished with baked enamel.
 2. Cabinet interior shall be insulated with minimum one inch thick foil face fiberglass.
 3. Outdoor unit compartment shall be isolated and have an acoustic lining to assure quiet operation.
- H. Compressor: Compressor shall be two stage or variable speed type hermetic scroll.
1. Compressor shall be furnished with access valves and it shall be installed on rubber isolators to reduce sound vibration.
 2. Furnish with high and low-pressure protection.
 3. Each heat pump shall be furnished with factory installed suction accumulator. Field installed accumulators are not permitted.
 4. It shall be furnished with high and low-pressure protection, brass external vapor supply line service valves, vapor return line service valves with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps, filter drier, pressure relief, liquid line solenoid valves, thermostatic expansion valves, and a holding charge of refrigerant.
- I. Refrigeration Components: Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader type fittings with brass caps, accumulator, bi-flow filter

drier, pressure relief, reversing valve, heating mode metering device, and a holding charge of refrigerant.

J. Controls and Safeties:

1. Compressor motor assembly shall be protected with high and low-pressure switches, internal overloads, internal thermostat, internal relief valve, and anti-recycle relay, or time cycle device to prevent rapid cycling of compressor after any off cycle.
2. Control panel shall be pre-wired in unit casing.
3. The control circuit shall incorporate a safety circuit to render refrigerant system (compressor and outdoor air motor) inoperative should there be a loss of airflow or refrigerant.
4. Units shall also be furnished with automatic condenser-fan motor protection, high condensing temperature protection, compressor motor current and temperature overload protection, high pressure relief and condenser fan failure protection.

K. EMS Diagnostic Points:

1. Supply air temperature.
2. Return air temperature.
3. Space temperature.
4. Filter status.
5. Fan status.
6. Compressor status.
7. Other diagnostic point required by current Title 24, automated fault detection and diagnostics (FDD).

L. Low Ambient Operation: Head pressure control shall be provided for operation at outside air temperature below 45 degrees F.

M. Safeties:

1. High condensing temperature protection.
2. Compressor motor current and temperature overload protection.
3. High pressure relief.
4. Outdoor fan failure protection.

N. Filters:

1. Filters shall be 2-inch standard size high capacity replaceable media type, MERV 13, or equal, installed in an external 2-inch rack filter section and complete with an access door.
2. An-line filter-drier shall be furnished with equipment and installed at Project site.

O. Economizer: Provide on units with capacities equal to, or larger than 4.5 tons nominal capacity, when the Prescriptive Compliance approach is utilized to comply with Energy Efficiency Standards or where necessary to achieve CHPS pre-requisite and/or CHPS building flush-out compliance. Economizer shall be manufacturer's standard; factory furnished and field installed. Economizer control shall maintain a fixed supply air

temperature during free cooling operation by providing full modulation of operable outside and return air dampers.

P. Provide programmable digital thermostat with following features:

1. 7-day time clock.
2. Heat, cool, automatic changeover.
3. Occupied / Unoccupied modes.
4. Dry contact switch for input from an external device such as a central time clock, occupancy sensor, or a telephone activated device.
5. Robertshaw, Honeywell, Johnson Controls, Carrier, Schneider Electric, Viconics, or equal with built-in occupancy sensor. Refer to Section 23 0900 for areas with zone damper controls.
6. Remote sensors. School Areas that could be subject to vandalism or accidental impact damage such as Gymnasiums, Auditoriums, Multipurpose Rooms, Corridors and Lobbies shall be provided with thermostats with remote return air duct or room sensors. Verify remote location of sensors and thermostats with Architect.

Q. Demand Control Ventilation:

1. Units of 6.25 nominal tons and higher capacity shall be provided with Indoor Air Quality (CO2) Sensor and Accessory Electronic Expansion Boards.
2. The unit shall have ability to provide demand ventilation indoor-air quality (IAQ) control through economizer when provided with an indoor air quality sensor and accessory expansion board.
3. The IAQ sensor shall be duct mounted in return air main duct unless otherwise indicated on Drawings. The set point shall be adjustable.
4. The IAQ sensor shall be powered through unit. If not, required control transformer shall be provided by manufacturer. Coordinate power requirements and location with Division 26.
5. The IAQ sensor shall provide a 4 to 20 mA signal to expansion board.

R. Start-up: Factory test each unit before shipment to Project site. Performance test shall include full refrigeration start-up, fan and controls start-up. Each unit shall be provided with its own report with its own serial number. Non-tested units are not permitted to be delivered to Project site. Provide full start-up of units to include full refrigeration and provide a written report.

S. Parts Availability: Submit proof in writing that majority (minimum 80 percent) of replacements parts are commonly available and not proprietary. Also, submit proof in writing that a local parts sales and service facility exists, where replacement parts will be warehoused in quantity. Guarantee timely availability for parts that are proprietary.

2.5 ROOF MOUNTED POWER SUPPLY AND EXHAUST VENTILATORS

A. RMEV-1

1. Manufacturer:

CARNES	GREENHECK	LOREN COOL	PENNBARRY	TWIN CITY & BLOWER	OR EQUAL
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VEBK Series	GB Series	ACEB	Domex-Belt Drive	BCRD	
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2. Spun aluminum, roof mounted, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings. Provide required accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.
3. Housing: The spun aluminum structural components shall be constructed of minimum 18 gage Aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate.

2.6 FILTERS

- A. Air filters shall be of pleated, high capacity, disposable type of efficiencies indicated on drawings. Each filter shall consist of a non-woven cotton fabric media, media support grid, and enclosing frame. Filter shall be UL 900 listed, Class 2.
- B. Filter media shall provide an average efficiency as specified on drawings per ASHRAE Standard 52.2.
- C. Initial resistance of air filters shall not exceed following limits for each efficiency level at face velocities indicated. Lower resistance requirements, if indicated on drawings shall have precedence.
 - 30 percent (MERV 8) 0.27 inch water gage at 500 feet per minute
 - 75 percent (MERV 11) 0.28 inch water gage at 500 feet per minute
 - 85 percent (MERV 13) 0.30 inch water gage at 500 feet per minute
- D. Use standard size Filter Medias only.
- E. Media support shall be a welded wire grid or a rigid frame with an effective open area of not less than 96 percent.
 1. Media support shall be bonded to filter media to eliminate possibility of media oscillation and media pull-away.
 2. Media support grid shall be formed in such a manner that it effectively forms a radial pleat design, providing total use of filter media.
- F. Enclosing frame shall be bonded to air entering and air exit side of each pleat, to ensure pleat stability. Inside periphery of enclosing frame shall be bonded to filter pack, thus eliminating possibility of air bypass.
- G. Holding frames shall be factory fabricated of 16 gage galvanized steel, or equivalent and shall be furnished with gaskets and spring type positive sealing fasteners. Fasteners shall be capable of being attached or removed without use of tools.
- H. Manufacturers: Camfil Farr, Koch, or AAF.

2.7 LOUVERS, AIR CONDITIONING (use in conjunction with relief damper)

- A. Standard steel louvers shall be furnished complete with frames, blades, finish and construction details per Drawings and manufacturer's recommendations.
- B. Louvers shall be furnished with horizontal blades, 2 inches deep for air through wall installation in conjunction with gravity relief damper for backdraft protection that will open at 0.01 inch wc room static pressure as indicated on Drawings. Blades shall be 16-gage steel, spaced at 1 7/8-inch at 30 degrees angle, and with baked epoxy coating. Panel size shall be as indicated but not less than 24 inches width by 18 inches in height.

PART 3 - EXECUTION

3.1 GENERAL

- A. Examine areas under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 EQUIPMENT FOUNDATIONS

- A. Provide foundations (housekeeping pads, level platforms or curbs) for mechanical equipment whether indicated on drawings or not. Equipment foundations shall be of sufficient size and weight, and of proper design to preclude shifting of equipment under operating conditions, or under abnormal conditions imposed upon equipment.
- B. Provide foundations (housekeeping pads, level platforms or curbs) for mechanical equipment whether indicated on drawings or not. Foundations shall meet requirements of equipment manufacturer and, when required by Architect, obtain from equipment manufacturer, approval of foundation design and construction, for equipment to be installed. Equipment vibration shall be maintained within design limits, and shall be dampened and isolated. Isolators shall be bolted to a structural member so as to be readily removable.

3.3 EQUIPMENT DESIGN AND INSTALLATION

- A. Uniformity: Unless otherwise specified, equipment of same type or classification shall be product of same manufacturer.
- B. Application: Only provide equipment as reviewed by Architect.
- C. Equipment Installation: Equipment installation shall be in strict accordance with these Specifications, and installation instructions of manufacturers. Equipment installed on concrete foundations shall be grouted before piping is installed. Piping shall be installed in such a manner as not to place a strain on equipment. Flanged joints shall be adequately extended before installation. Piping shall be graded, anchored, guided and supported, without low pockets.
 - 1. Install equipment in a neat and skillful manner, properly aligned, leveled, and adjusted for satisfactory operation.
 - 2. Install so connecting and disconnecting of piping and accessories can be readily accomplished, parts are readily accessible for inspection, service and repair.

Space shall be provided to readily remove filters, coils, compressors and fan wheels. Access doors shall be hinged with cam lock door handles.

3. Provide flexible connections for duct, pipe and conduit connections at moving equipment.

3.4 NOISE AND VIBRATION

- A. Operation of Equipment: Mechanical equipment and piping systems shall operate without exceeding specified noise and/or vibration levels.
- B. Corrective Measures: If specified noise and/or vibration levels are exceeded, provide necessary changes to reduce noise and/or vibration levels to within specified levels.

3.5 FIELD TESTS AND INSPECTION

- A. General: Perform field inspections, field tests, and trial operations as specified in Section 23 0500: Common Work Results for HVAC. Provide labor, equipment and incidentals required for testing. The Project Inspector will witness field tests and trial operations as specified in Section 23 0500: Common Work Results for HVAC.
- B. Equipment and Material: Equipment and material certified as being successfully tested by manufacturer, in accordance with referenced Specifications and standards, will not require re-testing before installation. Equipment and materials not tested at place of manufacture will be tested before or after installation, as applicable or necessary, to determine compliance with reference Specifications and standards.
- C. Start-Up and Operational Test: System shall be started up and initially operated with components operating. During this test, various strainers or filters shall be periodically cleaned until no further accumulation of foreign material occurs. Adjust safety and automatic control instruments as required to provide proper operation and control sequence. Refer to Section 23 0500: Common Work Results for HVAC.
- D. Extent of Field Tests: After installation and before completion, Work of this Section shall be subjected to required field tests, including those specified here and in Section 23 0500: Common Work Results for HVAC.
- E. Operation and Maintenance Data: Provide required operation and maintenance data as specified in Section 23 0500: Common Work Results for HVAC.

3.6 REFRIGERANT PIPING

- A. Unless otherwise indicated, main liquid and suction lines from condensing unit to evaporator coil shall be of sizes specified by manufacturer.
- B. Refrigeration piping shall be refrigeration grade copper tubing, type L hard-drawn. In instances where refrigeration lines are installed in an inaccessible location and must be snaked through conduit or a trench, that portion of tubing required to complete connections through conduit or trench may be soft drawn. Maintain entire system clean and dry during installation. Pipe shall be sealed until installed.
- C. Refrigeration piping, both hard and soft-drawn, shall be straight and free from kinks, restrictions and horizontal runs shall be sloped towards compressor one inch to 10 feet

wherever possible. Vapor line oil traps shall be installed on bottom of vertical risers and inverted oil trap shall be installed on top of vertical risers.

- D. Joints shall be installed with Sil-Fos 15, Silvaloy 15, or equal.
- E. Flare nuts required on suction lines shall be of short forged or frost-proof type. Other fittings shall be standard sweat-soldered type. Ells and return bends shall be long radius type. Install leak lock material.
- F. Refrigeration Piping: Joints shall be silver brazed and leak tested. Field fabricated lines shall be thoroughly flushed and cleaned before connection. Bleed nitrogen through lines during silver brazing, and cap and seal lines when not completed and connected to equipment.
- G. Sleeve penetrations of floors, walls and ceiling to allow for free motion of piping. Provide 24 gage galvanized iron pipe and chrome-plated escutcheon plates. Pack annular space between pipe and sleeve with incombustible material such as fiberglass and seal each end with mastic to provide a waterproof seal.
- H. Install insulated couplings at points of connection between dissimilar metals for cathodic protection. Insulate copper tubing from ferrous materials and hangers with 2-inch thickness of 3-inch wide strip, 10 mil polyvinyl tape wrapped around pipe.
- I. Support piping by iron hangers and supports. Hydra-Zorb cushion clamps, LSP Products Group Acousto Clamp, or equal, on non-insulated piping, and Klo-Shure coupling clamp on insulated piping, or equal.
- J. Provide saddles to protect pipe insulation.
- K. Provide connections of copper, copper plated steel, steel, and brass pipe and tubing with Harris Products Group Safety-Silv 56, Lucas-Milhaupt, Inc., or equal, complying with ANSI/AWS A5.8 and NSF 51.
- L. Insulate refrigerant suction lines.
- M. On split heat pump systems, insulate both vapor and liquid lines. For insulation materials, refer to Section 23 0700: HVAC Insulation.

3.7 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off Project site.

3.8 PROTECTION

- A. Protect Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 80 01

HEAT PUMP VARIABLE REFRIGERANT FLOW EQUIPMENT

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

- A. Related Documents:
 - 1. Division 01: General Requirements.
 - 2. Section 22 1000: Plumbing.
 - 3. Section 23 0500: Common Work Results for HVAC.
 - 4. Section 23 0513: Basic HVAC Materials and Methods.
 - 5. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
 - 6. Section 23 0923: Environmental Control and Energy Management System.
- B. The heat pump variable refrigerant flow system is a two-pipe system consisting of a single or multiple outdoor units, multiple indoor units of various types and capacities, individual or central indoor unit controls with on/off temperature settings, all connected by fully insulated refrigerant lines utilizing factory supplied, fully insulated, branching kits. Indoor units are connected to condensate piping that shall be terminated to the nearest drain point.
- C. The system shall be fully capable of providing heating or cooling as requested by the individual indoor zones that can consist of single or multiple indoor units. The heating priority shall be the default factory setting and can be changed to cooling, majority, or a single zone priority.
- D. The maximum number of connected indoor units shall not exceed 64.
- E. The total connected indoor unit capacity shall range between 50 and 150% of the outdoor unit capacity based on indoor unit type & size selected.

1.2 QUALITY ASSURANCE

- A. Units shall be listed by ETL (Engineering Testing Laboratory) and be evaluated in accordance with UL standard 1995, 4th. edition.
- B. Units shall be listed in the AHRI directory.
- C. All units shall meet the Federal minimum efficiency standards and be tested per AHRI 1230 Standard.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Units shall be shipped in one piece and shall be stored and handled per unit manufacturer's recommendations.

- B. Units shall be supplied with a base rail that provides openings for moving the unit by fork truck or rigging the unit by crane.

1.4 WARRANTY

- A. Compressors shall be provided with manufacturer's five year warranty, replacement only.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Manufacturers: Toshiba, Mitsubishi, Daikin.

- 1. Basis of Design: [Toshiba]

- General: Factory-assembled, single piece air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and the multiple inverter-driven twin rotary compressors.

- 2. The maximum sound pressure rating for a single module shall not exceed 64 dBA sound pressure in cooling and 65 dBA in heating and for multiple modular systems the sound pressure numbers should not exceed 68 dBA and 69 dBA. Sound pressure ratings are measured at a distance of 3 ft out and 4 ½ ft up from the side of the outdoor unit.
 - 3. The outdoor unit shall include an oversized accumulator and a liquid tank for proper heating performance while allowing the indoor unit PMV (pulse modulating valve) metering device to shut off completely when a zone is satisfied.
 - 4. The outdoor unit shall be protected by a high-pressure switch, high-pressure sensor, low-pressure sensor, fusible plug, PC board, and inverter overload protector.
 - 5. The outdoor unit shall be capable of operating in cooling mode down to 14F ambient air temperature and down to -13 F wet bulb ambient air temperature in heating.
 - 6. The outdoor unit shall include a total oil management system that balances oil between compressors within a module, replenishes compressor oil to the compressors in a module from the oil separator if required, and allows oil and refrigerant to move between multiple modular units if required, even if one of the units is not running.

- B. Unit Cabinet:

- 1. Unit cabinet shall be constructed of pre-coated steel, finished on both inside and outside.
 - 2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressors, fan, and control components.
 - 3. Compressors shall be isolated in a compartment and have an acoustic wrap to assure quiet operation.
 - 4. The outdoor unit control panel shall include a sliding window to access adjustable controls and an LED display for setup and diagnostics.
 - 5. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (method 6061).

C. Fans:

1. Outdoor fan shall discharge air vertically and be driven by a DC inverter variable speed motor with 64 steps that is capable of running down to 60 rpm.
2. Outdoor fan motor shall be totally-enclosed with permanently-lubricated bearings.
3. Motor shall be protected by internal thermal overload protection.
4. Fan blade shall be non-metallic and shall be statically and dynamically balanced.
5. Outdoor fan shall be protected by a raised non metallic protective grille.

D. Compressors:

1. Each outdoor unit module shall be equipped with two inverter-driven twin rotary compressors with full range control to an accuracy of ± 0.1 Hz.
2. Compressor shall be totally enclosed in the machine compartment.
3. Compressors shall be equipped with factory mounted crankcase heaters.
4. Internal overloads shall protect the compressor from over-temperature operation.
5. Motor shall be suitable for operation in an R-410A refrigerant atmosphere.
6. Compressor assembly shall be installed on rubber vibration isolators.
7. To maximize compressor reliability, multiple compressors within a module shall be started and operated in variable patterns to ensure equal run time on all compressors.
8. To ensure maximum efficiency throughout the system operation range, no compressor is required to run at maximum speed under any condition.

E. Outdoor Coil:

1. Coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.
2. The coil configuration shall be 4-sided and fully separated from the machine compartment for more effective heat transfer and sound isolation.
3. The coil fins shall have a factory-applied corrosion resistant blue-fin finish.

F. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:

1. Controls:
 - a. Compressor speed to match the refrigerant flow and capacity with the system requirements.
 - b. Outdoor fan motor speed for higher efficiency and lower sound.
 - c. Oil control for improved system reliability and comfort
 - d. Pulse modulating valve control for precise control of the refrigerant distribution and accurate capacity management to avoid starving any units.
 - e. Control of compressor staging to maximize reliability and minimum run time on all compressors.
 - f. Module control of compressor operation, compressor speed, and outdoor heat exchanger surface to maximize efficiency and sound level and reliability across the entire operating range of the system.

- g. Control of the outdoor heat exchanger surface (main vs sub heat exchangers) for maximum efficiency and comfort.
 - 2. Safeties: The following safety devices shall be part of the condensing unit:
 - a. High-pressure switch
 - b. Fuses
 - c. Crankcase heater
 - d. Fusible plug
 - e. Overcurrent relay for the compressor
 - f. Thermal protectors for compressor and fan motor
 - g. Compressor time delay
 - h. Oil recovery system
 - i. Oil level sensor
 - j. Overcurrent sensor
 - k. Compressor suction and discharge temperature sensor
 - l. Compressor suction and discharge pressure sensor
- G. Electrical Requirements:
 - 1. All sizes shall utilize 208/230-1-60 (V-Ph-Hz) field power supply.
 - 2. Multiple systems shall have separate field power supply to each module.
 - 3. Two-core, standard, shielded low voltage cable shall be required for communication between outdoor and indoor unit.
 - 4. All power and control wiring must be installed per NEC and all local electrical codes.
- H. Refrigerant Piping and Line Lengths:
 - 1. Piping connections shall be from the front or the bottom of the unit. The unit shall be capable of operating with maximum connected refrigerant line lengths up to 3281 (ft) actual based on total system capacity and refrigerant amount.
 - 2. The outdoor unit shall have the ability to operate with a maximum height of 230 ft between the outdoor and the lowest indoor unit.
 - 3. The maximum distance between the outdoor unit and the furthest fan coil shall not exceed 623 ft actual or 771 ft equivalent. No line size changes or oil traps shall be required.
 - 4. The system shall be capable of operating when the height difference between the upper and the lower fan coil is 131 ft.
- I. Auxiliary Refrigerant Components:
 - 1. All field-supplied copper tubing connecting the outdoor unit to the indoor unit shall use factory-supplied branching kits consisting of either Y joints or headers to ensure even refrigerant flow.
 - 2. To ensure piping flexibility, the system shall allow having Y joints or headers downstream of another header.

3. When combining multiple modules, and in order to maximize efficiency and comfort, a 3/8-in. oil balance line shall be used to allow the flow oil and refrigerant between the two units, even when one of the units is not running.

END OF SECTION

SECTION 23 80 03

HEAT RECOVERY VARIABLE REFRIGERANT FLOW EQUIPMENT

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

A. RELATED DOCUMENTS

1. Division 01: General Requirements.
2. Section 22 1000: Plumbing.
3. Section 23 0500: Common Work Results for HVAC.
4. Section 23 0513: Basic HVAC Materials and Methods.
5. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
6. Section 23 0923: Environmental Control and Energy Management System.

B. The heat recovery variable refrigerant flow system is a three-pipe system consisting of a single or multiple outdoor units, multiple indoor units of various types and capacities, and multiple flow selector boxes, individual or central indoor unit controls with on/off temperature settings, all connected by fully insulated refrigerant lines utilizing factory-supplied, fully insulated branching kits. Indoor units are connected to condensate piping that shall be terminated to the nearest drain point.

C. The system shall be fully capable of simultaneous heating and cooling operation as requested by the individual indoor zones that can consist of single or multiple indoor units.

D. The maximum number of connected indoor units shall not exceed 64.

E. The total connected indoor unit capacity shall range between 50 and 150% of the outdoor unit capacity.

1.2 QUALITY ASSURANCE

A. Units shall be listed by ETL (Engineering Testing Laboratory) and be evaluated in accordance with UL standard 1995, 4th. edition.

B. Units shall be listed in the AHRI directory.

C. All units shall meet the Federal minimum efficiency standards and be tested per AHRI 1230 Standard

1.3 DELIVERY, STORAGE, AND HANDLING

A. Units shall be shipped in one piece and shall be stored and handled per unit manufacturer's recommendations.

B. Units shall be supplied with a base rail that provides openings for moving the unit by fork truck or rigging the unit by crane.

1.4 WARRANTY

- A. Compressors shall be provided with manufacturer's five year warranty, replacement only.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Manufacturers: Toshiba, Mitsubishi, Daikin.

1. Basis of Design: [Toshiba]
2. General: Factory-assembled, single-piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and the multiple inverter-driven twin rotary compressors.
3. The maximum sound pressure rating for a single module shall not exceed 66.5 dBA sound pressure in cooling and 67.0 dBA in heating. For twinned systems the sound pressure level shall not exceed 69.5 dBA and 70.0 dBA. For 3-module systems the sound pressure level shall not exceed 71.5 dBA and 71.5 dBA. Sound pressure ratings are measured at a distance of 3.28 ft out and 4.92 ft up from the side of the outdoor unit.
4. The outdoor unit shall include an oversized accumulator and a liquid tank for proper heating performance while allowing the indoor unit PMV (pulse modulating valve) metering device to shut off completely when a zone is satisfied.
5. The outdoor unit shall be protected by a high-pressure switch, high-pressure sensor, low-pressure sensor, fusible plug, PC board, and an inverter overload protector.
6. The outdoor unit shall be capable of operating in cooling mode down to 14 F dry bulb ambient air temperature and down to -13 F wet bulb ambient air temperature in heating. For simultaneous heating and cooling the unit shall be capable of operating between 14 F and 60 F ambient air temperature.
7. The outdoor unit shall include a total oil management system that balances oil between compressors within a module, replenishes compressor oil to the compressors in a module from the oil separator if required, and allows oil and refrigerant to move between twinned or 3-module units if required, even if one of the units is not running.

- B. Unit Cabinet:

1. Unit cabinet shall be constructed of pre-coated steel, finished on both inside and outside.
2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressors, fan, and control components.
3. Compressors shall be isolated in a compartment and have an acoustic wrap to assure quiet operation.
4. The outdoor unit control panel shall include a sliding window to access adjustable controls and an LED display for setup and diagnostics.
5. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (method 6061).

C. Fans:

1. Outdoor fan shall discharge air vertically and be driven by a DC-inverter variable-speed motor with 64 steps that is capable of running down to 60 rpm.
2. Outdoor fan motor shall be totally-enclosed with permanently-lubricated bearings.
3. Motor shall be protected by internal thermal overload protection.
4. Fan blade shall be non-metallic and shall be statically and dynamically balanced.
5. Outdoor fan shall be protected by a raised non-metallic protective grille.

D. Compressors:

1. Each outdoor unit module shall be equipped with two inverter-driven twin rotary compressors with full-range control to an accuracy of ± 0.1 Hz.
2. Compressor shall be totally enclosed in the machine compartment.
3. Compressors shall be equipped with factory-mounted crankcase heaters.
4. Internal safety logic shall protect the compressor from over-temperature operation.
5. Motor shall be suitable for operation in an R-410A refrigerant atmosphere.
6. Compressor assembly shall be installed on rubber vibration isolators.
7. To maximize compressor reliability, multiple compressors within a module shall be started and operated in variable patterns to ensure equal run time on all compressors.
8. To ensure maximum efficiency throughout the system operation range, no compressor is required to run at maximum speed under any condition.

E. Outdoor Coil:

1. Coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.
2. The coil configuration shall be 4-sided and fully separated from the machine compartment for more effective heat transfer and sound isolation.
3. The coil fins shall have a factory-applied corrosion resistant blue-fin finish.

F. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:

1. Controls:
 - a. Compressor speed to match the refrigerant flow and capacity with the system requirements.
 - b. Outdoor fan motor speed for higher efficiency and lower sound.
 - c. Oil control for improved system reliability and comfort
 - d. Pulse modulating valve control for precise control of the refrigerant distribution and accurate capacity management to avoid starving any units.
 - e. Control of compressor staging to maximize reliability and minimum run time on all compressors.

- f. Module control of compressor operation, compressor speed, and outdoor heat exchanger surface to maximize efficiency and sound level and reliability across the entire operating range of the system.
 - g. Control of the outdoor heat exchanger surface (main vs sub heat exchangers) for maximum efficiency and comfort.
 - 2. Safeties: The following safety devices shall be part of the condensing unit:
 - a. High-pressure switch
 - b. Fuses
 - c. Crankcase heater
 - d. Fusible plug
 - e. Over current relay for the compressor
 - f. Thermal protectors for compressor and fan motor
 - g. Compressor time delay
 - h. Oil recovery system
 - i. Oil level sensor
 - j. Over-current sensor
 - k. Compressor suction and discharge temperature sensor
 - l. Compressor suction and discharge pressure sensor
- G. Electrical Requirements:
 - 1. All sizes shall utilize 208/230-3-60 (V-Ph-Hz) field power supply.
 - 2. Modular systems shall have separate field power supply to each module.
 - 3. Two-core, stranded, shielded low voltage cable shall be required for communication between outdoor and indoor unit.
 - 4. All power and control wiring must be installed per NEC and all local electrical codes.
- H. Refrigerant Piping and Line Lengths:
 - 1. Piping connections shall be from the front or the bottom of the unit.
 - 2. The unit shall be capable of operating with maximum connected refrigerant line lengths of 3281 ft (actual).
 - 3. The outdoor unit shall have the ability to operate with a maximum height of 230 ft. between the outdoor and the lowest indoor unit.
 - 4. The maximum distance between the outdoor unit and the furthest fan coil shall not exceed 591 ft actual or 656 ft equivalent. No line size changes or oil traps shall be required.
 - 5. The system shall be capable of operating when the height difference between the upper and the lower fan coil is 131 ft.
- I. Auxiliary Refrigerant Components:
 - 1. All field supplied copper tubing connecting the outdoor unit to the indoor unit shall use factory-supplied branching kits consisting of either Y joints or headers to ensure even refrigerant flow.

2. To ensure piping flexibility the system shall allow having Y joints or headers downstream of another header.
3. For modular systems, in order to maximize efficiency and comfort, a 3/8-in. oil balance line shall be used to allow the flow of oil and refrigerant between the modular units even when one of the units is not running.
4. A flow selector box will be required to regulate the flow of high-pressure hot gas or high-pressure liquid to the fan coil requiring heating or cooling.
5. Up to 8 fan coils, all requiring same duty cycle, may be connected to a single flow selector box.
6. A fan coil that runs in cooling only shall not be required to connect to a flow selector box.
7. The single port flow selector box can be installed up to 49 ft from the indoor unit.
8. The multi port flow selector box can be installed up to 164 ft from the indoor unit.
9. The single port flow selector box shall be wired from the indoor unit using a factory-supplied power and control wire harness.
10. The multi port flow selector box shall be powered by a dedicated 208/230-1-60 field power supply.
11. The single port flow selector box shall not require a drain connection.
12. The multi port flow selector shall require a drain connection.
13. The single port and multi port flow selector box shall include a galvanized steel enclosure, and shall be tested prior to shipment.
14. The single port flow selector box shall include full interior insulation.

END OF SECTION

SECTION 26 05 13
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. Principal items of work in this section include but are not limited to:
1. Ensure quality assurance, testing and final acceptance requirements for premises cabling installations comply with industry standards and Project Construction Documents.

PART 2 - PRODUCTS

2.1 BOXES, ENCLOSURES, KEYS AND LOCKS

- A. Outlet Boxes and Fittings:
1. Outlet boxes installed in concealed Work shall be galvanized steel, pressed, or welded type, with knockouts.
 2. In exposed Work, where conduit runs change direction or size, outlet boxes and conduit fittings shall be cast metal with threaded hubs cast integral with box or fitting.
 3. Fittings shall be cast metal and non-corrosive. Ferrous metal fittings shall be cadmium-plated, or zinc galvanized. Castings shall be true to pattern, smooth, straight, with even edges and corners, of uniform thickness of metal, and shall be free of cracks, gas holes, flaws, excessive shrinkage, and burnt-out sand.
 4. Covers for fittings shall be galvanized steel or non-corrosive aluminum and shall be designed for particular fitting installed.
 5. Light fixture outlets shall be 4-inch octagon, 4-inch square, 2 1/8-inch deep or larger, depending upon number of conductors or conduits therein. Plaster rings shall be furnished with round opening with two ears drilled 2 23/32 inches center to center.
 6. For local device outlets provide 4-inch square 2 1/8-inch deep, boxes for single gang, 5-inch square boxes for two-gang, and special solid gang boxes with gang plaster ring for more than two switches.
 7. For TV outlets, and horns and strobes provide manufacturer's supplied back box as needed. For television outlets, provide 4-gang deep boxes and 4-gang plaster rings.
 8. Plaster rings shall be provided on flush-mounted outlet boxes except where otherwise indicated or specified. Plaster rings shall be same depth as finished surface. Install approved ring extension to obtain depth to finish surface.
 9. In existing plywood wall or drywall construction, and where flexible steel conduit is fished into walls, single-gang and 2-gang outlets for wiring devices may be sectional steel boxes with plaster ears. Boxes shall be fastened to plywood with flat-head screws

in each plaster ear screw hole. Boxes fastened to gypsum board shall be Racor, Appleton, Cooper, Bowers, or equal.

10. Factory made knockout seals shall be installed to seal box knockouts, which are not intact.
11. Where flexible conduit is extended from flush outlet boxes, provide and install weatherproof universal box extension adapters.

B. Junction and Pull boxes:

1. Junction and pull boxes, in addition to those indicated, shall only be used in compliance with codes, recognized standards, and Contract Documents.
2. Interior and non-weatherproof boxes shall be constructed of blue or galvanized steel with ample laps, spot welded, and shall be rigid under torsion and deflecting forces. Boxes shall be furnished with auxiliary angle iron framing where necessary to ensure rigidity.
3. Covers shall be fastened to box with enough machine screws to ensure continuous contact all around. Flush type boxes shall be drilled and tapped for cover screws if boxes are not installed plumb. Surfaces of pull and junction boxes and covers shall be labeled in black marker ink designating system, panelboard and circuit designation contained in box. In exposed Work, designation shall be installed on inside of pullbox or junction box cover.
4. Weatherproof NEMA 3R pull and junction boxes shall conform to foregoing for interior boxes with following modifications:
 - a. Cover of flush mounting boxes shall be furnished with a weather-tight gasket cemented to, and trimmed even with, cover all around.
 - b. Surface or semi-flush mounting pull and junction boxes shall be UL, or another Nationally Recognized Testing Laboratory (NRTL) listed as rain-tight and shall be furnished complete with threaded conduit hubs.
 - c. Exposed portions of boxes shall be galvanized and finished with one prime coat and one coat of baked-on gray enamel, unless already furnished with factory baked-on finish.
5. Junction and pull boxes shall be rigidly fastened to structure and shall not depend on conduits for support.
6. Underground Concrete Pull Boxes:
 - a. Pre-cast concrete pull boxes. Concrete pull boxes shall be traffic type, reinforced for H-20 wheel loading, pre-cast concrete. Pull boxes with inside dimensions of 2 feet by 3 feet by 3 feet deep shall consist of a base section, top ring, and cover. Base section shall be furnished with 2 knockouts measuring 10 inches by 10 inches in each 3 feet side, and one 20 inches by 20 inches knockout in each 2-foot side. Pull boxes with inside dimension 4 feet by 4 feet by 4 feet deep shall consist of a base section, midsection, topping, and cover. Base section shall be furnished with 2 knockouts measuring 8-inch by 16-inch on each of two opposite sides, and one 20-inch by 20-inch knockout on each of other two opposite sides. Pull boxes shall be furnished with a minimum of 6-inch diameter sump knockout and one-inch diameter ground rod knockout. In pull boxes, furnish and install

cable racks on walls. Racks shall be furnished with 3 porcelain cable holders on vertical steel mounting bars. Pull boxes shall be furnished with 3/4-inch diameter pull irons. Covers shall be traffic-type consisting of steel safety plate bolted to frame. Covers shall be marked as electrical, power, or signal as required.

- b. Provide end bells in duct entrances. Terminate each metal conduit with insulated bushing provided with a grounding terminal.
 - c. Install pulling irons on opposite walls and below horizontal centerlines of ducts and bricked-up openings, and in bottom. Install pulling irons with each end hooked around a reinforcing bar.
 - d. Remove floor drain knockout and provide a depth of 24 inches of crushed rock below box extending a minimum of 12 inches beyond on all sides.
 - e. Permanently and effectively ground metal equipment cases, cable racks, and similar items in pull boxes to site grounding electrode system. Provide grounding conductor in compliance with CEC Article 250.
 - f. Provide 6-inch deep sand base under pull boxes.
 - g. Identify power and signal cables by tagging in manholes and pull boxes. Tie securely to cables with nylon cord.
 - h. Top of steel plate shall provide a minimum coefficient of static friction of 0.5 for either wet or dry locations, when tested for any shoe sole material. Test shall comply with ASTM D 1047 or F 489 or F 609 standards. Submit manufacturer's test results for Architect's review as part of materials and equipment submittals.
 - i. The use of underground extension boxes shall be limited to not more than 1 times the original depth of pull box.
 - j. Approved Products: Oldcastle Precast, Jensen Precast, Kistner, Western Precast, or approved equal.
- 7. Underground utility boxes shall be reinforced concrete with non-setting shoulders to prevent settlement following installation. Boxes shall be furnished with cast iron cover with finger hole, size as indicated on Drawings. Utility boxes shall be as manufactured by Oldcastle, Jensen, Kistner, Western Precast, or equal.
 - 8. Manholes, vaults, and pull boxes required by a utility company, and installed as part of this Contract, shall meet requirements of servicing utility company.

C. Floor Outlets:

- 1. Floor Outlets (except for extension outlets) shall be cast iron, watertight floor boxes with flush brass floor plates, and shall be set to finish flush with finish floor covering, whether it be carpeted, wood, resilient floor covering, or other finish materials.
 - a. Floor boxes shall be used in offices, classrooms, and in library areas only.
 - b. Approved Products: Harvey Hubbell Inc. B-2503, Thomas & Betts 640 series, Legrand Omnibox, or approved equal.

2. Telephones above floor outlets, where not subject to water, shall be provided with Harvey Hubbell Inc. SC-3098 pedestals with SC309T plates. Refer to other Division 26 sections. Floor boxes shall be used in offices, classrooms and in Library areas only.
 - a. Approved Products: Legrand 525 series, Thomas & Betts FPT-400 Series, or approved equal
 3. Plugs above floor outlets where not subject to water shall be provided with pedestal s and device plates. Refer to other Division 26 sections. Floor boxes shall be used in offices, classrooms, and library areas only.
 - a. Approved products: Pedestals shall be Legrand 525 series, Thomas & Betts FPT-400 Series, Harvey Hubbell Inc. SC-3098; Device plates shall be Hubbell SS309D, or District approved equal.
 4. Two gang and single box pedestal boxes shall be listed for wet locations where subject to water. Provide required cover plates.
 - a. Floor outlets shall be used in Cafeteria, Cafeteria serving areas, or any areas where floors are subjected to water.
 - b. Approved products: Single gang boxes - Hubbell SA-6687. Two gang boxes shall be Hubbell SA-6885, or approved equal.
 5. Extension floor outlets shall be cast iron with cast iron covers, and 1/2-inch offset entries for above-floor conduit extensions; Boxes shall be designed to permit access to wiring without disturbing above-floor extensions and shall be set flush with finish floor.
 6. Above floor service fittings for data outlets and surge suppression receptacles shall be faceplate interchangeable, die cast aluminum.
 - a. Approved products: Hubbell SC3098 with cover plates SS309DS, Legrand 525 series, Thomas & Betts FPT-400 Series, or approved equal.
- D. Floor Pockets – Plugging Boxes:
1. Three-Gang floor lighting pockets shall be flush floor type recess floor mounted enclosure, with cast iron floor plate and hinged cast iron door notched for cables.
 - a. Each floor pocket shall be provided with three 20-amp, 3 wire, 125-volt receptacles with matching caps.
 - b. Approved products: Legrand or Hubbell Recessed Floor Boxes, C.W. Cole TLS 353-6, or equal, for wood floors and C.W. Cole TLS-353-6-C, or approved equal for concrete slabs.
 2. Single Gang:
 - a. Receptacle floor pockets shall be single gang, flush floor type, with cast iron floor plate, hinged cast iron door notched for cable and cast-iron box. Provide each pocket with a standard, single grounding type receptacle unless otherwise indicated.

- 1) Approved Products: C.W. Cole TLA-362-1-FE, or approved Legrand or Hubbell recessed floor box, or approved equal. For wood floors provide C.W. Cole TLS-362-1, or approved equal.
- b. Microphone or projector floor pockets shall be single gang flush floor type with cast iron floor plate, hinged cast iron door, notched for cable and cast-iron box.
- 1) Approved Products: Legrand or Hubbell recessed floor box, C.W. Cole TLA-362-3-FE, C.W. Cole TLS-362-3, in wood floors, or approved equal.

E. Keys and Locks:

1. Provide two keys with furnished door locks, including cabinet door locks and switchboard locks, two keys for lock switches on switchboards or control panels, and two keys with interlocks or other furnished lock switches. Deliver keys to OAR.
2. Special keys and locks shall only be provided where specified. Locks shall be keyed to Corbin No. 60 or 70 as follows:
 - a. Access to operate equipment shall be keyed to Corbin 60.
 - b. Access to service areas shall be keyed to Corbin 70.

2.2 RECEPTACLES AND SWITCHES

A. Receptacles:

1. Duplex receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be wired on the side and back with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be PVC. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts.

a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
(20 amps) NEMA 5-20	PS5362-I	HBL5362-I	5362-I
(15 amps) NEMA 5-15	PS5262-I	HBL5262-I	5262-I

Approved equal products are acceptable

2. Duplex receptacles on circuits supplied by panel boards with integral surge suppression shall be Pass & Seymour model number PS5262BL (blue), Hubbell DRUBTVSS15, Leviton 5262-SBU, 15-amps, 120-volts, or approved equal.
3. Single receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be back and side wire with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be thermoplastic. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts. For circuits consisting of one single receptacle only, ampere rating of receptacle shall be same as circuit breaker or fuse.
 - a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell Leviton</u>	
(20 amps) NEMA 5-20R	5361-I	HBL5361-I	5361-I
(15 amps) NEMA 5-15R	5261-I	HBL5261-I	5261-I

Approved equal products are acceptable.

4. Single 15 and 20-amps receptacles on circuits supplied by panel boards with integral surge suppression shall be blue in color.
 - a. Approved products: Pass & Seymour NEMA 5-20R model number 5361-BL (blue), NEMA 5-15R model number 5261-BL (blue), or approved equal.
5. Kiln and range receptacles, provide 3-pole, 4-wire, grounding type, rated 50 amps or as indicated on plans. Receptacle shall be rated 125/250 volts NEMA 14-50R. Provide 2-gang, stainless steel plates.

- a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell Leviton</u>	
NEMA 14-50R	3894	HBL9450A	279
WALL PLATE SS703	S703	84026	

Approved equal products are acceptable.

6. Dryer receptacles. Provide 3-wire, non-grounding type, rated 30 amps at 125/250 volts, NEMA 10-30R, with 2-gang stainless steel plates. Coordinate location of junction box with the work of Section 10 2815, Hand and Hair Dryers.

- a. Approved Products:

NEMA #	Pass & Seymour	Hubbell Leviton	
NEMA 10-30R	3860	HBL9350	5207
WALL PLATE SS703	S703	84026	

Approved equal products are acceptable.

7. Provide specification grade ground-fault circuit interrupter (GFCI) type receptacles in accordance with 2010 UL standards. GFCI receptacles shall have a trip indication light. Receptacle terminal screws shall be back and side wire with internal screw pressure plates. Test and reset buttons shall match device body and shall be ivory. GFCI receptacles shall be manufactured in standard configuration for installation with stainless steel smooth plates. Exterior mounted receptacles shall be mounted inside weatherproof enclosure.

- a. Approved products:

NEMA #	Pass & Seymour	Hubbell Leviton	
NEMA 5-20R	2095-I	GFR5352-IA	7899-I

NEMA 5-15R 1595-I GFR5252-IA 8598-I

Approved equal products are acceptable.

8. Provide weatherproof receptacles, except where otherwise indicated or specified, consisting of GFCI receptacles, as specified herein, and metal plates with die-cast lockable hinged lids and weatherproof mats;

Tamper-resistant receptacles with thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects. Receptacles shall have extra heavy-duty brass, one-piece mounting strap with integral ground. Receptacles shall be ivory color, impact resistant nylon face and back body.

- a. Approved products:

NEMA #	Pass & Seymour	Arrow Hart	Leviton
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NEMA 5-20R TR63-I TR8300V		8300SGI	
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NEMA 5-15R TR62-I TR8200V		8200SGI	
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Approved equal products are acceptable.

9. Provide transient voltage surge suppression (TVSS) receptacles offering metal oxide varistors (MOVs) protecting normal and common modes, (L-N, L-G, N-G) with 500V suppressed voltage. TVSS devices shall offer 3-mode equal protection with 210 joules minimum per mode of energy absorption and 13,000-amp maximum surge capability. TVSS devices shall have 3 thermal fuses and two over-current protection fuses. TVSS devices shall have LED visual only surge status indicator to alert user to surge suppression circuit condition. Visual indicator will be illuminated (red) when power is on and surge suppression circuit is fully functional. Visual indicator will not be illuminated when power is off or unit experiences loss of surge suppression protection. Terminals shall be back and side wire including ground terminal. Color shall be blue.

- a. Approved Products

NEMA #	Pass& Seymour	Hubbell	Leviton
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NEMA 5-20R 5352BLSP		HBL5360SA	5380B
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NEMA 5-15R 5252BLSP		HBL5260SA	5280B
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Approved equal products are acceptable.

B. Switches

1. Local Switches:

- a. Local switches shall be high strength thermoplastic toggle, industrial grade, rated 20 amps at 120-277 volts AC only, with plaster ears, external screw pressure plate back and side wired, and standard size composition cups which fully enclose mechanism. Switches shall be approved for installation at currents up to full rating on resistive, inductive, tungsten filament lamp and fluorescent lamp loads, and for up to 80 percent of rating for motor loads. Switches shall have oversized silver alloy contacts for long life and better heat dissipation. Provide

switches as single pole, double pole, 3-way, 4-way, non-lock type. Provide non-lock type switches with ivory handles;

	Pass & Seymour	Hubbell	Leviton
Single pole	PS20AC1I	HBL1221I	1221-2I
Double pole	PS20AC2I	HBL1222I	1222-2I
Three-way	PS20AC3I	HBL1223I	1223-2I
Four-way	PS20AC4I	HBL1224I	1224-2I

Approved equal products are acceptable.

- b. Lock type switches shall be specification industrial grade, 20 amp, 120-277 volts with metal or nylon key guides with on/off indication, and operable by same key. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16-inch long forks, 5/32-inch spacing between forks and 5/16-inch width overall.

- 1) Approved products:

	Pass & Seymour	Arrow Hart
Single pole	PS20AC1L w/#500 Key-2L	1221L w/1201LK Key
Double pole	PS20AC2Lw/#500 Key	1222L w/1201LK Key
Three-way	PS20AC3L w/#500 Key	1223L w/1201LK Key
Four Way	PS20AC4L w/#500 Key	1224L w/1201LK Key

Approved equal products are acceptable.

- c. Rotary lock switches shall incorporate a tumbler type lock to prevent unauthorized operation. Lock shall be tumbler type by Corbin, keyed to a HH41 key. Lock switch to be installed with pin tumblers facing downward. Key shall be removable in all positions. Each device shall be complete with 2 keys. Keys shall be delivered only to the OAR. Switches shall be rated at 20 amps, 120-volt or 277-volt AC. Switch plates shall be of stainless steel, engraved with on and off positions indicated.

- 1) Approved products:

	Arrow Hart
Single pole	AH1191N
Double pole	AH1192N
Three-way	AH1193N

Approved equal products are acceptable.

- d. Pilot light switches shall be rated 20 amps and shall conform to specifications for local switches. Switches shall be furnished with red, Lexan handles that are lighted by LED lamps. Pilot light shall light when load is on. Pilot light 120-volt switches

1) Approved products:

Pass & Seymour Hubbell Leviton

Single pole PS20AC1-RPL HBL1221-PL 1221-PLR

Double pole PS20AC2-RPL HBL1222-PL 1222-PLR

Three-way PS20AC3-RPL HBL1223-PL 1223-PLR

Approved equal products are acceptable.

- 2) 20 amps, 277 volts rated pilot light switches shall be single pole and shall conform to specifications for local switches, and the requirements of paragraph d above.

a) Approved Products:

Pass & Seymour Leviton Hubbell

PS20AC1-RPL 1221-7PR HBL1221-PL7

- e. Provide remote control switches for mechanically held contactors arranged for 3-wire control, toggle type, momentary contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclose mechanism, and ivory handles.

1) Approved products:

Pass & Seymour Hubbell Leviton

1251-I HBL1557-I 1285-I

Approved equal products are acceptable.

- f. Provide remote control switches for magnetically held contactors arranged for 3-wire control, toggle type, maintained contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclosed mechanism, and ivory handles.

1) Approved products:

Pass and Seymour Hubbell Leviton

1225-I HBL 1385 1285-I

Approved equal products are acceptable.

- g. Momentary Contact locking key type switch. 20A 120/277V center off. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/32" spacing between forks and 5/16" width overall.
 - 1) Approved products:

Arrow Hart AH1995L w/ AH2000 key

Approved equal products are acceptable.
 - h. Momentary Contact switch low voltage 1 pole 3A 24VAC 3 position center off. Key for locking switch shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/31" spacing between forks and 5/16" width overall.
 - 1) Approved products:

Pass and Seymour Toggle 1081I, Locking 1081KGRY w/#500 Key

Approved equal products are acceptable.
2. Time Switches and Photoelectric Controls for existing construction.
- a. Provide time switches with a 7-day, solid-state, electronic type capable of fully automatic or manual operation and housed in a sheet steel enclosure unless built into a panel or switchboard. Resistive or inductive contacts rated for 25-amps, each pole 240-VAC; 5-amps tungsten or 277-VAC pilot duty, each pole 240-VAC. Time switches to contain a non-volatile clock and non-volatile memory with a built-in rechargeable super capacitor power carry-over system. Battery carryover is not acceptable. Provide a minimum of 15 on/off set points per week. Timing to be in one-minute increments with a minimum on or off time of one minute. Time switch digital displays to indicate days of week, hours, and minutes. Display to contain a load status light to indicate when equipment is in operation.
 - b. Required:
 - 1) Liquid crystal display panel.
 - 2) Holiday scheduling: Up to 40 dates may be assigned special holiday schedules, up to one year in advance.
 - 3) Automatically adjusts to and from daylight savings time and for leap year.
 - 4) Contact ratings: 10 amp at 240 VAC.
 - 5) Safety override switch for each circuit to either provide shut down of circuit or to override on.
 - 6) Selective review: All or part of schedule shall be displayed at touch of a key.
 - 7) Super Capacitor for power carry-over system.
 - 8) Supply voltage: 120/277-Volt.

- 9) 365-day advance scheduling.
- c. Approved products: Tork Model EW 101B series, Intermatic ET90000 series, or approved equal.
- d. Photoelectric control: Shall be rated 2,000 watts, 120V with single pole, single throw, normally closed contact, enclosed in a die-cast aluminum gasketed enclosure with 1/2-inch conduit fitting,
 - 1) Approved products: Tork series 2100, or approved equal.
- 3. Emergency Lighting Control Unit
 - a. The Emergency Lighting Control Unit shall provide all required functionality to allow a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.
 - b. The emergency lighting control unit shall allow control of emergency lighting fixture in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.
 - c. The device shall have normally closed dry contacts capable of switching 10-amp emergency ballast loads at 120-277 VAC, 60 Hz., 2-amp tungsten loads at 120 VAC, 60Hz., LED loads at 120-277V VAC, 60 Hz
 - d. The device shall have universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.
 - e. The device shall provide separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency)
 - f. The device's normal power input terminal shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.
 - g. The unit shall automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
 - h. Approved products: WattStopper ELCU-100 Emergency Lighting Control Unit, LVS #EPC-PM Series, Lighting Control Design #GR 2001 series, or approved equal.
- 4. School Main Entrance Intercom Station: Refer to specification section 28 1000 – Access Control System.

2.3 IDENTIFICATION AND SIGNS

A. Identification Plates:

1. Provide identification plates for the following unless otherwise specified, for switchboards, unit substations, motor control centers, control panels, push-button stations, time switches, contactors, motor starters, motor switches, panelboards, and terminal cabinets.
2. Identification plates shall be of plastic stock and shall adequately describe function, voltage and phase of identified equipment. Where identification plates are detailed or described on Drawings, inscription and size of letters shall be as indicated. For lighting and power panels, identification plates shall indicate panel designation, voltage, and phase of panel. For terminal cabinets, identification plates shall indicate system contained in terminal cabinet.
3. Identification plates shall be black-and-white nameplate stock of bakelite with characters cut through black exposing white. Plates shall be furnished with beveled edges and shall be securely fastened in place with No. 4 Phillips-head, cadmium-plated steel, self-tapping screws. Characters shall be 3/16 inch high, unless otherwise indicated.

B. Markings:

1. Install identification markings to surface-mounted starters, switches, disconnect switches, contactors, and other devices controlling motors and appliances. Provide abbreviations required along with an identifying number. Markings to be provided with locking type stencils using paint of a contrasting color. Figures shall be 3/8 inch high unless otherwise indicated. Dymo Industries Inc., self-sticking plastic labels, with embossed characters made with a typewriter may be installed instead of stencils and paint; p-touch self adhesive plastic, or Brother P-Touch self sticking laminated plastic labels may be installed.
2. High Voltage: High voltage switchboards, cabinets, boxes, and conduits exposed in accessible locations, including under buildings and in attics, are required to be marked "WARNING-HIGH VOLTAGE – ABOVE 600 VOLTS". Markings for switchboards shall consist of 18 gage steel, porcelain enamel sign of standard manufacture. Markings for boxes, cabinets, and conduits shall be by means of stenciling or printed self-adhesive markers, Westline Tel-A-Pipe, or equal. Provide letters of black on orange background and not less than 1-7/8 inches high. On conduit runs, install markings at intervals not exceeding 10 feet in any individual area. Markings shall be installed after other painting Work is complete.

C. Warning Signs:

1. Provide a warning sign on outside of each door or gate to rooms or enclosures containing high voltage equipment. Signs required reading, "WARNING - HIGH VOLTAGE - KEEP OUT". Provide 2-inch high lettering.
2. Provide a warning sign on each high-voltage non-load break disconnect and fused cutout (not oil filled). Signs required reading, "DO NOT OPEN UNDER LOAD". Provide 2-inch-high lettering.
3. Provide signs of standard manufacture, 18 gage steel, with porcelain enamel finish. Provide red lettering on a white background. BOXES, ENCLOSURES, KEYS AND LOCKS

PART 3 - EXECUTION

3.1 INSTALLATION AND SUPPORT OF BOXES

- A. Install outlet boxes flush with finished surface of wall or ceiling. Install plumb and securely fastened to structure, independent of conduit. Except where otherwise indicated, provide factory-fabricated adjustable attachment bar hangers between studs to support outlet boxes. When installation is performed in fire rated walls, maintain the wall's rating integrity by means of approved fire stop methods.
- B. Outlet boxes installed in suspended or furred ceilings with steel runner or furring channels shall be supported, except where otherwise indicated, by a Unistrut P-4000 Tessco A1200HS-10, Cooper B-Line B22s-HG, or approved equal channel spanning main ceiling runner channels. Each box shall be supported from its channel by a 3/8-inch 16 threaded steel rod with a Unistrut P-4008, Fastenal #48604, Copper B-Line 78101140346 or approved equal; nut and a Tomic No. 711-B Adapta-Stud, or approved equal. Rod shall be tightened to a jamb fit with channel and its nut. Box shall be locked to rod by means of a 1/2-inch locknut on stud and a 3/8-inch 16 hex nut locking stud to rod.
- C. Heights of outlets and equipment indicated on Drawings shall govern. In absence of such indications, following heights shall be maintained with heights measured to centerline unless otherwise noted:
 - 1. Install wall-mounted switches at 48 inches above finished floor.
 - 2. Outlet boxes for fire alarm pull stations shall be mounted at a mounting height above finished floor that ensures that the operating handle of the initiating device is no higher than 48 inches from finished floor.
 - 3. Wall mounted fire alarm strobe or horn/strobe devices shall be mounted such that the entire lens is not less than 80 inches above finished floor. If ceiling heights allow, wall mounted appliances shall have bottom of lens a minimum of 80 inches but not more than 96 inches to the top of lens.
 - 4. Install outdoor fire alarm audible devices or fire alarm sprinkler flow bells at least 10 feet but not more than 12 feet above finished floor to center. Provide STI or other approved protective covers as required in plans.
 - 5. Voice evacuation speakers mounted indoors shall be mounted in ceiling space or if mounted on wall shall not be less than 10 feet to center above finished floor.
 - 6. Install clocks and speakers, in classrooms and offices, 8 feet above finished floor. Unless otherwise indicated.
 - 7. In rooms other than places of assembly such as, but not limited to, multipurpose rooms, auditoriums, and libraries, clock outlets and speakers in classrooms and offices shall be mounted 8 feet above finished floors. Other assembly areas such as gymnasiums shall be mounted 10 to 12 feet above finished floor. Provide STI, or equal protective covers for clocks when required.
 - 8. Install fire alarm strobe lights 80 inches to bottom of light above finished floor.
 - 9. Install outside bells and yard light outlets 4 feet above second floor level for 2 or more story buildings, 12 inches below top plate level for one story buildings without covered porch or arcade, and 12 inches below covered porch and arcade ceilings.

10. Install desk telephones, power receptacle outlets, and data outlets 15 inches above finished floor.
11. Install panelboards and terminal cabinets 6 feet 6 inches from finish floor to top of cabinet.
12. Install television outlets at a height corresponding to location of television monitor, or as indicated on plans.
13. The use of extension boxes shall be limited to not more than 1 times the original depth of junction box.

3.2 COVER PLATES

- A. Provide a plate on each switch, plug, pilot light, data, interphone, public telephone, and television outlet, and on existing and reset outlets where so indicated or required. Plates shall be of stainless steel unless otherwise specified.
- B. Flush wiring device and signal system outlets indicated to be blank covered, shall be covered with blank stainless-steel plates. Flush lighting outlets to be blanked shall be covered with Wiremold 5736 steel covers, or equal, painted to match surrounding finish. Provide stainless steel covers to blank indicated or required surface-mounted outlets.
- C. In the following cases, and at required locations. Switch and receptacle plates shall be engraved with the device(s), or fixtures being controlled, or as indicated:
 1. Three-gang and larger gang switches in locations other than classrooms.
 2. Lock switches.
 3. Pilot switches.
 4. Switches so located that operator cannot see fixtures, or items of equipment controlled while his hand is on the switch.
 5. Switches not in same room with fixtures or items of unit heaters, air curtains, fly fans, etcetera.
 6. Receptacles operating at other than 120 V shall be identified with the operating voltage.
 7. Switches operating on 277 V shall be identified with the operating voltage.
 8. Where indicated on Drawings.
- D. Designations shall be as indicated on Drawings or as specified by Architect.
- E. Standard GFI cover plates shall be Pass & Seymour 4600, Raco 5028-0, or equal. GFI cover plates shall be provided with a CAM lock mechanism with two keys or a padlock hasp that does not protrude through the face of the cover and will allow the shank of locks keyed Corbin No. 60 keys.

3.3 IDENTIFICATION OF CIRCUITS AND EQUIPMENT

- A. Provide descriptive nameplates or tags permanently attached to switchboards, motor control centers, transformers, panelboards, circuit breakers, disconnect switches, starters,

pushbutton control stations and other apparatus installed for operation or control of circuits, appliances, fire alarm control panel(s), fire alarm annunciator(s), power supplies, terminal cabinets, energy management control units, and Information technology system backbone and distribution equipment points.

- B. Provide nameplates of engraved laminated plastic, or etched metal. Submit Shop Drawings denoting dimensions and format to Architect before installation. Fasten to equipment with escutcheon pins, rivets, self-tapping screws, or machine screws. Self-adhering or adhesive backed nameplates are not permitted.
- C. Fasten tags to feeder wiring in conduits at every point where runs are broken or terminated, including pull wires in empty conduits. Indicate circuit, phase, and function. Tag branch circuits in panel boards and motor control centers. Tags may be manufactured of pressure-sensitive plastic or embossed self-attached stainless steel or brass ribbon.
- D. Provide circuit identification cards and cardholders in all panel boards. Cardholders shall consist of metal frame retaining a clear plastic cover permanently attached to inside of panel door. List of circuits shall be typewritten on a card. Circuit description shall include name or number of circuit's area and connected load.
- E. Junction and pull boxes shall have covers stenciled with box number when indicated on Drawings, or circuit numbers according to panel schedules. Data shall be lettered in a conspicuous manner with a color contrasting with finish.
- F. Name shall be correctly engraved, with a legend indicating function or areas, when required by codes or indicated on Drawings.

3.4 PROTECTION

- A. Protect Work of this section until Substantial Completion.

3.5 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION

SECTION 26 05 19
LOW VOLTAGE WIRES (600 VOLT AC)

PART 1 - GENERAL

1.1 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes: Low-voltage wire, splices, terminations and installation.

1.2 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. List of Materials: Submit a complete list of proposed materials.
- C. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, insulation type, resistivity, conductivity, impedance, and conductance. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.
- D. Prior to start of construction; provide letter from wiring and electrical cables manufacturer certifying that the products are qualified/ listed as low electromagnetic field products.

1.3 SUBSTITUTIONS/DEVIATIONS

- A. Deviations from these section requirements shall not be accepted without written approval from OWNER'S Design Standards When Deviations are proposed the following information shall be submitted:
 - 1. Substitution request form stating reasons and benefits to OWNER.
 - 2. OWNER'S approval shall be obtained for any equipment or materials substitutions.
- B. Submittals must comply with contract general provisions.

1.4 QUALITY ASSURANCE

- A. Components and materials shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes.
- B. Wiring installation shall be performed under the supervision of state certified electricians. Contractor or Installer's electricians shall be certified in accordance with Labor Code sections 3099, and 3099.2 and section 209.0 of the California Code of Regulations.
- C. Contractor shall have adequate experience installing systems of similar size and complexity.
 - 1. Qualifications of Installer: Minimum five years of experience installing products and systems of similar scope and complexity.
 - 2. Installer shall have completed at least five projects of equivalent scope and complexity.

3. Contractor shall have completed and commissioned a minimum of five service agreements that provide similar support services to those needed for this project.
4. System startup and testing shall be performed under direct observation of the Project Inspector and OAR.
5. The Project Inspector will observe installation of feeder cables. Notify the Project Inspector not less than two working days in advance of the proposed time of feeder installation.

1.5 WARRANTY

- A. Provide a one-year labor warranty.
- B. Provide material warranty of no less than 10 years.
- C. Warranty period begins at substantial completion or project acceptance for beneficial occupancy.
- D. CONTRACTOR shall warranty all products and materials. Multiple warranty sources is not acceptable.

PART 2 - PRODUCTS

2.1 WIRES

- A. Pressure cable connectors shall be pre-insulated 3M Scotchlok, Ideal Wing Nut, O-Z/Gedney or equal.
- B. Wires shall be single conductor type THHN or THWN insulated with polyvinyl chloride and covered with a protective sheath of nylon, rated at 600 volts. Wires may be operated at a maximum continuous conductor temperature in dry locations of 90 degrees C. and 75 degrees C. in wet locations. Wires and cables shall be listed by Underwriter's Laboratories (UL) Standard 83 for thermoplastic insulated wires, and listed for installation in accordance with Article 310 of the California Electrical Code (CEC).
- C. Conductors shall be solid copper for 12 AWG and smaller conductors, and stranded copper for 10 AWG and larger conductors.
- D. Conductors shall be insulated with PVC and sheathed with nylon.
- E. Wires shall be identified by surface markings indicating manufacturer's identification, conductor size and metal, voltage rating, UL symbol, type designations and optional rating. Indentations for lettering are not permitted.
- F. Wires shall be tested in accordance with the requirements of UL standard for types THWN and THHN.
- G. Conductors shall be solid Class B or stranded Class C annealed uncoated copper in accordance with UL standards, or another Nationally Recognized Testing Laboratory (NRTL).

2.2 STANDARDS

- A. THWN/THHN wires shall comply with the following standards:

1. UL 83 for thermoplastic insulated wires.
2. UL 1063 for machine tool wires and cables.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wires shall not be installed until debris and moisture is removed from conduits, boxes, and cabinets. Wires stored at site shall be protected from physical damage until they are installed and walls are completed.
- B. Wire-pulling compounds furnished as lubricants for installation of conductors in raceways shall be compounds approved and listed by UL, NRTL, or equal. Oil, grease, graphite, or similar substances are not permitted. Pulling of 2 AWG or larger conductors shall be performed with a cable pull machine. Any runs shorter than 50 feet are exempt. When pulling conductors, do not exceed manufacturer's recommended values
- C. At outlets for light, power, and signal equipment, pigtail splices with 8-inch circuit conductor leads for connection to fixtures, equipment, and devices.
- D. Pressure cable connectors, Yellow, Red, or Blue spring-loaded twist-on type, may be furnished in splicing number 8 AWG or smaller wires for wiring systems. Listed Push-in spring clamp wire connectors, Ideal In-Sure, or equal may be used in luminaires for fixture wiring.
- E. Joints, splices, taps, and connections to switchboard neutral, bonding or grounding conductors, conductors to ground busses, and transformer connections for wires 6 gage and larger shall be performed with high-pressure cable connectors approved for installation with copper conductors. Connectors shall be insulated with heavy wall heat shrink WCSM, or cold-applied roll-on sleeve RVS. Insulation level shall be a minimum of 600V and joints, splices, and taps shall be qualified to ANSI C 119.1, UL, NRTL, or equal listed mechanical pressure connections.
- F. Connections to any bussing and high-pressure cable connectors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.
- G. Connection of any bonding or grounding conductors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.
- H. Wire switchboards, panel cabinets, pull boxes, and other cabinets except public address, shall be neatly grouped and tied in bundles with nylon ties at 10-inch intervals. In switchboards, panels and terminal blocks, wires shall be fanned out to terminals. If bundles are longer than 24 inches, a maximum of nine current carrying conductors may be bundled together.
- I. Install conductor lengths with a minimum length within the wiring space. Conductors must be long enough to reach the terminal location in a manner that avoids strain on the connecting lug.
- J. Maintain the conductor required bending radius.

- K. Neutral conductors larger than 6 gage, which are not color identified throughout their entire length, shall be taped, painted white or natural gray, or taped white where they appear in switchboards, cabinet, gutters or pull boxes. Neutral conductors 6 gage and smaller shall be white color identified throughout their entire length.
- L. Fire alarm and clock wiring shall be continuous from terminal cabinets or from equipment to each device. Splices are not permitted between devices and/or terminal cabinets at junction and pull boxes. Wiring shall be terminated at terminal blocks or devices only.
- M. Wiring systems shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of feeder and branch circuit conductor's insulation resistance. The insulation of the conductors shall be tested prior to connections to any panelboards, switchboards, variable frequency drives, lighting control systems, ballasts, and wiring devices such as but not limited to GFI receptacles, TVSS receptacles, or equipment. Insulation testing of panelboards and switchboards shall be independently performed from the insulation testing of any conductors as specified in other sections of this specification.
 - 1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of feeder conductors. Tests must be conducted with wires disconnected at both ends.
 - a. Provide calibration program records to assure the testing instrument to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).
 - b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.
 - c. Test reports shall include the following:
 - 1) Identification of the testing organization.
 - 2) Equipment identification.
 - 3) Ambient conditions.
 - 4) Identification of the testing technician.
 - 5) Summary of project.
 - 6) Description of equipment being tested.
 - 7) Description of tests.
 - 8) Test results.
 - 9) Analysis, interpretation and recommendations.
 - 2. Utilize the services of an approved independent testing laboratory or a qualified contractor's employee (Technician certified in accordance with ANSI/NETA ETT-2000 Standard for Certification of Electrical Testing Personnel) to perform megger time-

resistance insulation testing of branch circuit conductors. Tests must be conducted with wires disconnected at both ends.

- a. Test equipment and report requirements stipulated under paragraph 3.01.N.1 apply to branch circuit testing.
3. Tests shall be performed in the presence of the Project Inspector.
4. Insulation resistance shall not be less than 100 mega-ohms.

3.2 COLOR CODES

A. General Wiring:

1. For phase and neutral conductors 6 gage or larger, permanent plastic-colored tape may be furnished to mark conductor end instead of coded insulation. Tape shall cover not less than 2 inches of conductor insulation within enclosure.
2. Color code conductor insulation as follows:

SYSTEM VOLTAGE		
Conductor	208Y/120	480Y/277
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Natural Gray

Neutrals shall be colored-distinguished if circuits of two voltage systems are used in the same raceway.

3. Where two voltage systems are combined in an enclosure; CONTRACTOR shall apply a permanent color code label where the circuits originate.

3.3 FEEDER IDENTIFICATION

- A. Feeder wires and cables shall be identified at each point the conduit run is broken by a cabinet, box, gutter, etc. Where terminal ends are available, identification shall be by means of heat shrink wire markers, which provide terminal strain relief. Markers shall be by Tyco Electronics, Panduit, Brady Perma-Sleeve, or equal. Identification in other areas shall be by means of wrap-around tape markers from Tyco Electronics, Panduit, Brady Perma-Code or equal. Markers shall include feeder designation, size, and description.

3.4 TAPE AND SPLICE KITS

- A. Splices, joints, and connectors joining conductors in dry and wet locations shall be covered with insulation equivalent to that provided on conductors. Free ends of conductors connected to energized sources shall be taped. Voids in irregular connectors shall be filled with insulating compound before taping. Thermoplastic insulating tape approved by UL, NRTL, or equal for installation as sole insulation of splices shall be furnished and shall be installed according to manufacturer's printed specifications.

3.5 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.6 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

**SECTION 26 05 26
GROUNDING AND BONDING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide and install an effective grounding and bonding system.
- B. Related Requirements:
 - 1. Refer to related sections for their system grounding requirements.
 - 2. Division 01 - General Requirements.
 - 3. Division 26 – Electrical.
 - 4. Division 27 – Communications.
 - 5. Division 28 - Electronic Safety and Security.

1.2 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. IEEE 142 Green Book.
 - 2. Underwriter's Laboratories (UL).
 - 3. California Electrical Code.
 - 4. Building Industry Consultant Services International (BICSI).
 - 5. EIA/TIA (Signal and power).
 - 6. Nationally Recognized Testing Laboratory (NRTL).

1.3 SYSTEM DESCRIPTION

- A. Equipment, components, or materials that enclose electrical conductors, or are likely to be energized by electrical currents shall be effectively grounded.
- B. Metal equipment parts such as switchboards, panelboards, metal enclosures, raceways, equipment grounding conductors, and earth grounding electrodes shall be effectively bonded into a continuous grounding path.
- C. Metallic systems or electrically conductive materials shall be effectively bonded to the building's grounding electrode system.
- D. A separately derived AC system shall be grounded to the equipment grounding conductor and to a separate "made" electrode of building grounding electrode system.

- E. Provide effective electrical equipment bond continuity to all metal raceways and enclosures. Grounding shall be achieved through a code sized green insulated grounding conductor provided within each raceway.
 - 1. Each flexible conduit over six feet in length shall be provided with a green insulated grounding conductor of required size.
 - 2. Provide code sized equipment grounding conductor in all flexible conduits as required by CEC.
 - 3. The length of flexible conduit installations shall not be less than six feet.
 - 4. Effectively ground metal raceways and enclosures at each end.
- F. Cold water, or other utility piping systems, shall not be utilized as grounding electrodes. In addition to bonding to cold water pipe provide at least one of the following made grounding electrodes:
 - 1. A dedicated "made" electrode, fabricated of at least 20 feet of uncoated galvanized 1/2 inch diameter rebar encased by at least two inches of concrete, and placed next to the bottom of a concrete foundation, or footing in direct contact with earth. A welded extended portion shall surface at the location of the common grounding electrode bus bar and be extended by a 3/0 exothermic welded bare copper cable, or be welded directly to the bus. The exothermic weld shall be at least four inches above finished floor in a dry location. The main grounding electrode and associated grounding conductors shall be in an enclosure and in conduit.
 - 2. Concrete enclosed electrode, fabricated of at least 20 feet of No. 2 AWG, minimum size, bare copper conductor, encased by at least two inches of concrete, located within or near bottom of a concrete foundation, or footing, which is in direct contact with earth. Footing rebar shall be connected to copper wire with approved connectors.
 - 3. An external grounding electrode, as specified hereafter or as required by the CEC shall be installed and connected to foundation or footing rebar.
- G. Non-current carrying metal parts of high-voltage (1000 Volts or more) equipment enclosures, signal and power conduits, switchboard and panelboard enclosures, motor frames, equipment cabinets, and metal frames of buildings shall be permanently and effectively bonded to the grounding system. Provide a CEC sized equipment grounding conductor in every raceway.
- H. Metallic or semi-conducting shields and lead sheaths of cables operating above 1000 Volts shall be permanently and effectively grounded at each splice and termination.
- I. Neutral of service conductors shall be grounded as follows:
 - 1. Neutral shall be solidly grounded at only one point within the Project site for that particular service. Preferable location of grounding point shall be at the service switchboard, or main switch.
 - 2. Equipment and conduit grounding conductors shall be bonded to that grounding point.
 - 3. If other buildings or structures on the Project site are served from a switchboard or panelboard in another building, power supply is classified as a feeder and not as a service.

4. Equipment grounding conductor shall be installed from switchboard to each individual building. At building, grounding conductor shall be bonded with power equipment enclosures, metal frames of building, etc., to "made" electrode for that building.
5. Feeder neutrals shall be bonded at service entrance point only; neutrals of separately derived systems shall be bonded at the source only.
- J. If there is a distribution transformer at a building the secondary neutral conductor shall be grounded to "made" electrode serving the building.
- K. Within every building, the main switchboard or panelboard, shall be bonded to the cold water line. Metallic piping systems such as gas, fire sprinkler, or other systems shall be bonded to the cold water line.

1.4 SUBMITTALS

- A. Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Furnished yard boxes shall be precast concrete and shall be approximately 14 inches wide by 19 inches long by 12 inches deep or larger.
 1. Boxes shall be furnished with bolt-down, checkered, cast iron covers and cast-iron frames cast into the yard boxes.
 2. Yard boxes shall comply with standard detail provided on Electrical Plans
 3. Provide yard boxes with hinged Frame Locking Cover.
 4. Approved products include Brooks No. 36 HFL, Jensen Precast, Oldcastle Precast, Western Precast, Kistner, or equal.
- B. External ground electrodes shall be copper-clad steel ground rods, minimum 3/4-inch diameter by ten feet long.
- C. Clamps and fittings used in ground boxes below grade shall be listed for direct burial.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Grounding electrodes shall be installed in the nearest suitable planting area, where not otherwise indicated on Drawings, and each electrode shall terminate within a concrete yard box installed flush with finish grade. In planting areas, finish elevation of concrete yard boxes shall be two inches above planting surfaces.
- B. If concrete enclosed electrode is provided, grounding wire shall be terminated to a suitable copper plate with grounding lugs and must be enclosed in a raceway or box.

- C. Grounding rods shall be driven to a depth of not less than eight feet. Permanent ground enhancement material, (GEM) as manufactured by Erico Electrical Products, Loresco Powerset, Tessco Ultrafil or equal, shall be installed at each ground rod to improve grounding effectiveness. Install in accordance with manufacture's installation instructions.
- D. Grounding electrodes shall provide a resistance to ground of not more than 25 ohms.
- E. When installing grounding rods, if resistance to ground exceeds 25 ohms, two or more rods connected in parallel, or coupled together shall be provided to meet CEC grounding resistance requirements.
- F. Ground rods shall be separated from one another by not less than ten feet.
- G. Parallel grounding rods shall be bonded together with listed fittings and grounding conductors in galvanized rigid steel conduit, buried not less than 12 inches below finish grade.

3.2 TESTING

- A. Provide the services of an approved independent testing laboratory to test grounding resistance of "made" electrodes, ground rods, bonding of building steel, water pipes, gas pipes and other utility piping. Tests shall be performed as follows:
 - 1. Visually and mechanically examine ground system connections for completeness and adequacy.
 - 2. Perform fall of potential tests on each ground rod or ground electrode where suitable locations are available per IEEE Standard No. 81, Section 8.2.1.2. Where suitable locations are not available, measurements will be referenced to a known dead earth or reference ground.
 - 3. Perform the two-point method test per IEEE No. 81, Section 8.2.1.1 to determine ground resistance between ground rod and building steel, and utility piping - such as water, gas and panelboard grounds. Metal hand railings at building entrances and at handicapped ramps shall also be tested.
 - 4. Test shall be performed in the presence of the Inspector.
- B. Submit 3 copies of test results to the Architect. Test results shall be submitted on an official form from the independent testing laboratory recording Project location, test engineer, test conditions, test equipment data, ground system layout or diagram, and final test results.

3.3 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.4 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 05 33
RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Raceways and wire ways
2. Conduit installation
3. Underground requirements

B. Related Requirements:

1. Section 26 05 00: Common Work Results for Electrical
2. Section 26 05 13: Basic Electrical Materials and Methods

C. Applicable Standards and Codes:

1. EIA/TIA 569 Standards
2. National American Standards Institute (ANSI)
3. National American Standards Institute (ANSI)
4. Nationally Recognized Testing Laboratory (NRTL)
5. California Electrical Code (CEC)
6. Uniform Building Code (UBC)
7. Underwriters Laboratory (UL)

1.2 SUBMITTALS

A. Materials List: Provide in accordance with Division 01

PART 2 - PRODUCTS

2.1 RACEWAYS

A. RACEWAYS:

1. Metallic conduit, and tubing shall be manufactured under the supervision of an UL, or another NRTL factory inspection and label service program. Each ten-foot length of conduit and tubing shall bear the UL or another NRTL label and manufacturer's name

2. Rigid metallic conduit shall be rigid steel, heavy wall, mild steel, zinc-coated, with an inside and outside protective coating manufactured in accordance with ANSI C 80.1. Couplings, elbows, bends, conduits, bushings and other fittings shall be the same materials and finish as the rigid metallic conduit. Fittings, connectors, and couplings shall be threaded type, manufactured in accordance with ANSI C 80.1 and UL 6.
 3. Electrical metallic tubing shall be steel tubing, zinc-coated with a protective enamel coating inside, manufactured in accordance with NEMA C 80.3. Fittings, couplings, and connectors shall be gland compression type, set screw couplings and connectors not permitted. All parts shall be manufactured in accordance with NEMA C80.3 and UL 6A. Electrical metallic tubing is designated hereinafter as EMT. Steel and rain tight fittings shall be approved and listed for the intended application
 4. Flexible steel conduit shall be of flexible interlocking strip construction with continuous zinc coating on strips, manufactured in accordance with UL 1
 - a. Connectors and couplings shall be required fittings of the type, which threads into convolutions of flexible conduit.
 5. Liquid-tight flexible metal conduit shall be galvanized heavy wall, flexible locked steel strip construction, UV rated, with smooth moisture and oil-proof, abrasion-resistant, extruded plastic jacket. Connectors shall be as required for installation with liquid-tight flexible conduit and shall be installed to provide a liquid-tight connection
 6. Non-metallic conduit shall be rigid PVC electrical conduit extruded to schedule 40 dimensions of Type II. Grade 1 high impact, polyvinyl chloride, sweeps, couplings, reducers and terminating fittings shall be listed under the UL, or another NRTL, and shall bear the manufacturer's listed marking
 7. Multi-cell raceway shall be four inch PVC, Type 40, UL or another NRTL listed for underground use with optical fiber and signal system cables. Raceway shall be furnished with 3-1/2 inch factory installed inner ducts with required internal spacers, and required couplers, sweeps, and end bells. Multicell raceway shall be Carlon Multigard, or District approved equal
 8. Metal Clad (MC) cable system is not allowed
- B. Sleeves for Conduits: Sleeves shall be adjustable type by Carlon, U.S. Plastic, PEP Plastic or equal
- C. Where conduit enters a building through a concrete foundation below grade, or ground water level, or where it is necessary to seal around a conduit where it passes through a concrete floor or wall, provide O-Z/Gedney Type FSK Thru Wall and Floor Seal, equivalent Cooper Crouse Hinds Thru-Wall, Legrand Thru-Wall, or equal
- D. Expansion Joints-Seismic Separations between building(s) and other locations as indicated on drawings:
1. Provide Thomas & Betts XJG-TB, O-Z/Gedney. type AX with bonding strap and clamps, Cooper XJGD or equal. At exterior locations, provide Thomas & Betts XJG-TB, O-Z/Gedney type EX, Cooper XJGD, or equal. Provide O-Z/Gedney type AXDX, or equal combination deflection/expansion fittings at all seismic separations. Provide manufacture's internal and external bonding jumpers at all locations. Liquid-tight metal conduit or flexible metal conduit shall not be approved at expansion joints, separations between buildings or seismic separations

2. Provide expansion fittings at intervals not exceeding 100 feet in conduits exposed to direct sunlight. Fittings may be installed in the conduit run or where conduit attaches to junction or pull boxes. OZ/Gedney type AX, TX or EXE series, or equivalent by Thomas and Betts, Crouse-Hinds or approved equal

E. Conduit Seal Fittings:

1. Provide conduit seal fittings where indicated on the Drawings. Conduit seals shall be of rigid galvanized steel. Seals in horizontal conduit installations shall be Thomas & Betts EYS, Appleton Type ESU, Crouse Hinds Type EYS, or equal. Seals in vertical conduit installations shall be Thomas & Betts EYD, Appleton Type SF, Crouse Hinds Type EYD, or equal, with continuous drain. When installing conduit seals make provision for percent fill space reduction in accordance with CEC
2. Install sealing compound after wire has been installed. Ensure drain is not blocked in vertical seals when installing compound. Where conduit seals are installed in hazardous area applications, there shall be no conduit coupling, fitting, etc., between seal and boundary of hazardous area

F. Surface Steel Raceway:

1. The surface steel raceway system for branch circuit wiring, data network, voice, video, and other low voltage wiring shall be as manufactured by the Wiremold Company, Hubbell, or Mono-Systems, Inc. or equal. The raceway system may be supplied pre-wired in accordance with all sections of these specifications and requirements herein, and shall be UL or another NRTL listed. Computer data installation shall be as required by other sections of this Division
2. If furnished pre-wired, the system must be listed in accordance with UL or another NRTL for "Multiple Outlet Assemblies" and so labeled on interior of the assembly. The pre-wired installation must contain no extra wire splices in the raceway as compared to a contractor assembled installation assembled from components. The pre-wired steel raceway shall be Hi-Pot tested at the factory to prevent any potential bare wire or shot circuit defects.
3. The raceway shall be a two-piece design with a metal base and snap-on metal cover, except for the Wiremold V700 system, Hubbell HBL750 series and Mono-Systems Inc. S145-700 series that shall be a one-piece design. The base and cover sections shall be a minimum of 0.040 inch wall thickness. The base section shall be available in ten-foot lengths. A hand-operated cutting tool shall be available for the base and cover to ensure clean, square cuts. Wiremold V500, Hubbell V500, and Mono Systems inc. SM500 series are not permitted.
4. A full complement of fittings shall be furnished, including but not limited to, flat internal and external elbows, tees, entrance fittings, wire clips, cover clips, couplings, support clips, C-hangers and end caps. The fitting color shall match the raceway color. Fittings shall be supplied with a base where indicated and/or required. A take-off fitting shall be furnished as required to adapt to existing flush wall boxes.
5. Device brackets shall be furnished for mounting single or two-gang devices within the raceway. Devices shall be provided with the ability of mounting flush or in conjunction with standard steel, stainless steel, or manufacturer's metal faceplates.
6. The raceway shall be furnished with a complete line of connectivity outlets and modular inserts for unshielded twisted pair including category 5, fiber-optic, coaxial, and other

cabling types with face plates and bezels to facilitate installation. Computer data installation shall be as required by other sections of this Division, and Division 27.

7. Raceway shall be furnished with corner elbows and tee fittings to maintain a cable bend radius which meets the requirements of fiber-optic and copper cables under EIA/TIA 569 for communications pathways.

G. Factory Pre-Wired Surface Metal Raceway:

1. Furnish and install pre-wired surface metal raceways as indicated on Drawings and as specified
2. Metal Raceway shall be galvanized steel Wiremold V4000, Hubbell 4000 series, or Mono-Systems Inc. SMS-4000 series complete with raceway base, cover, fittings, receptacles and mounting plates required for a complete assembly. Raceway shall have two wiring compartments with integral dividing barrier for isolating the wiring compartments.
3. Pre-wired assembly shall be UL, or another NRTL listed as a multi-outlet assembly and surface raceway as labeled on interior of assembly
4. Wiring devices and other components shall be factory installed, electrically wired and covers labeled as indicated on drawings. Each receptacle shall be identified with panelboard and circuit number from which it was fed. Grounding shall be maintained by means of factory installed grounding conductors
5. Where shown on Drawings, Raceway covers shall have provisions for mounting computer data outlets
6. Complete assembly is to consist of required fittings such as elbows, slide couplings for joining raceway sections, blank end caps and flat tees
7. Prewired assembly must contain no wire splices
8. Receptacles and wiring shall be as indicated on drawings and as specified
9. Where raceway is used for power and computer data outlets, installation of data outlets shall be as required by other sections of this specification.
10. Prior and during installation, verify and comply with manufacturer's installation instructions.
11. Entire assembly shall be tested for shorts, opens, ground faults, and wire insulation at factory and certified. Raceways shall be electrically continuous and bonded in accordance with California Electrical Code
12. Submit shop drawings for approval showing the complete layout of all components of each raceway, raceway lengths, each component description, location and circuit identification.
13. All wiring devices shall be removable without requiring disassembly of wireway.
14. Standard non OEM wiring devices shall be used as specified in District's specifications.

- H. Wireways shall be 16 gage galvanized steel enclosed hinge/screw wiring troughs, surface metal raceway, wireway, and auxiliary gutter designed to enclose electrical wiring. Wireway fittings shall be furnished with removable covers and sides to permit complete installation of conductors throughout the entire wireway run. Cover shall be furnished with keyhole slots to accept captive screws locking the cover securely closed. Wireways shall be UL or another NRTL listed, and shall be Square D Type LDB NEMA-1 enclosure for interior applications, or Type RDB NEMA-3R enclosure for exterior applications, or equal by Cooper B-line, Hoffman, Wire Guard, or Circle AW.
- I. Penetration in Fire-Rated Structures: Provide 3M, or equal, sealant and fire barriers for installing fire-rated seals around penetrations through floors, walls, and elevator hoistways. Fire stop system must be UL, or another NRTL listed, and classified for through-penetration applications of metallic conduits and busways.
- J. Pull Wires: Install 1/8 inch polypropylene cords in empty or spare conduits.

PART 3 - EXECUTIONS

3.1 CONDUIT INSTALLATION

- A. General Requirements:
 - 1. Provide complete and continuous systems of rigid metallic conduit, outlet boxes, junction boxes, fittings and cabinets for systems of electrical wiring including lighting, power, and signal systems, except as otherwise specified.
 - 2. Provide complete and continuous systems of rigid metallic conduit, outlet boxes, junction boxes, fittings and cabinets for systems of electrical wiring including lighting, power, and signal systems, except as otherwise specified.
 - 3. Provide complete and continuous systems of rigid metallic conduit, outlet boxes, junction boxes, fittings and cabinets for systems of electrical wiring including lighting, power, and signal systems, except as otherwise specified.
 - a. For continuous lengths not exceeding more than 50 feet between pull points (pull boxes, outlet boxes, etcetera).
 - b. With no maximum total raceway length located within a building interior when the flex is located in concealed locations
 - 4. Flexible Steel conduit shall not exceed 1-1/2 inches in size
 - 5. Liquid-tight flexible steel conduit shall only be installed, except where otherwise specified, for final connection of motor terminal boxes, shop equipment, cafeteria equipment, HVAC equipment and other equipment, or for frequent interchange, and shall be of sufficient length, not exceeding 36 inches, to permit full travel or adjustment of motor on its base. Liquid-tight flexible conduit shall not be used for equipment not requiring adjustment or frequent interchange.
 - 6. Connectors for flexible metal conduit shall be made of steel, and of the types which threads into convolutions of conduit. Connectors for watertight flexible metal conduit shall be as required for installation and shall be installed to provide a watertight connection

7. Exposed conduit shall be installed vertically and horizontally following the general configuration of the equipment, using cast threaded hub conduit fittings where required and shall be clamped to equipment with suitable iron brackets and one hole pipe strap
8. If connection is from a flush wall-mounted junction box, install an approved extension box
9. Underground feeder distribution conduits for systems may be non-metallic conduit instead of rigid conduit except where otherwise specified or indicated
10. Conduit shall be concealed unless otherwise indicated. Conduits exposed to view, except those in attic spaces and under buildings, shall be installed parallel or at right angles to structural members, walls, or lines of building. Conduits shall be installed to clear access openings
11. Bends or offsets will not be permitted unless absolutely necessary. Radius of each conduit bend or offset shall be as required by ordinance. Bends and offsets shall be performed with standard industry tools and equipment or may be factory fabricated bends or elbows complying with requirements for radius of bend specified. Heating of metallic conduit to facilitate bending is not permitted. Public telephone conduit bends and offsets shall be provided with a radius which is not less than ten times trade size of conduit unless otherwise permitted. Refer to underground installation, specified in this section, for radius of bends and offsets required for underground installations
12. Running threads are not permitted. Provide conduit unions where union joints are necessary. Conduit shall be maintained at least six inches from covering of hot water and steam pipes and 18 inches from flues and breechings. Open ends of conduits shall be sealed with permitted conduit seals during construction of buildings and during installation of underground systems
13. Expansion Joints/Seismic Separations/Separations between buildings/Locations Indicated: Provide Thomas & Betts XJG-TB, O-Z Electrical Mfg. Co. Inc. Type AX with bonding strap and clamps, Crouse Hinds XJGD, or equal. At exterior locations, provide Thomas & Betts XJG-TB, O-Z Electrical Mfg. Co. Inc. Type EX, Crouse Hinds XJGD, or equal. Provide Crouse Hinds, Thomas & Betts, or O-Z Electrical Mfg. Co. Type AXDX, or equal Combination Deflection/Expansion Fittings at all seismic separations. Provide manufactures internal and external Bonding Jumpers at all locations. Liquid-tight flexible conduit shall not be approved at expansion joints or seismic separations
14. Where conduits are terminated in groups at panelboards, switchboards, and signal cabinets, etc., provide templates or spacers to fasten conduits in proper position and to preserve alignment. Conduits terminating at signal cabinets shall only enter cabinets in the following locations:
 - a. Conduits entering top, side, and bottom of cabinets shall be aligned in a single row, centered two inches from rear of cabinet
 - b. Conduits entering back of cabinet shall be aligned in a single row centered two inches from top of cabinet
 - c. Conduits shall not be spaced closer than three inches on centers
15. Conduits above metal lath ceilings shall be rigidly suspended with pipe hangers or pipe racks or shall be secured to superstructure with factory fabricated pipe straps. Conduits in metal lath or steel stud partitions shall be tied to furring channels or studs. In ceiling spaces and in partitions, tie wires shall be spaced not more than 5 feet apart, shall fasten

conduit tight against channels and studs at point of tie and shall not support any of conduit weight. Tie wire shall be 16 gage galvanized double annealed steel

16. Where auxiliary supports, saddles, brackets, etc., are required to meet special conditions, they shall be fastened rigid and secure before conduit is attached
17. Conduit in ceiling spaces, stud walls, and under floors, shall be supported with factory fabricated pipe straps or shall be suspended with pipe hangers or pipe racks. Pipe straps shall be attached to and shall fasten conduit tight at point of support against ceiling and floor joists, rafters, and wall studs, or two-inch x four-inch headers fitted between joists or wall studs
18. Conduits installed on exposed steel trusses and rafters shall be fastened with factory fabricated conduit straps or clamps, which shall fasten conduit tight against supporting member at point of support
19. Conduits installed under buildings shall be strapped with factory fabricated conduit straps to underside of concrete floor or joists, or wood floor joists, or shall be suspended with pipe hangers or pipe racks. Conduits under building are not permitted to be placed directly on grade; they shall be suspended from building or shall be buried below surface or ground. 1-1/4 inch and larger conduits under buildings shall be installed with conduit hangers or racks
20. Pipe hangers for individual conduits shall be factory fabricated. Steel rods shall be 3/8 inch for two-inch conduit hangers and smaller and shall be 1/2 inch for 2 1/2-inch conduit hangers and larger
21. Pipe racks for groups of parallel conduits and for supporting total weights not exceeding 500 pounds shall be trapeze type and shall consist of a cross channel, Steel City Kindorf B-900, Unistrut P-1000, equivalent Cooper B-Line or equal, suspended with a 3/8 inch minimum diameter steel rod at each end. Rods shall be fastened with nuts, top and bottom to cross-channel and with square washers on top of channel. Conduits shall be clamped to top for cross-channel with conduit clamps, Steel City Kindorf C-105 or Unistrut P-1111 through P-1124, equivalent Cooper B-Line, or equal. Conduits shall not be stacked one on top of another, but a maximum of two tiers may be on same rack providing an additional cross-channel is installed. Where a pipe rack is to be longer than 24 inches, or if the supported weight exceeds 500 pounds, submit Shop Drawings of installation to the Architect for review
22. Conduits suspended on rods more than two feet long shall be rigidly braced to prevent horizontal motion or swaying. Installation shall meet zone 4 seismic requirements
23. Factory fabricated pipe straps shall be one or two-hole formed galvanized clamps, heavy-duty type, except where otherwise specified
24. Hangers, straps, rods, or pipe supports under concrete shall be attached to inserts set at time concrete is placed, or with approved concrete anchors. Under wood, install bolts, lag bolts, or lag screws; under steel joists or trusses, install beam clamps. Contractor shall submit size of anchors, bolts, screws, and installation method to Architect for approval prior to start of any work
25. Conduits shall be supported at intervals required by code, but not to exceed ten feet. One inch and smaller exposed conduits shall be fastened with one-hole malleable iron straps. Perforated straps and plumber's tape is not permitted for the support of conduits

26. Conduits stubbed up through a roof or an arcade shall be flashed with a waterproof flashing. Refer to Division 07 for additional requirements
27. Bushings and locknuts for rigid steel conduit shall be steel threaded insulating type. Setscrew bushings are not permitted
28. Flex conduits shall be cut square and not at an angle
29. Routing of conduits may be changed providing length of any conduit run is not increased more than ten percent of the length indicated on Drawings

B. Underground Requirements:

1. Conduits and multicell raceways installed underground shall be entirely encased in three inch thick concrete on all sides , except where otherwise specified. Provide required spacers to prevent any deflection when concrete is placed and to preserve position and alignment. Conduits and raceways shall be tied to spacers. Anchors shall be installed to prevent floating of conduits and raceways during placing of concrete. Provide red colored concrete to encase conduits of systems operating above 600 volts
2. Underground conduits and raceways shall be buried to a depth of not less than 24 inches below finished grade to top of the concrete envelope, unless otherwise specified
3. Assemble sections of conduit with required fittings. Cut ends of conduit shall be reamed to remove rough edges. Joints in conduits shall be provided liquid-tight. Bends at risers shall be completely below surface where possible
4. Conduits and raceways in a common trench shall be separated by at least three inches of concrete. Electrical power and/or lighting conduit runs installed in a common trench with conduits containing signal system wiring such as public address, telephone, intrusion detection, fire alarm, television, computer networking, and clock systems shall maintain a separation of a minimum of six inches from these types of signal system conduits and raceways. Electrical power, lighting and signal conduits and raceways installed in a common trench with other utility lines such as gas, water, sewer and storm lines shall maintain 12 inches separation from these types of utility lines
5. The Inspector will observe underground installations before and during concrete placement. A mandrel shall be drawn through each run of conduit in presence of the Inspector before and after placing concrete. Mandrel shall be six inches in length minimum, and have a diameter that is within 1/4 inches of diameter of conduit to be tested
6. Non-metallic conduit installations shall comply with following additional requirements. Joints in PVC conduit shall be sealed by means of required solvent-weld cement supplied by conduit manufacturer. Non-metallic conduit bends and deflections shall comply with requirements of applicable electrical code, except that minimum radius of any bend or offset for conduits sized from 1/2 inch to 1 1/2-inch inclusive shall not be less than 24 inches. Bends at risers and risers shall be PVC-coated rigid steel conduit. Radius of curve of bends or offsets in non-metallic conduit for public telephone system shall be not less than ten times trade size of conduit, unless otherwise specifically permitted
7. Furnish and install a six-inch wide, polyethylene, red underground barrier type 12 inches above full length of concrete reading, "CAUTION ELECTRIC LINE BURIED BELOW".

8. Underground conduit systems provided for utility companies shall be furnished to meet the requirements of the utility companies requiring service
9. Protect inside of conduit and raceway from dirt and rubbish during construction by capping openings
10. Add bell-end bushings for conduit stub-up including underground entries to pull boxes, and manholes. Under floor standing switchboards and motor control centers provide a four-inch galvanized nipple with ground bushing
11. Underground conduit for systems operating above 600 volts shall be a minimum size of four inches
12. At portable classroom all stub ups shall be installed with a coupling flush to finish grade
13. Underground conduits and raceways shall be swabbed prior to wire pull

C. General Installation Requirements for Computer Network System Conduits:

1. Location of outlet boxes and equipment on Drawings is approximate, unless dimensions are indicated. Drawings shall not be scaled to determine position and routing of wireways, drops, and outlet boxes. Location of outlet boxes and equipment shall conform to architectural features of the building and other Work already in place and must be ascertained in the field before start of Work
2. The maximum pulling tensions of the specified cables shall not be exceeded and proper radius of cable bends shall be maintained
3. For computer network wiring, conduit types shall be limited to rigid metal conduit, electrical metallic tubing, schedule 40 PVC, multi-cell raceways, and flexible metallic conduit for lengths less than six feet
4. Interior section of conduit run shall be not longer than 100 feet and shall not contain more than two bends of 90 degrees between pull points or pull boxes
5. The inside radius of a conduit bend shall be at least six times the internal diameter of the conduit. When the conduit size is greater than two inches, the inside radius shall be at least ten times the internal diameter of the conduit. For fiber-optic cable, the inside radius of a conduit bend shall be at least ten times the internal diameter of the conduit
6. Conduit shall be sized in accordance with Table 4.4-1 of EIA/ TIA 569 standard
7. Splicing or terminating cables in pull boxes is not permitted
8. For indoor application, a pull box shall be provided in conduit run where:
 - a. The length is over 100 feet
 - b. There are more than two bends of 90 degrees
 - c. There is a reverse bend in the run
9. Boxes shall be provided in a straight section of conduit and shall not be installed in lieu of a bend. The corresponding conduit ends are to be aligned with each other. Conduit fittings shall not be installed in place of pull boxes

10. Where a pull box is provided with raceways, pull box shall comply with the following:
 - a. For straight pull-through, provide a length of at least eight times the trade-size diameter of the largest raceway
 - b. For angle and U-pulls:
 - 1) Provide a distance between each raceway entry inside the box and the opposite wall of the box of at least six times the trade-size diameter of the largest raceway, this distance being increased by the sum of the trade-size diameters of the other raceways on the same wall of the box
 - 2) Provide a distance between the nearest edges of each raceway entry enclosing the same conductor of at least
 - a) Six times the trade-size diameter of the raceway; or
 - b) Six times the trade-size diameter of the larger raceway if they are of different size
 - c) For a raceway entering the wall of a pull box opposite to a removable cover, provide a distance from the wall to the cover of not less than the trade-size diameter of the largest raceway plus six times the diameter of the largest conductor
11. Drawings generally indicate Work to be installed, but do not indicate all bends, transitions of special fittings required to clear beams, girders or other Work already in place. Investigate conditions where conduits and wireways are to be installed, and furnish and install required fittings

3.2 STUBS

- A. Panelboard: Install two one inch conduits from each flush mounted panelboard to access under floor space and to access above ceiling space where these conditions occur. Cap conduits with standard galvanized pipe caps
- B. Floor: At points where floor stubs are indicated in open floor areas, for connections to machines and equipment, conduits shall be terminated with couplings, tops flush with finished floor. Stubs shall extend above couplings the indicated distance. Where capped stubs are designated, couplings shall be closed with cast iron plugs with screw drive slots.
- C. Underground:
 1. Underground conduit stubs shall be terminated at locations indicated, and shall extend five feet beyond building foundations, steps, arcades, concrete walks and paving. Rigid metallic conduit stubs and non-metallic conduit stubs shall be capped by installing a coupling flush in end wall of concrete encasement and plugging with a permitted plug. Project record drawings shall indicate location of ends of underground conduit stubs fully dimensioned and triangulated with reference to buildings or permanent landmarks. These dimensions, including depth below finished grade, shall be marked on project record drawings in presence of the Inspector before backfilling trench. Where extending existing concrete encased stubs, clean, chip and wire brush end of existing concrete and brush on a heavy coat of neat cement paste or epoxy bonding agent.

2. Over ends of individual underground conduit stubs or groups of conduit stubs, install four-inch by 18-inch deep PVC filled with concrete, flush with finished grade in asphaltic concrete or lawns, and two inches above finished grade in planting areas. Cast a three-inch by three-inch brass plate engraved "ELECT" flush in top of concrete. Secure plate to concrete with brass dowels or as indicated on drawings.

3.3 PROTECTION

- A. Protect the Work of this section until Substantial Completion

END OF SECTION

SECTION 26 08 00
ELECTRICAL SYSTEM COMMISSIONING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section Includes:

1. General requirements for Commissioning (Cx) of lighting systems components, lighting controls and HVAC systems line voltage interconnection components, including installation, start-up, testing and documentation according to construction documents and Commissioning Plan (CxP).
2. Standard procedures for the execution of commissioning work shall be in conformance with Division 1, Section 01 9113 General Commissioning Requirements. Coordinate work with the Commissioning Services Provider (CxSP).

1.2 RELATED REQUIREMENTS

- A. Division 01 - General Requirements.
- B. Section 01 9113: General Commissioning Requirements.
- C. Section 01 7900: Maintenance and Operations Staff Demonstration and Training.
- D. Section 23 8000: Heating, Ventilation, and Air Conditioning Equipment.
- E. Section 23 0800: HVAC Systems Commissioning.
- F. Section 23 0923: Environmental Control and Energy Management Systems.
- G. Section 23 0813: Environmental Controls and Energy Management System Commissioning.
- H. Section 26 0500: Common Work Results for Electrical.
- I. Section 26 0513: Basic Electrical Materials and Methods.
- J. Section 26 0526: Grounding and Bonding.
- K. Section 26 0519: Low Voltage Wires (600 Volt AC).
- L. Section 26 0586: Motors and Drives.
- M. Section 26 2419: Motor Control Center and Motor Control Devices.
- N. Section 26 5010: Solid State (LED) Lighting.
- O. Section 26 0923: Lighting Control Systems.
- P. Section 26 5563: Theatrical Lighting and Stage Dimming Systems (Middle and High Schools).

- Q. Section 26 5566: Theatrical Lighting and Stage Dimming Systems (Elementary Schools).
- R. Section 26 5568: Athletic Fields Lighting.

1.3 REFERENCES

- A. Applicable codes, standards, and references: inspections and tests shall be in accordance with the following applicable codes and standards:
 - 1. National Electrical Testing Association – NETA.
 - 2. National Electrical manufacturer’s Association – NEMA.
 - 3. American Society for Testing and Materials – ASTM.
 - 4. Institute of Electrical and Electronic Engineers – IEEE.
 - 5. American National Standards Institute – ANSI.
 - 6. National Electrical Safety Code – NESC.
 - 7. California Building Code – CBC.
 - 8. California Electrical Code – CEC.
 - 9. California Green Building Standards Code (CalGreen).
 - 10. Conglomerate for High Performance Schools (CHPS).
 - 11. Insulated Power Cables Engineers Association – IPCEA.
 - 12. Occupational Safety and Health Administration – OSHA.
 - 13. National Institute of Standards and Technology – NIST.
 - 14. National Fire Protection Association – NFPA.
 - 15. California Electrical Code.
 - 16. ANSI/NFPA 70B – Electrical Equipment Maintenance.
 - 17. NFPA 70E – Electrical Safety Requirements for Employee Work Places.
 - 18. ANSI/NFPA 101– Life Safety Code.

1.4 SUBMITTALS

- A. Submittals shall include the following:
 - 1. Submit required Cx submittals in accordance with Division 1 Specification Sections.
 - 2. Copy of the Architect’s reviewed and accepted submittals to the CxSP via the OAR.

3. List of team members who will represent the CONTRACTOR in the Pre-functional Equipment Checks and Functional Performance Testing, at least two weeks prior to the start of Pre-functional Equipment Checks.
4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, checklist documentation and field checklist forms to be used by factory or field technicians, and a copy of full details of OWNER-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of OWNER to keep Warranty in force, clearly defined.
5. Detailed manufacturer's recommended procedures and schedules for Pre-functional Equipment Checks, supplemented by CONTRACTOR's specific procedures, and Pre-functional Tests, at least four weeks prior to the start of Pre-functional Performance Tests.
6. After facility's commission is complete, submit completed Pre-functional Equipment Checklists and Functional Performance Test checklists organized by system and by subsystem. Bind information in a single package. The results of failed tests shall be included along with a description of the corrective actions taken.

1.5 MEETINGS, SEQUENCING AND SCHEDULING

- A. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Division 26 Sections has been successfully completed, and tests, inspection reports and Operation and Maintenance manuals required in Division 26 Sections have been submitted and approved. The start-up and Pre-functional Equipment Checklists shall be completed and submitted to the OWNER prior to the functional performance tests.
 1. Coordinate electrical work with the work of other trades prior to scheduling of any Testing.
 2. Coordinate the completion of electrical testing, inspection, and calibration prior to start up.

1.6 QUALITY CONTROL

- A. Incorporate manufacturer's recommended procedures for the systems and equipment to be commissioned under this Section.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Equipment to be utilized in the commissioning process shall meet the following requirements:
 1. Provide test equipment as necessary for the equipment and systems to be commissioned.
 2. Provide testing equipment and accessories that are free of defects and certified for use.
 3. Provide testing equipment with current calibration labels per NIST Standards.
 4. Testing equipment shall be UL Listed.

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS REQUIREMENTS

- A. Work to be performed prior to commissioning:
 - 1. Complete all phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.
 - 2. Start-up services required to bring each system into full operational state and ready for functional performance testing:
 - a. Completion of authorized manufacturer representative's start-up procedures and recommendations.
 - 1) Provide Manufacture's start-up completed forms.
 - b. Completion of pre-functional checklists.
 - c. Copy of required manufacturer and field testing.
 - d. Motor rotation check.
 - e. Control sequences of operation.
 - f. Full and partial load performance.
 - 3. If modifications or corrections to the installed systems are required to bring the system(s) to acceptance levels due to CONTRACTOR's incorrect installation or defective materials, such modifications or corrections shall be made at no additional cost to the OWNER.
- B. Functional tests shall not start until each system is complete and the above items have been documented and submitted to the Engineer of Record, Cx Services Provider and OWNER for review.
 - 1. Pre-commissioning Responsibilities: Inspection, calibration and testing of the equipment and devices necessary to commission the following systems:
 - 2. Electrical Lighting Systems.
 - 3. Lighting Controls.
 - 4. HVAC line voltage electrical components.
 - 5. Line voltage interface of Environmental Controls and Energy Management System with other systems.
 - 6. Photovoltaic Systems.

3.2 PREPARATION

- A. Provide certified electricians and/or qualified personnel as required with adequate tools and equipment necessary to perform Testing.

- B. Provide all equipment required for the commissioning of equipment and systems indicated in article 3.01.B.
- C. Provide certified testing agency personnel or report(s) as required.

3.3 TESTING

- A. Testing documentation shall include the following minimum information:
 - 1. Test number.
 - 2. Equipment used for the test, with manufacturer and model number and date of last calibration.
 - 3. Date and time of the test.
 - 4. Indication of whether the record is the first commissioning test, or a retest following correction of a previously identified issue.
 - 5. Identification of the system, subsystem, assembly, or equipment.
 - 6. Conditions under which the test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of the test.
 - 7. Systems and assemblies test results, performance and compliance with contract requirements.
 - 8. Issue number and description of corrected issue that prompted retesting.
 - 9. Name and signature(s) of witnesses and the person(s) who performed the test(s).
- B. Test lighting and controls systems to verify performance, operation, functionality, light levels, energy usage, and compliance with construction documents.
 - 1. Start up, test and document results under the observation of the CxSP.
 - 2. Execute the Functional Performance Test (FPT) under the observation of the CxSP.
 - 3. Provide completed and signed FPTs to CxSP for inclusion in the commissioning report.
 - 4. Functions and Testing Conditions:
 - a. Occupancy sensors and timer controls for lighting:
 - 1) Verify that specified functions and features are set up, debugged and fully operable at time of test.
 - 2) Verify that occupant override feature functions as intended in the contract documents.
 - 3) Verify that sensors response times/durations are set properly.
 - 4) Test the sequence of operation for features and modes and confirm that adjustable times match the design specifications and contract documents.

- 5) Verify that sensors are located per manufacturer's recommendations.
- b. Electric lighting dimming, photocells and controls:
 - 1) Test the dimming controls during daytime when conditions are such that controls should be dimming electric lighting.
 - 2) Verify that amperage changes in light fixtures are proportional to external light changes. Verify that dimmed light levels uniformity at the specified work plane remain within specified limits.
 - 3) Verify that delays and ramp times are set and functioning so that the speed of change of light fixture output is slow enough to not bother occupants, and in compliance with the specifications.
 - 4) Verify that dimming does not cause lower than specified light levels in adjacent "non-dimmed" spaces.
 - 5) Verify that the controls and sensors cannot be easily overridden or disabled by occupants.
 - 6) Verify that dimming systems in places of assembly are interfaced with the Central Fire Alarm system.
 - 7) Verify that dimmed lighting in these areas shall come back to full bright during a fire alarm or emergency condition.
- c. Illumination Levels, Night Conditions:
 - 1) Verify that lighting throughout the building is operating automatically.
 - 2) Test with doors closed (to simulate actual occupancy) and after finishes are complete.
- d. Illumination Levels, Day Conditions:
 - 1) Verify that lighting levels comply with average maintained foot-candle levels shown on plans.
 - 2) Verify that lighting throughout the building is operating automatically.
 - 3) Test with doors closed (to simulate actual occupancy), after finishes are complete, and room is furnished.
 - 4) Test at different times during the day, or under OWNER-approved simulated conditions, to ensure proper system response and to determine that lighting levels are within specified requirements.
 - 5) In classrooms and educational spaces test the system for the different pre-determined settings. Quiet time, AV mode, all on/off, up/down dimming, and standard operations.
5. Lighting Power Density: Verify building lighting power density. Perform the test with interior lighting turned on and any manual or automatic controls temporarily overridden.

Provide statement of compliance with 100% design energy report. Measurements shall be taken at least one minute after lights are turned on.

6. Emergency Lighting System: Verify that the system operates automatically under any condition, without human intervention, and that it resets back to normal operations after the power failure or emergency condition is over or cleared.

C. Acceptance Criteria:

1. Lighting Controls: For the conditions, sequences and modes tested; dimming, occupancy, photocell, and timing controls, integral components and related equipment shall respond to changing conditions and parameters defined in the Contract Documents.
2. Illumination Levels: Average light levels in the tested space at the work plane elevation shall be in the range of plus or minus 10% of the specified light level range for the space.
3. Lighting Power Density: Average instantaneous lighting power density shall be within plus or minus ten percent of that indicated in the Construction Documents.
4. Power factors on lighting circuits shall be greater or equal to 0.95, or as required by lighting fixture specifications.
5. Electrical system total harmonic distortion shall be smaller than 20%.
6. Electrical equipment AIC ratings shall be as indicated in construction drawings.
7. Feeders % voltage drop. Flag feeders with voltage drop greater than 3%.

D. Sampling Strategy for Identical Units:

1. Lighting Controls: Test all automatic interior lighting controls.
2. Illumination Levels: Test all spaces, zones and rooms to verify as proper light levels.

3.4 HVAC Electrical Component Testing

- A. Document HVAC Division 23 electrical components using the startup procedure submitted by CONTRACTOR and accepted by the CxSP.
- B. Complete and submit Start-up, Pre-functional, and Functional Checklists.
- C. Verify the following information prior to HVAC system equipment startup.
 1. Voltage.
 2. Phase.
 3. Motor Size.
 4. Lock Rotor Amperage.
 5. Full Load Amperage.

- 6. Minimum and Maximum Circuit Ampacity.
- 7. Feeder protection or branch circuit protection, breaker or fuse size as applicable.
- D. Coordinate and check corresponding unit electrical protection.

3.5 ADJUSTING

- A. Incorrect installations, including improper adjustments may result in additional work being required for Cx acceptance.
 - 1. Perform work required to correct installations not meeting contract requirements at no additional cost to the OWNER.
- B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.
 - 1. Refer to the Cx Plan for retesting requirements necessary to achieve required system performance.
 - a. The cost of additional and/or supplementary services inquired by OWNER as a result of CONTRACTOR's lack of performance, or inability to resolve identified issues will be solely the responsibility of the CONTRACTOR.

3.6 TRAINING

- A. Provide training and documentation as required in construction documents.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Low-voltage lighting control system.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 26 0500 – Common Work Results for Electrical.
3. Section 26 0513 – Basic Electrical Materials and Methods.
4. Section 26 0519 – Low-Voltage Wires (600 Volt AC).
5. Section 26 0533 – Raceways, Boxes, Fittings, and Supports.
6. Section 26 0800 – Electrical Systems Commissioning.
7. Section 26 2416 – Panelboards and Signal Terminal Cabinets.
8. Section 26 5000 – Lighting.
9. Section 26 5010 – Solid State (LED) Lighting.
10. Section 26 5200 – Emergency Power.

1.2 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Submit a complete one-line diagram of the proposed system configuration for Architect/Engineer's review. The riser diagram shall identify but not be limited to wiring, equipment, components, interconnection with other systems, and location and type of raceways.
- C. Manufacturer's Data: Submit catalog cuts and description of each system component.
- D. Provide wiring diagrams and installation details for lighting control equipment.
- E. Provide a complete sequence of operation and system interface requirements with fire alarm, and other applicable systems as depicted in construction documents.
- F. Shop Drawings: Submit a complete set of detailed Shop Drawings for the entire lighting control system; the shop drawings shall include but not be limited to relay panels with designations and dimensions, day light sensor's locations based on manufacturer's recommendations, and system components with manufacturer's part numbers.

- G. Installation Instructions: Submit manufacturer's written installation instructions, wiring diagrams. Instructions shall include recommendations for handling of equipment and parts, and protection and storage requirements.
- H. Software flow diagram of and complete sequence of operation.
- I. Software licenses and electronic keys, and list of assigned passwords.
- J. Supplemental local or factory training schedule for post warranty support.
- K. A complete list of recommended spare parts with pricing for the OWNER's use in keeping the environmental control system downtime to a minimum.

1.3 QUALITY ASSURANCE

- A. Components shall be listed and labeled by Underwriter's Laboratories (UL), or another Nationally Recognized Testing Laboratory (NRTL).
- B. Lighting control system and peripheral devices with IP addresses shall be UL listed in compliance with UL-2900 – Cyber Security Network Connected Systems.
- C. Lighting Control Systems shall comply with the state of California Building and Electrical Codes, and Title 24 energy requirements in effect at time of submittal for building permit.
- D. Conduct a coordination meeting with the lighting control contractor, electrical contractor, EOR, Manufacturer Representative, Commissioning Agent, and the OAR to validate the location of lighting control system components, including daylight, vacancy, motion sensors. Sensors shall be located based on manufacturer's recommendations.
- E. Systems components shall be Title 24 compliant and listed as California Energy Commission approved products.

1.4 WARRANTY

- A. Manufacturer shall provide a three-year material warranty.
- B. Installer shall provide a two-year installation warranty.

1.5 TRAINING

- A. Provide a competent instructor who is factory trained and has comprehensive knowledge of system components and operations to provide full instructions to designated personnel in the system operation, maintenance, and programming. Training shall be specifically oriented to installed equipment and systems.
- B. Training shall include system overview, time schedules, override commands, emergency operation, and programming and report generation for school based non-technical personnel.
- C. Provide an eight hours OWNER's personnel and Maintenance and Operations technical employees training session; this training session shall cover and provide the following:
 - 1. As-built drawings of System layouts and point to point connection diagrams.
 - 2. System components cut sheets.

3. Operations and maintenance data.
 4. Programmer and maintenance training: database entry; trend logs application programs, diagnostic routines, reporting, failure recovery and calibration, and expose the trainees to system's features, components, system architecture, operations, programming, report generation, communications, reading and interpreting alarms, and any other pertinent information required for the operations and maintenance of the system.
 5. Training sessions shall accommodate a minimum of 20 persons and be facilitated at CONTRACTOR's training facility, which should be no more than 50 miles from the Project Site.
 6. Obtain OWNER's approval for training locations exceeding 50 miles. In such cases, the CONTRACTOR shall be responsible for transportation expenses.
 7. CONTRACTOR shall provide training computers for all attendees. Computers shall be ready for live training sessions.
 8. Instructor(s) shall give the trainees the opportunity to practice on simulated and actual (installed) systems.
- D. The training session shall have an itemized agenda covering all aspects of the training to be covered in the sessions. CONTRACTOR shall obtain agendas approval from OWNER and Commissioning Agent.

1.6 SYSTEM REQUIREMENTS

- A. The lighting controls shall be a centralized system furnished with digital room controllers, capable of working as a network system that communicates via common data line (s).
- B. The system shall be furnished with transformers, control electronics, hardware, resident software and complete programming, occupancy sensors, constant light controllers, exterior light sensors, photocells, digital and analog switches, dimmer switches, conduit and wiring for a complete and functional installation.
 1. Software shall be resident within the lighting control system.
 2. System shall provide local access to programming functions at the master Lighting Control Panel (LCP) and remote access to programming functions via computers or other intelligent communication devices running an industry standard internet browser.
 3. System software shall provide real time status of all components and ancillary devices.
 4. For on-site access, the lighting control system shall have a built-in touchscreen allowing authorized access to localized control and programming
- C. Areas controlled by a motion sensor; such as rooms with one luminaire and emergency fixtures designed to operate 24 hours a day, seven days a week shall be programmed accordingly.
- D. The system shall have a server built into the master LCP. The server shall effectively work/operate through HTML pages from any authorized workstation.

1. WEB front end shall be accessible over an OWNER provided Ethernet 10/100 Mbps to the local area network.
 2. Protocol shall be TCP/IP and allow either http (hypertext transfer protocol) or https (hypertext transfer protocol secured) connections.
- E. Desktop computers are not part of this section and will be provided by others. Non-networked, non-digital, non-server capable systems are not acceptable.
- F. Lighting control system shall be able to be monitored and take commands from a remote Personal Computer (PC); should the remote PC go off-line system programming uploaded to the lighting control system shall continue to operate as intended. Systems requiring an on-line PC or server for normal operation are not acceptable
- G. Devices shall be factory pre-addressed but be able to be field addressable also. Systems requiring field addressing only are not acceptable.
- H. Programs, schedules, time of day, etcetera, shall be held in non-volatile memory at power failure. At restoration of power, lighting control system shall implement programs required by current time and date.
- I. System shall be capable of flashing lighting OFF/ON for any relay or lighting zone prior to the lights beings turned OFF. The warning interval time between the flash and the final lights off signal shall be definable for each zone. Occupant shall be able to override any scheduled OFF sweep using local lighting zone override switches within the zone or occupied space. Occupant override time shall be pre-programmed not to exceed two hours, or current California Title 24 requirements.
- J. The system shall be capable of implementing ON, OFF, Raise (dimming), and Lower (dimming), and preset commands, group or zone by means of devices connected to programmable inputs in the lighting control system.
- K. Programming and scheduling shall be done at the master LCP and/or remotely via the Internet. Remote connections shall function in real time control and real time feedback.
- L. System may consist of centralized relay panels, room controllers, digital switches, analog switches, photocells, motion sensors, lumen control devices, dimmer switches, and various digital interfaces. All system components, including remote and centralized room controllers, digital switches, etc. shall operate and be integrated as a network.
1. Remote Room Controllers (RRC) shall control lighting fixtures in that area or space.
 2. The RRC shall provide power to ancillary and control devices, such as occupancy sensors, and take input from controlling devices, such as daylight and occupancy/vacancy sensors.
 3. RRP's shall be capable of taking inputs from OWNER specification line voltage type switches.
- M. RRC, switches, photocells and occupancy sensors, and ancillary devices and components shall be integrated per lighting control manufacturer's instructions.
- N. Location of devices and relay panels or relay controllers installed above ceilings shall be identified with a printed label attached to ceiling elements. Locate label directly below equipment location.

1.7 LIGHTING CONTROL OVERVIEW-BY AREA CONTROLLED

A. Classrooms:

1. Classrooms shall be controlled by a combination of vacancy sensors, daylight controllers and dimmers switches.
2. The vacancy sensor is to automatically switch lights OFF when the room is not occupied for 15 minutes.
3. Daylight controls shall automatically adjust light intensity according to the natural light level in the room to maintain a uniform level of lighting in the range of 30-50 foot-candles.
4. The daylight sensors shall be enabled and disabled by the vacancy sensors to ensure daylight-controlled lights never automatically turn ON when room is unoccupied. The lighting control system shall allow an authorized person to disable the daylight sensors and dimming controls.
5. Wall switches, and dimmers are to manually switch lights ON and OFF. Switches shall comply with the operational requirements of the current T24, and include location of device, accessibility and override capability.
6. Quiet time switch is to temporarily bypass the occupancy sensors for a pre-programmed period of one hour, or as indicated on drawings.

B. Corridors and Open Areas:

1. Corridors and other common areas are to be controlled by a combination of programmable low voltage keyed switches and time schedules supplied by the networked lighting control system.
 - a. Low voltage keyed switches are operable 24 hours a day and are to manually switch lights ON and OFF.
 - b. The central timer is to automatically sweep lights OFF after hours and provide scheduling capability where and when occupancy sensors are not used.
 - c. Interior corridors require occupancy sensors.

C. Custodial, Unsupervised and Equipment Rooms:

1. Provide occupancy sensors with automatic on-off capability in addition to manual switches, and programming features indicated on plans. These sensors shall turn off the lights in the room via 15 minutes pre-set programmable interval after the room has been vacated.

D. Exterior Security Lights:

1. Program exterior wall packs and security lights to be controlled via exterior light sensors, and time switches as indicated on drawings.
 - a. Program lights to ON state when natural lighting is below 5 foot-candles
 - b. Program lights to OFF when natural light level is greater than 5 foot-candles.

E. Exterior, Non-Security Lights:

1. Exterior non-security lighting in parking lots, corridors and pathways, and decorative lights shall be controlled via exterior light sensor working in conjunction with programmable controlled time schedules via the lighting control system.
 - a. Program lights to ON state when natural lighting is below 5 foot-candles, and when scheduled time is set to ON.
 - b. Program lights to OFF state when natural light level is greater than 5 foot-candles, and when scheduled time is set to OFF.

F. Restrooms:

1. Student Restroom Lighting and Exhaust Fans (Fans interlocked with lights):
 - a. Restroom lights shall be controlled from the lighting control panel via assigned relays.
 - b. Provide by-pass lock type, vandal resistance key operated switch adjacent to the door, and ceiling mounted occupancy sensors for on/off controls.
 - c. The sensor shall turn off the lights via a programmable pre-set 15 minutes interval, after the room has been vacated.
2. Staff Restrooms Lights and Exhaust Fans (Fans interlocked with lights):
 - a. Restrooms lights and fan shall be controlled from the lighting control panel via assigned relays.
 - b. Provide ceiling mounted occupancy sensors, and by-pass toggle switches for system override adjacent to the door.
 - c. The sensor shall turn off the lights via a programmable pre-set 15 minutes interval, after the room has been vacated.

G. Emergency Lighting:

1. Provide emergency lighting controls circuitry to achieve override or bypass of manually operated switches, lighting control systems, dimmers and occupancy sensors during power failures.
2. Each area of luminaries or groups of luminaries shall be equipped with and be controlled by a UL924 listed emergency lighting control unit to allow the detection of localized power failures.

PART 2 - PRODUCTS

2.1 CENTRAL LIGHTING CONTROL PANELS

- A. Central Lighting Control Panels (CLCP) shall be located in electrical closets.

- B. Panels shall be surface or flush mounted type as indicated on Drawings, with a hinged door assembly. Doors shall be furnished with flush type locks, spring latching, Corbin locks for metal doors, keyed to Corbin No. 60 keys. Panels shall include the following components or features:
1. Shall be preprogrammed and preassembled with control equipment and relays as indicated on the lighting plans.
 2. Shall be equipped with suitable dividers separating Class 1 and Class 2 compartments, 120v and 277v compartments as well as "normal and emergency" compartments.
 3. Lighting control relays as indicated on Drawings. Provide 10 percent spare relays for centralized relay panels up to the maximum capacity of panel.
 4. Shall be equipped with a neatly typewritten schedule with number and name of rooms or areas served by the relay circuits. Room numbers and names used shall be determined at the Project site and may not be those indicated on Drawings. Schedule shall indicate panel designation and voltage and shall be mounted in a frame under transparent plastic 1/32-inch-thick on inside of panel cabinet.
 5. Each panel shall be rated for 120 or 277 VAC.
 6. Shall be preassembled, preprogrammed and include relays capable of switching 20 amps lighting loads for 120 or 277 VAC.
 7. Central lighting control panels, remote lighting control panels, relays, low voltage switches, interior light sensors, exterior light sensors, and associated control electronics shall be furnished by Lighting Control and Design (LC & D), Douglas Lighting Controls, or equal.
 8. Approved products: Douglas Dialog Series, LC & D #GR-2400 series, or equal.

2.2 REMOTE ROOM CONTROLLERS

- A. Remote Room Controllers (RRC) shall be mounted in the ceiling space as indicated on plans.
1. Each RRC shall be connected to the network lighting control system using manufacturer's recommended wiring method and configuration.
 2. Provide a printed label "RLCP" to the T-bar grid below the RRC".
 3. Approved products: LC&D GR-2404 Series or Douglas WRC-4244.
- B. Each RRC shall contain the following hardware features:
1. Digital dataline switch inputs.
 2. 12 VDC and 24 VDC inputs for occupancy sensors requiring DC voltage for analog occupancy sensors, or Digital dataline type inputs for occupancy and light sensors.
- C. Switches shall be capable of switching individual relays, local groups of relays within the panel or global groups of relays system wide. Each switch shall be configured to be ON, OFF, RAISE, LOWER, or Toggle.

- D. The RRC shall digital dataline occupancy sensors. The sensors shall be configured for OFF only or ON/OFF switching scenarios.
- E. Photo sensor shall be linked with occupancy sensing so that when light levels are high enough, the occupancy/vacancy sensor will not switch the photo-controlled relays ON.

2.3 RELAYS

- A. Relays shall be warranted for a minimum of three-years.
- B. Relays shall be individually added or replaced. Lighting control systems incapable of replacing individual relays are not acceptable.
- C. Each lighting control relay shall be capable of controlling incandescent, fluorescent, LED sources, and HID lighting loads. Relays not rated for all types of lighting loads are not acceptable.
- D. Approved Products:
 - 1. Single Pole: Douglas WR-6161, LC&D SL-277-NC, or equal.
 - 2. Double Pole: Douglas WR-6172, LC&D SL-480-NC, or equal.

2.4 LOW VOLTAGE SWITCHES

- A. Low voltage switches shall be wired in compliance with manufactures requirements. Digital switches shall be part of the lighting control system network.
 - 1. Provide stainless steel switch plates, unless noted otherwise in construction documents.
 - 2. Approved Products: LC&D Chelsea series, Douglas WSW-3500 series, or approved equal.
- B. Physical removal of any single switch shall have no effect on the communication between relay panels in the rest of the lighting control network. Lighting control systems requiring the continuous connection of all low voltage switches are not acceptable.
- C. Keyed switches shall be digital.
 - 1. Approved products: Douglas WSK-35XX Series, LC&D KS Series, or equal.
 - 2. Provide stainless steel switch plates, unless noted otherwise in construction documents.
- D. Classrooms witches controlling luminaires in classrooms shall be digital and be wired to programmable inputs in the lighting control system network.
 - 1. Each switch shall be programmed to control ON only, OFF only or ON and OFF, dimming, audio/visual and quiet time one, some, or all relays in the entire network.
 - 2. Whiteboard luminaires shall be controlled independently with On, Off, and dimming capabilities.

- E. High abuse areas (common areas, gymnasiums, etcetera) shall be controlled using a vandal resistant, touch sensitive high abuse switch and available with up to three buttons in a single gang. Multi gang versions shall also be available.
 - 1. Touch pads shall be stainless steel and capable of handling both high abuse and power wash cleaning crews' activities.
 - 2. Switches shall be digital or analog as indicted on plans.
 - 3. High abuse switch touch buttons shall control a single relay or group(s) of relays of the lighting control system.
 - 4. Touch buttons shall be controllable via programmed commands to enable or disable, ON, OFF, Toggle or Maintain operation functions. Programming shall be done locally or remotely.
 - 5. Touch pad(s) shall be identified as to function by an engraved label.
- F. Switches must be capable of handling electrostatic discharges of at least 30,000 volts (1cm spark) without any interruption or failure in operation.

2.5 INTERIOR DAYLIGHT SENSORS

- A. Interior daylight sensors shall cause light fixtures to brighten or dim to maintain pre-determined and uniform light levels.
- B. The sensors shall permit any relay to switch at a unique light level and shall attempt to maintain a constant light level by switching individual relays ON or OFF as the ambient light level changes.
- C. Controllers offering single set point controls are not acceptable.
- D. Each interior daylight sensor shall continuously monitor the true light level and shall broadcast this level to lighting control network. Controllers requiring readings at the sensor head itself are not acceptable.
- E. Each interior daylight sensor shall be fully adjustable via the lighting control software. Controllers requiring adjustments at the sensor head are not acceptable.
- F. Provide daylight sensors in all rooms with windows, skylights, or daylight filtration. Refer to lighting plans to determine which switch legs are controlled by the daylight controller.
- G. Approved Products: LC&D iPC Series, Douglas WPS-3711, Douglas WPP-INT, or equal.

2.6 EXTERIOR LIGHT SENSORS

- A. One exterior light sensor shall permit different relays to switch at different light levels. Sensors offering less than 14 remotely settable trip points are not acceptable.
- B. Exterior light sensor shall continuously monitor light levels and shall broadcast this level over the lighting control network. Exterior light sensor shall be fully adjustable via the networked lighting control system.
- C. Sensors and controllers requiring adjustments at the sensor head are not acceptable.

- D. Sensors shall be UL or NRTL listed for exterior application.
- E. Approved products: Douglas WPS-3741B, LC&D PCO, or equal.

2.7 DIMMING CONTROLLER

- A. Remote relay panels shall be capable of outputting 0V – 10V dimming signal for each relay provided in the remote room controller. LED Dimming drivers shall be controlled by industry standard 0V-10V control input.
- B. LED Drivers using proprietary control protocols shall not be acceptable.
- C. To maximize daylight harvesting and minimize disruption to occupants, each dimming output shall provide adjustment for baseline, start point, mid point, end point, trim fade up rate, fade down rate, time delay and enable/disable masking.
- D. Photocells settings must be remotely accessible.
- E. Systems that provide ON, OFF with Time Delay only and systems that do not provide remote accessibility are not acceptable.
- F. Mount photocells in locations indicated on plans and according to manufacturer's recommendations for daylight system type, open or closed loop. Trip points shall be able to be programmed and altered remotely via programming functions at the master Lighting Control Panel (LCP) and remote access to programming functions via computers or other intelligent communication devices.
- G. Photocells requiring manual trip point adjustment, or systems that provide local adjustment only are not acceptable.
- H. Photocells used for interior lighting control shall have multiple settings such as start-point, mid-point, off-point, fade-up rate, fade-down etc.
- I. Approved Products: Douglas WPS-3711, Douglas WPP-INT, LC&D iPC series, or equal.

2.8 OCCUPANCY SENSORS

- A. Occupancy Sensors:
 - 1. Ceiling-Mounted Dual Technology Sensors:
 - a. Sensors shall be dual technology infrared-ultrasonic capable of detecting presence in floor area to be controlled, by detecting Doppler shifts in transmitted ultrasound and infrared technology.
 - b. ADI-Voice technology may be used in addition to the required infrared-ultrasonic features.
 - c. Detection shall be maintained when a person moves only within a maximum distance of 12 inches, in either a horizontal or vertical manner, at approximate speed of 12 inches per second. Lights shall not go off when a person is reading or writing while seated at a desk.
 - d. Each sensor shall be furnished with a convenient shunt provision, which will enable a person to by-pass sensor in event of failure.

- e. Sensitivity shall not change more than ten percent in temperature range of 0 degrees F. to 120 degrees F., and in humidity range of ten percent to 80 percent. Sensitivity adjustment shall be provided for each technology.
 - f. Time delay range shall be adjustable from 15 seconds to 15 minutes.
 - g. Sensors power supply shall be provided by power pack, consisting of a transformer and contact closure relay in one package. Power output of transformer shall be capable of operating a minimum of two sensors.
 - h. Approved products: Watt Stopper No. DT-200, similar as manufactured by Leviton, Sensor Switch, Unenco, or equal.
2. Dual Technology Passive Infrared Wall Switch Sensors with Daylight Controls:
- a. Sensors shall be capable of detecting presence in floor area to be controlled, by detecting changes in infrared-ultrasonic energy. Small movements shall be detected such as when a person is writing while seated at a desk.
 - b. Passive infrared sensor shall utilize a dual-element sensor and a multi-element fresnel lens.
 - c. Sensor shall be furnished with a daylight filter which ensures that sensor is insensitive to short-wavelength infrared waves, such as those emitted by the sun.
 - d. Sensors shall be furnished with convenient bypass provisions, which enable lighting to be turned on in case of failure.
 - e. Time delay range shall be adjustable from 15 seconds to 15 minutes.
 - f. Sensitivity adjustment shall range from 0 (off) to ten (maximum).
 - g. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering with adjustments and hardware.
 - h. Each sensor shall cover up to 800 square feet, with a field-of-view of 180 degrees.
 - i. Sensor shall be a completely self-contained control system.
 - j. Power shall be provided via an internal transformer.
 - k. Switching mechanism shall be a latching dry contact relay.
 - l. Sensor shall be capable of switching from 30 to 1000 Watts, LED, incandescent or fluorescent light sources.
 - m. Sensor shall be furnished with a daylight feature, adjustable from ten to 400 foot-candles, that maintains lighting off when a desired foot-candle level is present.
 - n. Sensors shall be dual voltage, 120 volt and 277 Volt.

- o. Approved products: Watt Stopper No. WI 200, I 300, similar as manufactured by Leviton Sensor Switch, Unenco, or equal.

2.9 LIGHT LEVEL CONTROLERS (EXISTING FACILITIES)

- A. Controller shall be capable of detecting changes in lighting levels; it shall utilize an internal photoconductive cell to measure light levels through 50 percent diffused lens.
- B. Controller shall be capable of controlling any type of lighting. It shall be a self-contained 24 VDC device that controls lighting through use of power switch packs.
- C. Controller shall be capable of turning lighting on and off between ten and 200 foot-candles.
- D. Controller shall be furnished with an adjustable dead-band feature to prevent lighting from cycling when lighting goes on and off, and from minor changes due to cloud cover.
- E. Controller shall be furnished with an adjustable time delay range of five seconds to five minutes.
- F. Controller shall be furnished with an LED lamp indicating status of sensor. LED shall have different colors for on and off status.
- G. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering with adjustments and hardware.
- H. Each controller shall be equipped with a by-pass mechanism, which will enable lighting to be turned on during failure conditions.
- I. Approved manufacturers: Watt Stopper No. LS-100 XA, or similar products by Leviton, Sensor Switch, Unenco or equal.

2.10 UNIT INVERTERS

- A. Unit Inverters shall be rapid start type consisting of emergency power packs designed to be installed in channels of new lighting fixtures.
- B. Power pack construction shall be of durable polycarbonate housing.
- C. Units shall be furnished with test switches and pilot lights.
- D. Units shall automatically power designated lamp(s) for 90 minutes of emergency service upon failure of utility power.
- E. Upon return of utility power, battery shall automatically recharge.
- F. Batteries shall be field-replaceable, sealed, rechargeable, spill-proof, maintenance-free nickel cadmium.
- G. High efficiency inverter/charger design shall include low-voltage disconnect to prevent deep discharge of battery and dual voltage designed for connection to either 120 or 277 volts. Chargers shall recharge fully discharged batteries to provide 90 minutes operation within 24 hours. Power pack shall not operate if shut off manually.
- H. An unconditional five-year warranty is required.

- I. Approved products: Dual-Lite UFO-5 Series, Bodine, Iota I series, Beghelli Luce, or equal.

2.11 INTERFACE TO BUILDING MANAGEMENT SYSTEM

- A. A. When interface to the Building Management System is required, The lighting control system shall provide a BACnet/IP interface module that communicates with the BMS via a BACnet/IP network. (a collection of one or more IP sub networks (IP domains) that are assigned a single BACnet network number). Verify if interface to BMS is required.
- B. BACnet/IP interface module shall provide the capability for the BMS to:
 - 1. Communicate directly with each relay in the lighting control system network and each group used within the lighting control system.
 - 2. Monitor the status and status changes of each relay and each group.
- C. Install wiring and confirm operation of the lighting control BACnet/IP interface module per the lighting control manufacturer's instructions. Installing, wiring, and interfacing of BMS components to the lighting control system.

PART 3 - EXECUTION

3.1 GENERAL

- A. Lighting control system shall not be used for any other purpose other than its intended use and application.
- B. Provide required interconnections with other systems such as emergency power sources, fire alarm systems, and building management system as required or indicated on drawings.
- C. Installation shall meet or exceed standard practice of workmanship and quality.
- D. Drawings are diagrammatic in nature and indicate work to be provided, but do not provide means and methods, bends, transitions, or special fittings required to clear beams, girders or other work already in place. Investigate conditions where conduits are to be installed and furnished and install required fittings.

3.2 INSTALLATION AND SET-UP

- A. Verify that conduit for line voltage wires enters panel in line voltage areas and conduit for low-voltage control wires enters panel on low-voltage areas. Refer to manufacturer's drawings for location of line and low-voltage areas.
- B. Provide for digital type switches and make all connections according to lighting control manufacturer's requirements.
- C. Central Lighting Control Panels and Remote Room Controllers shall be connected via a data line (Douglas uses a non-polarized two No. 18 and LC&D uses Cat5 four twisted pair cable, with RJ45 end connectors). Connect entire lighting control system per manufacturer's requirements. Do not exceed manufacturer's total data line length requirement.
- D. Panels shall be located so that they are readily accessible and not exposed to physical damage.

- E. Panel locations shall be furnished with enough working space around panels to comply with the California Electrical Code.
- F. Panels shall be securely fastened to the mounting surface by at least four points.
- G. Unused openings in the cabinet shall be effectively closed.
- H. Cabinets shall be grounded in accordance with Article 250 of the California Electrical Code, and manufacturer's recommendations.
- I. Lugs shall be suitable and listed for installation with the conductor being connected.
- J. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- K. Maintain the required bending radius of conductors inside cabinets.
- L. Clean cabinets of foreign material such as cement, plaster and paint.
- M. Distribute and arrange conductors neatly in the wiring gutters.
- N. Follow the manufacturer's torque values to tighten lugs.
- O. Before energizing the panelboard, the following steps shall be taken:
- P. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been furnished.
- Q. Remove shipping blocks from component devices and the panel interior.
- R. Remove debris from panelboard interior.
- S. Follow manufacturers' instructions for installation.

3.3 OPERATING/SERVICE MANUALS

- A. Service and Operation Manuals:
 - 1. Submit operation and service manuals. Complete manuals shall be bound in flexible binders and data shall be typewritten or drafted.
 - 2. Record drawings: Provide (3) printed and one electronic copy on flush media of as built documents in latest version of ACAD of the entire system; including, floor plans with equipment, and devices layouts and wiring, interconnections with other systems, conduit and cable runs, programmed configurations, sequence of operations, system labeling codes, system passwords, and other pertinent information.
 - 3. Manuals shall include instructions necessary for proper operation and servicing of system and shall include complete wiring circuit diagrams of system, wiring destination schedules for circuits and replacement part numbers. Manuals shall include as-built cable Project site plot plans and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on cables. Programming forms of systems shall be submitted with complete information.

3.4 PROTECTION

- A. Protect all work, equipment and components of the lighting control system until Substantial Completion.

3.5 TESTING

- A. Set-up, commissioning and testing of the lighting control system, and OWNER instruction shall include:
- B. Confirmation of system programming.
- C. Confirmation of operation of individual relays, switches, occupancy sensors and daylight sensors.
- D. Operation of system's features under normal and emergency operations.
- E. Before energizing check and demonstrate in the presence of the Project Inspector that cables and wire connections are free from short circuits, ground faults, and that there is continuity, and necessary insulation.
- F. Confirm system operations and functionality.
- G. Check system interface response to other systems such as fire alarm and emergency power system conditions.

3.6 SPARE PARTS

- A. Provide a minimum of five percent spare parts of each type of relay, sensors, switches, and peripheral devices.

3.7 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

**SECTION 26 10 00
SERVICE ENTRANCE**

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish all labor, material and equipment necessary for the complete installation of the Service Entrance Electrical System as shown on the Drawings, including final connections as specified herein. Work shall be performed in accordance with the the requirements of the local Utility Company, codes and regulations, and applicable industry standards.
- B. Section Includes: Underground power service conduits from utility company service pole, transformer, vault or other designated service point to OWNER'S service equipment.
- C. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 03 3000 – Cast-In-Place Concrete.
 - 3. Section 26 0500 – Common Work Results for Electrical.
 - 4. Section 26 0513 – Basic Electrical Materials and Methods.
 - 5. Section 26 0533 – Raceways, Boxes Fittings, and Supports.
 - 6. Section 26 0526 – Grounding and Bonding.
 - 7. Section 26 0519 – Low-Voltage Wires (<600 Volt AC).
 - 8. Section 26 0800 – Electrical Systems Commissioning.
 - 9. Section 26 1100 – Load Center Unit Substations.
 - 10. Section 26 1200 – Medium Voltage Transformers.
 - 11. Section 26 2413 – Switchboards.
 - 12. Section 26 2600 – Power Distribution Units.
 - 13. Section 31 2313 – Excavation, and Fill

1.2 REFERENCES

- A. ANSI/NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. California Electrical Code (CEC).
- C. IEEE C57.12.28 – Standard for Pad-Mounted equipment Enclosure Integrity.

- D. IEEE 551 - Recommended Practice for Calculating AC Short-Circuit Currents in Industrial and Commercial Power Systems.
- E. IEEE 1584 – Performing Arc-Flash Hazard Calculations.
- F. Los Angeles Department of Water and Power Electrical Service Requirements.
- G. Southern California Edison ESR – Electrical Service Requirements.
- H. UL 891-Switchboards.
- I. UL/ANSI 891 – Standard for Safety Switchboards.

1.3 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Shop Drawings: Include a front elevation indicating dimensions and locations of equipment on switchboard, make, kind and size, capacity of equipment and bussing, location of each service conduit entering switchboard, barriers, nameplate inscriptions, finish, total weight and size of switchboard and locations and sizes of anchor bolts.
- C. Submit Fault Current, Coordination and Arc-Flash reports based on installed conditions and equipment.
 - 1. Provide installation and seismic anchorage details.

1.4 SYSTEM REQUIREMENTS

- A. Where required and indicated on Drawings, install transformer vault, outdoor transformer enclosure, pad and slab box, manholes or other equipment in accordance with utility company drawings and standards.
- B. Coordinate all work with the utility company electrical service requirements.
- C. Consult utility company to determine exact location of serving point, service poles, quadrants on poles for service risers, transformer location(s), underground work, and work and materials. Service installation shall be complete and ready for cable installation. Service cable shall be provided by utility company and paid for by OWNER.
- D. Reports: Provide short-circuit, coordination and arc-flash reports signed and stamped by a registered electrical engineer. Studies shall be in accordance with applicable IEEE guidelines and applicable codes. Submit two copies of each study for Engineer of Record review.
 - 1. Provide a system coordination report based on approved equipment and installed equipment for all main and branch circuit protective devices including transformers secondary protective devices. Study report shall be in accordance with IEEE 242 and recorded on log paper. The circuit protective devices shall be set based on the coordination study. Submit a written record of protective device settings.
 - 2. Provide a complete arc-flash report in accordance with code and IEEE 1584. The report shall be based on installed equipment, and feeders' sizes and lengths. The report shall indicate trip times for protective device(s) settings, arcing fault current

values, and incident energy and flash boundaries. The arc-flash report shall indicate clothing requirements for each piece of equipment.

3. Provide a short circuit withstand capacity/ Interrupting capacity of main and distribution equipment and circuit breakers in accordance with IEEE 551.
- E. Equipment shall be labeled with Short Circuit Current Rating (SCCR), and in compliance with UL 891 requirements.
- F. All work shall be done in compliance with California Electrical Code and authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Transformer Pads: Concrete transformer pads shall be provided as indicated on Drawings and shall meet requirements of serving electric utility company.
- B. Service Conduits: As described under Section 26 0533: Raceways, Boxes Fittings, and Supports. For utility portion of wiring and conduit runs, comply with utility company requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Service conduits shall terminate at service poles or other service point, as indicated on Drawings and shall extend underground to main service terminating pull section as indicated on drawings. Bends in conduits shall be long radius type and sweeps shall have a radius of not less than 12 times conduit trade size for conduits up to 5" diameter, and 10 times for conduits with a diameter greater than 5". Underground conduits shall be encased in concrete three inches thick on all sides with multiple conduits spaced not less than 1-1/2 inches apart, or utility company recommended spacing, whichever is more stringent. Provide support for conduits to prevent floating when encased.
- B. Service Cables:
 1. Overhead: Shall be connected to metering compartment of switchboards.
 2. Underground: Shall be in service terminating pull section as required and directed by utility company.

3.2 CONDUITS CROSSING PUBLIC DEDICATED PROPERTY

- A. Where service or other conduits cross a street, alley, highway, or other public dedicated property, provide necessary arrangements to open and close public property and pay costs in connection with required licenses, permits, fees and deposits. Conduits shall be installed in a manner required by utility company and authorities having jurisdiction.

3.3 STRUCTURAL CONDITIONS

- A. Where conduits are to pass through or interfere with structural members, or where notching, boring or cutting of structure is necessary, or where special openings are required through walls, floors, footings, or other building elements to accommodate electrical Work, such Work shall be performed as required by the Architect and DSA.
- B. Placement of conduits in concrete slabs and structural members shall comply with requirements of applicable section of CCR, Title 24, Public Works and shall be as required by Architect and DSA.
- C. Where a concrete encasement for underground conduits abuts a foundation wall or underground structure which conduits enter, encasement shall be maintained in position in relation to structure as indicated on Drawings, or rest on a haunch integral with wall or structure, or shall extend down to footing projection, or shall be doveled into structure. Underground structures shall include manholes, pull boxes, vaults, and buildings.
- D. Cutting and patching of rough and finish Work shall be performed as required for installation of Work under this section. Patching shall be of same materials, workmanship and finish and shall accurately match surrounding Work.

3.4 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.5 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: This specification covers single-phase and three-phase general purpose individually mounted dry-type transformers, 600 V maximum, for power and lighting applications. It includes transformers as specified and as indicated on Drawings.
- B. Work, material or equipment shall comply with the codes, ordinances and regulations of the local government having jurisdiction, including the regulations of serving utilities and any participating government agencies having jurisdiction.
- C. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 4. Section 26 0526: Grounding and Bonding.
 - 5. Section 26 0519: Low-Voltage Wires (600 Volts AC)
 - 6. Section 26 0533: Raceways and Boxes, Fittings and Supports.
 - 7. Section 26 2600: Power Distribution Units.
 - 8. Division 27: Communications.
- D. Codes and Applicable standards: Products and installation shall meet or exceed the latest edition of the following standards.
 - 1. ANSI/IEEE C57.96, Distribution and Power Transformers, Guide for Loading Dry-Type Transformers; Appendix to ANSI C57.12 Standards.
 - 2. Department of Energy, Energy Act of 2005.
 - 3. International Electrical Code adopted by the State of California.
 - 4. ANSI/NEMA 250 Enclosure for Electrical Equipment (1000 Volts Maximum)
 - 5. IEEE C57.12.91, Test Code for Dry-Type Distribution and Power Transformers.
 - 6. IEEE C57.110 – IEEE Recommended Practice for establishing liquid-filled and dry-type power and distribution transformer capability when supplying nonsinusoidal load currents.
 - 7. 1100-IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.

8. NEMA standard 20, Dry-Type Transformers for General applications.
 9. UL 506, Specialty Transformers.
 10. UL 1561, Dry-Type General Purpose and Power Transformers.
 11. NEMA TP-1, Guide for Determining Energy Efficiency for Distribution Transformers.
 12. NEMA TP-2, Standard Test Method for Measuring the Energy Consumption of Distribution Transformers.
 13. NEMA TP-3, Standard for the Labeling of Distribution Transformer Efficiency.
 14. CSA 802.2-00 Minimum Efficiency Values for Dry Type Transformers
 15. California Building Code (CBC)
 16. Tri-axial shake test results conducted in accordance with AC156 test protocol.
 17. NFPA 70 National Electric Code
- E. No requirement of these drawings and specifications shall be construed to void any of the provisions of the above standards. Any conflicts or changes required to the contract documents in order to obtain compliance with applicable codes shall be brought to the immediate attention of the Owner by the CONTRACTOR.

F. ACRONYMS

ANSI	American National Standards Institute
AOR	Architect of Record
CEC	California Electrical Code
EOR	Engineer of Record
IBC	International Building Code
IEEE	Institute of Electrical and Electronics Engineers
NEC	National Electrical Code
NEMA	National Electrical manufacturers Association

1.2 DESIGN REQUIREMENTS

- A. Premium Efficiency transformers with internal losses at 35 percent loading reduced by 30 percent when using temperature and material correction factor to 75 degrees C per NEMA Standard TP1
- B. Load Mix: Transformer shall be UL 1561 listed to feed a mix of equipment load profiles such as computer without detracting or significant degradation of efficiency.
- C. Construction: Windings shall be continuous wound copper with brazed or welded terminations.

1. Insulation and Varnish Systems: Epoxy Polyester impregnation
 2. Terminals, including those for changing taps must be readily accessible by removing a front cover plate.
- D. Performance of transformers shall meet or exceed the requirements of applicable codes and standards, the DOE Energy Policy Act of 2005 - Public Law 109-58 and the latest requirements of the California Energy Commission Appliance Efficiency Regulations. In addition; transformers shall be designed to an efficiency standard higher than the lowest legal standard for the purpose of contributing to LEED Energy and Atmosphere (Optimized Energy Performance) and Utility Rebates.
- E. Transformers shall be self-cooled type with 220 degrees C. insulation and a maximum temperature rise of 130 degrees C. under continuous full load conditions with an ambient of 40 degrees C.
- F. Transformers shall be furnished with four 2.50 percent (two above and two below normal voltage) taps. Windings shall be of fire-resistant type, designed for natural convection cooling through normal air circulation.
- G. Core mounting frames and enclosures shall be of welded and bolted construction with sufficient mechanical strength and rigidity to withstand shipping, installation, and short circuit stresses.
- H. Enclosure cover plates shall be sheet steel, captive bolted to enclosure framework. Enclosure shall provide suitable ventilating openings with rodent-proof screens, NEMA 1 enclosure. Enclosure shall be provided with lifting lugs and jacking plates as required. Transformers installed outdoors shall be provided with weatherproof NEMA 3R enclosure and weather proof kit.
1. Submit rodent-proof screen sample for OWNER's approval.
- I. Transformers shall be furnished complete with mounting channels and mounting bolts. Metal parts, excepting cores and core mounting frames shall be furnished clean, rust-proofed, and provided with a coat of an inert primer.
- J. Transformers up to 35 KVA shall not exceed 40 decibels. Transformers 36 KVA or more shall be a minimum of 5 decibels below NEMA standards per unit. Transformers shall be provided with vibration dampers consisting of California Dynamic, Mason Industries, Korfund or equal neoprene mounting pad and Elastorib sheeting. Size and number of shock mounts shall be in accordance with manufacturer's recommendations.
- K. Transformers shall be UL listed.
- L. Each transformer to be installed under this section shall be sound tested at the factory. CONTRACTOR shall provide two copies of transformers tests reports for EOR's review.
- M. Equipment shown on drawings to scale is approximate only and based upon a general class of equipment specified. The CONTRACTOR shall verify dimensions and clearances prior to commencement of work.
- N. Verify points of connection with the manufacturer's requirements, instructions, or recommendations prior to installation. Actual dimensions, weights, clearances and installation requirements shall be verified and coordinated by the CONTRACTOR.

1. Electrostatic shield.
2. NLP series shall have a maximum sound level of 3 dB below NEMA standards.
3. Double-size neutral terminal.
4. Additional coil capacity to compensate for higher non-linear load loss.
5. Heavy-gage ventilated indoor enclosures (provide weather shields where installed indoors).
6. K-rated transformers shall meet other requirements of this section.

1.3 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Shop Drawings: Include make, catalog number, dimensions, weight, KVA Rating, Percent Impedance, finish, type, insulation class, design temperature, sound levels, efficiency and taps provided. Include regulation at 80 percent and 100 percent of full load, no-load loss, full-load loss, percent efficiency, percent impedance, noise level and continuous capacity rating.
- C. Provide manufacturers data and inspection report that confirms transformers to be UL 1561 listed.
- D. Provide a connection schematic diagram.
- E. Provide the following tests reports: Project Inspector will review the reports for conformance with specified criteria, and compliance with the applicable standards. Submit one copy for each set of shop drawings being submitted.
 1. Load Losses: Measurements shall be taken at multiple load levels and plotted to show compliance with specifications and correlated to efficiency curve for the transformer size and type.
 2. Provide No-Load and Total Losses report.
 3. Applied Voltage.
 4. Temperature Rise.
 5. Induced Voltage.
 6. Sound Level.
 7. Impulse Test.
 8. Manufacturer's nonlinear load test representing real world load mix. Transformers not meeting this requirement shall not be installed.
- F. Submit harmonics test plan as follows:
 1. NEMA ST-20.
 - a. Open Circuit Test (no load losses):

- 1) Use for both Linear and non-Linear.
- 2) Measure Power.
- b. Short Circuit Test (load losses):
 - 1) Short Primary Winding.
 - 2) Linear Test – complete with linear profile through secondary winding.
- c. Non-Linear Test.
 - 1) Complete with non-linear profile through secondary windings.
 - 2) Measure Power.
- d. Take data and graph efficiency per NEMA ST-20.
 - 1) Graph-1 – Linear Loads 0 to 100 Percent Loads.
 - 2) Graph 2 – Non-Linear Profile K-9 0 to 100 Percent loads.
- e. Test Plans measuring Power IN and Power Out will not be accepted since procedures are not covered by any standard.

1.4 WARRANTY

- A. Transformers shall be warranted to be free from defects in materials, fabrication and execution for a period of three years from the date of substantial completion.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Transformers manufactured by Siemens, Square D, General Electric, PowerSmiths, MGM, and Cutler Hammer or equal.
- B. There shall be no openings through which foreign objects such as sticks, rods, wires, or the like might enter and contact live parts. Provide means for padlocking compartment doors.
 1. Connection terminal points shall be bottom fed and located as far as possible below vent openings, or below top connections.
 2. Terminals shall be protected from external/foreign objects contact.

PART 3 - EXECUTION

3.1 DELIVERY AND STORAGE

- A. Deliver, storage, protect and handle products in accordance with the manufacturer's recommendations.

3.2 INSTALLATION

- A. Transformer core frame shall be installed level on shock absorbing pads within enclosure. Comply with seismic requirements of CBC.
- B. Mounting bolts on floor mounted transformers shall be extended into pads only and shall not be in direct contact with building structural members.
- C. Flexible jumpers shall be installed for grounding continuity from enclosure to conduits or bus ducts where required.
- D. Transformers installed outdoors or below grade shall be mounted on concrete pads as specified in Section 03 3000: Cast-In-Place Concrete.
- E. Install transformer ventilation openings not closer than 6 inches from wall surfaces.
- F. Do not install transformers in corrosive environments such as swimming pool pump and boiler rooms, or similar areas.

3.3 VOLTAGE CHECK

- A. Set taps on transformers to provide satisfactory operating voltages with present loads energized, including new loads and existing loads. A check shall be performed in the presence of the Project Inspector at a panel fed from each transformer, which is farthest from transformer. Voltages at transformers ranging from 118 to 122 volts inclusive, for 120 volt systems and proportionately equivalent for higher voltage systems are permitted.
- B. Provide instruments and accessories required to perform checks. Voltmeters shall be accurate within .075 percent or one percent and shall have scales permitting voltage readings to be performed on upper half of scale. Calibration of the meters shall be observed by the Project Inspector.
- C. Adjust transformer taps under full load operating conditions, to provide normal operating voltages at the loads.

3.4 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.5 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off Project site.
- B. Repair scratched or marred surfaces affected during the execution of work. Repair surfaces shall match original finish.

END OF SECTION

SECTION 26 24 13 SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Main switchboard, including metering facilities required by the utility company.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 03 3100: Cast-In-Place Concrete.
 - 3. Section 26 0500: Common Work Results for Electrical.
 - 4. Section 26 0513: Basic Electrical Materials and Methods.
 - 5. Section 26 0526: Grounding and Bonding.
 - 6. Section 26 0519: Low-Voltage Wires (600 Volt AC).
 - 7. Section 26 1000: Service Entrance.
 - 8. Division 27: Communications.
 - 9. Division 28: Electronic Safety and Security.
- C. Related Industry Standards: The most current version of the following industry standards.
 - 1. ANSI/NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. California Electrical Code (CEC).
 - 3. IEEE C57.12.28 – Standard for Pad-Mounted equipment Enclosure Integrity.
 - 4. IEEE 551 - Recommended Practice for Calculating AC Short-Circuit Currents in Industrial and Commercial Power Systems.
 - 5. IEEE 1584 – Performing Arc-Flash Hazard Calculations.
 - 6. UL/ANSI 891 – Standard for Safety Switchboards.

1.2 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Shop Drawings:
 - 1. Include a front elevation indicating dimensions and locations of equipment on switchboard, make, kind and size or capacity of equipment and bussing, location of

each service conduit entering switchboard, barriers, nameplate inscriptions, finish, total weight and size of switchboard and locations and sizes of anchor bolts.

- C. Fault Current, Coordination and Arc-Flash Reports: the following reports shall be prepared using SKM Systems Analysis, ETAP Powering Success, EasyPower, or equal.
1. Provide a short-circuit and coordination report signed and stamp by a registered electrical engineer. Studies shall be in accordance with applicable IEEE guidelines. Submit two copies of each study for review prior to ordering and installing equipment.
 2. Provide a system coordination report for main and branch circuit protective devices including transformers secondary protective devices. Study shall be recorded on log paper. The circuit protective devices shall be set based on the coordination study. A final written record of protective device settings shall be submitted.
 3. Provide a complete arch-flash report based on installed equipment, and feeders' sizes and lengths. Prepare the report in accordance with code requirements and IEEE 1584 standard. The report shall indicate trip times for protective device(s) settings, arcing fault current values, and incident energy and flash boundaries. The arc-flash report shall indicate clothing requirements for each piece of equipment.
 4. Provide installation detail and seismic anchorage notes for switchboards.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

- A. General Description: Switchboards shall be product of W.A. Benjamin Electric, Cuttler Hammer, General Electric, Siemens, or equal, and shall conform to the following requirements:
1. Complete assembly, including steel framing and covers, bus system, and breaker mounting, shall satisfy applicable provisions of UL 891 and NEMA PB-2 and the California Electrical Code for low-voltage distribution switchboards. Switchboards shall be furnished with UL labels.
 2. Switchboards shall be floor standing, dead front, dead rear, line bussed, front operated and connected, circuit-breaker type, unless otherwise indicated and shall contain equipment indicated and specified. Switchboard shall be complete with pull, service, and distribution sections as required.
 3. Required equipment shall be enclosed in fully interchangeable die formed steel sectional cabinets with top and bottom plates and required braces and gussets so that cabinets will be absolutely rigid, plumb and uniform in size. Each cabinet shall be a separate and independent unit with assembly holes die-stamped or jig drilled; openings for interconnections shall be so placed that cabinet can be located in any position in assembly without drilling or cutting holes on job. Deliver switchboard to Project site in completely assembled sections and provide required assembly bolts and blanking plates. Front plates and doors shall be of not less than 12 gage furniture steel, completely removable, secured to cabinet with machine screws, with cup washers uniformly and symmetrically spaced. Provide hinged wire gutter covers for distribution sections. Equipment shall meet NEMA and UL standards.

4. Main circuit breaker or main fusible switch shall be as follows:
 - a. Main circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic with solid state trips, bolted to bus with frame size and trip ratings as indicated on drawings. Voltage, amperage ratings and number of poles shall be as indicated on breakers. Main breaker shall provide a minimum short-circuit interrupting capacity as determined by utility company. Provide shunt-trip and integral ground fault devices, as indicated on drawings. Breakers shall be furnished with lockout provisions.
 - b. Main fusible switch 800 amps or larger ampacity shall be high pressure contact, stored energy, quick-make/quick-break operation, with current limiting fuses, as indicated on Drawings. Provide shunt-trip, and integral ground fault devices, as indicated on Drawings. Were required, switches shall be motor operated and be furnished with an electrical trip mechanism piloted by output of ground fault sensing circuitry. Switch shall be furnished with lockout provisions.
5. Feeder circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic or solid-state type bolted to bus, with handles clearly indicating tripped position. Breakers shall be furnished with a single handle with no tie-bar. Voltage, amperage, and number of poles shall be as indicated on Drawings. Breaker ratings shall be on handle or label. Breakers shall be furnished with lockout provisions approved by the State of California for padlocking and shall provide a minimum symmetrical short-circuit interrupting rating, as indicated on Drawings. Series rated circuit breaker combinations are not acceptable.
6. Fusible feeder switches shall be quick-make, quick-break, voltage rating and number of poles as indicated on Drawings, with visible blades and dual horsepower ratings. Switch handles shall physically indicate on and off positions. Switches shall be lockable only in off position and accept three industrial type heavy-duty padlocks. Switch covers and handles shall be interlocked to prevent opening in on position. Provide means to permit authorized personnel to release interlock for inspection purposes. Switches shall be equipped with Class R current limiting fuses or dual element fuse of size and capacity indicated on Drawings.
7. Utility metering provisions shall meet requirements of serving utility and shall be furnished with necessary fittings.
8. Switchboard bus bar material and size shall be per plan between current transformer and main section and distribution sections; also, full height of breaker space in distribution portions. Busses shall have standard current density as provided by manufacturer. Bus structure shall be free-fitted and shall have sufficient strength to withstand short-circuit as indicated on drawings. Connections shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices. Bus bar bracing shall be designed to withstand maximum available short-circuit current. Connections for cables to circuit breakers, switches and motor control devices shall be heavy-duty mechanical pressure type terminal lugs. Provide service cable lugs as required by utility company. Cables and internal wiring shall be supported with suitable cleats.
9. Switchboard distribution sections shall be furnished with full height bussing. Unused spaces shall be provided with blank covers. Switchboards, as complete units, shall be given single short-circuit current ratings by manufacturer. Such ratings shall be established by actual tests by manufacturer, in accordance with UL specifications, on equipment constructed similarly to the furnished switchboard.

10. Provide a large nameplate identifying switchboard, indicating service voltage, originating power source, function and current rating. Nameplate shall be furnished with 3/16-inch engraved black letters on white background. Name plate shall be mechanically fastened to switchboard.
11. Provide labels for circuit breakers, disconnect switches, and or other disconnecting means in switchboards. Labels shall be a P-Touch type or equal, with a minimum width of 3/8 inch with black letters on white background. Label shall indicate name of load served, name or room number and if in different building, name of building. If equipment is installed in same room as source, label should indicate source name and "in this room".
12. Paint cabinets, framework and plates inside and out with one coat of rust-resistant metal primer and one coat of gray enamel, baked on, or lacquer sprayed on.
13. Manufacture boards according to reviewed Shop Drawings. Switchboard shall meet requirements of legally constituted authorities having jurisdiction, and respective serving utility.
14. Switchboards installed outdoors shall be weatherproof NEMA Type 3R enclosure. Enclosure construction shall be formed of code gage galvanized steel with ANSI No. 61 gray enamel finish. Heavy-duty, three-point latching, vault type door handles with padlocking provisions shall be furnished on doors. Padlocks shall be furnished keyed to Corbin No. 60 keys. Switchboards installed outdoors shall be specifically required to maintain service during extreme outdoor ambient temperatures of a minimum of 150 degrees Fahrenheit in NEMA Type 3R enclosures.
15. For grounded wye electrical service switchboards rated more than 150 volts, to ground and 1,000 amperes or more, provide ground fault protection for main protective device. Ground fault protection shall be UL listed, with ground sensor encircling phase conductors and neutral conductors integral with the main protective device. Provide testing of ground fault protection system by an independent recognized testing laboratory. Testing lab shall provide necessary testing equipment at the Project site and perform a certified test on ground protection system in presence of the Project Inspector. The ground fault setting shall be selected to coordinate with downstream circuit protective devices. Verify that the system neutral is grounded at the service entrance switchboard only, except neutrals of step-down distribution transformers. For branch circuit protective devices, rated 800 amps or more, provide ground fault protection where shown on the drawings, or as described above, for main protective device. Coordinate settings with main protective device ground fault protection.
16. In main and distribution switchboards provide a multifunctional digital meter with true RMS measured Amperes (each phase and neutral) Volts (line-to-line and line-to-neutral), Power Factor, Frequency, VA, VAR, Watts, KWH, KVARH, KVAH, voltage/current unbalance, and demand metering: W, VAR, Amperes, VA. Meter to have a front mounted RS232 port to allow programming and meter values via laptop computer and supplied software. The meter shall be GE Multiline PQM with BACnet translator capabilities; equal or better meters will be acceptable with District's approval only. Contractor shall supply the metering software and electronic key to owner.
17. Connections to bussing shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Switchboards shall be located so that they are readily accessible and not exposed to physical damage.
- B. Switchboard locations shall provide sufficient working space around the switchboard to comply with the California Electrical Code.
- C. Switchboards shall be securely fastened to the mounting surface.
- D. Switchboard cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
- E. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
- F. Lugs shall be suitable and as required for installation with the conductor being connected.
- G. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- H. Maintain the required bending radius of conductors inside the cabinet.
- I. Distribute and arrange conductors neatly in the wiring gutters.
- J. Tightening the wire lugs or conductor connections shall be performed in the presence of the Project Inspector. Torque values shall be those recommended by manufacturer.
- K. Remove shipping blocks from component devices.
- L. Manually exercise circuit breakers to verify they operate freely.
- M. Remove debris from switchboard interior.
- N. Follow manufacturer's instructions for installation.
- O. Furnish one spare fuse for each fusible switch installed. Spare fuses shall be of the same type and rated as those installed.
- P. Do not install in highly corrosive environments such as pool equipment, boiler, chemical and corrosive materials storage rooms, and similar areas. When equipment is installed in such areas, it shall be labeled and listed for the application.
- Q. Switchboard equipment and system components shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of bolted electrical connections, and perform insulation resistance tests on each bus section, phase-to-phase and phase-to-ground for one minute in accordance with requirements stated in NETA-ATS 2007 table 100.1. Test shall be performed in the following manner:
- R. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of bussing, circuit breakers and/or fused switches. The fused

switches shall be equipped with fuses or temporary jumpers in place of fuses. Breaker and fused switches shall be tested in the closed position. No wiring shall be connected to the line or load side of the switchgear during testing.

- S. Provide calibration program records to assure the testing instruments to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).
 - 1. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.
 - a. Test reports shall include the following:
 - b. Identification of the testing organization.
 - c. Equipment identification.
 - d. Ambient conditions.
 - e. Identification of the testing technician.
 - f. Summary of project.
 - g. Description of equipment being tested.
 - h. Description of tests.
 - i. Test results.
 - j. Analysis, interpretation and recommendations.
 - 2. Perform tests in the presence of the Project Inspector.
 - 3. During testing, provisions shall be made to prevent damage to solid state components, or electronic equipment such as TVSS equipment that may be tied onto switchboard bussing.
 - 4. Test results shall meet manufacturer's recommendations or NETA ATS- 2007 recommendations, whichever is more stringent.

3.2 PADS AND ANCHORING

- A. Where free-standing equipment is installed at exterior locations or in locations below grade, concrete pads shall be provided as specified in Section 03 3000: Cast-In-Place Concrete.
- B. Where a utility meter is installed in a switchboard, concrete pad shall extend three feet from face of switchboard door or board, whichever is greater. Concrete pad installation shall comply with electric utility company requirements.
- C. Anchor bolts for freestanding equipment shall meet CBC Seismic design requirements, and manufacturer's installation recommendations. The more stringent requirements will be enforced.
- D. Project Record Documents: Provide project record drawings of switchboards as installed, indicating main and branch circuit ratings, circuit numbers and part numbers.

- E. For ground fault relays and sensors, the following information shall be provided:
 - 1. Certified Calibration and Acceptance Test.
 - 2. Installation Instructions.
 - 3. Operating Instructions.
 - 4. Maintenance Instructions.
 - 5. Replacement Parts List.
 - 6. Final Test Report.
- F. Test information shall be submitted to the Architect. Nameplates may be fabricated of engraved laminated plastic or etched metal and shall be permanently attached with escutcheon pins or screws.

3.3 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.4 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION

SECTION 26 25 16
PANELBOARDS AND SIGNAL TERMINAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Lighting and power distribution facilities, including panelboards.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 4. Section 26 2600: Power Distribution Units.
 - 5. Section 26 5000: Lighting.
 - 6. Division 27: Communications.
 - 7. Division 28: Electronic Safety and Security.

1.2 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Shop Drawings: Include a front elevation indicating cabinet dimensions, make, location and capacity of equipment, size of gutters, type of mounting, finish, and catalog number of locks. General layout of internal devices, wiring drawings with wire numbers and device connections, vendor cut sheets of devices in enclosure and bill of materials listing description, manufacturer, part number, and quantity of items shall be included.
- C. Installation Instructions: Submit manufacturer's written installation instructions.

1.3 DESIGN REQUIREMENTS

- A. Panelboards:
 - 1. Panelboards shall be wall-mounted, enclosed safety type with 120/240 volt, three-wire solid neutral 277/480 volt, four-wire or 120/208 volt, four-wire solid neutral mains as indicated on Drawings or specified. First panelboard of each building shall be provided with main or sub-feeder circuit breakers where so indicated.
 - 2. Single pole branches shall be molded case, thermal magnetic circuit breakers with inverse time delay, trip free, quick-make, quick-break mechanism and silver alloy contacts. Circuit breakers shall be fully rated, with ampere rating marked on handle and shall indicate on/off and tripped positions. Ground fault interrupters shall be incorporated into circuit breakers where indicated. They shall be listed by UL, or other NRTL as ground fault devices. Provide appropriate lug kit of sufficient size to accommodate the feeders.

3. Two- and three-pole branches shall be enclosed, and shall be thermal magnetic circuit breakers with inverse time delay, tamper-proof, ambient compensated, single handle, internal common trip, and quick-make, quick-break mechanism with silver alloy contacts. Circuit breakers shall be fully rated or as otherwise indicated on the Drawings.
 4. Main and subfeeder circuit breakers shall be enclosed, thermal magnetic type with inverse time delay, single handle common trip, quick-make, quick-break mechanism, corrosion-resistant bearings and silver alloy contacts. Ampere frame size and trip rating shall be as indicated on Drawings. Breakers over 225 amperes shall be furnished with interchangeable trip units. Handles of main and subfeeder circuit breakers shall be provided cabinet door. Voltage rating shall be as indicated on Drawings.
 5. Circuit breakers shall be fully rated and of one-piece, bolt-on type and shall meet short-circuit interrupting capacity requirements indicated on Drawings. Series rated circuit breaker combinations are not acceptable.
 6. Internal connections shall be fabricated with bus bars(material as shown on plans) and the busses shall extend for full length of space available for branch circuit breakers. Feeder cable connectors shall be installed at point of feeder entrance. Terminals shall be furnished with copper conductors. Panelboards fed by conductors having over-current protection greater than 200 amperes shall be protected on supply side by over-current devices having a rating not greater than that of panelboards. Bussing shall be fully rated. Heat rated bussing is not acceptable.
 7. Except where otherwise indicated, circuit breakers shall be in two vertical rows connected to bus bars in a distributed phase arrangement. Two-pole branches shall be balanced on busses. Single pole branches shall be numbered adjacent to its circuit breaker, with odd numbers on left and even numbers on right.
 8. Specified circuit breaker spaces shall be furnished with hardware required for future installation of circuit breakers.
 9. Provide locking devices for individual circuit breakers. Padlocking devices shall be secured to circuit breakers and by panel dead front plates.
- B. Surge Suppressors: Where indicated on Drawings, provide transient voltage surge suppressors as an integral part of panelboards. Panelboards shall be complete with 200 percent rated copper neutral bus, ground bus and isolated ground bus in addition to requirements of this section. Surge suppressors shall be as follows:
1. Surge Capacity:
 - a. Line-to-neutral for wye systems: 80 KA.
 - b. Line-to-ground: 80 KA.
 - c. Neutral-to-ground: 80 KA, three-phase wye.
 - d. Line-to-neutral plus line-to-ground: 160 KA.
 2. UL 1449 2nd Edition Suppressed Voltage Rating for 208/120 Wye System:
 - a. Line-to-neutral: 400 volts.
 - b. Line-to-ground: 400 volts.

- c. Neutral-to-ground: 400 volts.
 - d. Maximum continuous over-voltage: 150 volts.
3. EMI/RFI High-Frequency Noise Power Filter (Characteristics):
- a. 100 KHz at 44 dB.
 - b. 100 MHz at 44 dB.
 - c. 10 MHz at 44 dB.
 - d. 100 MHz at 444 dB.
4. MOVs shall be thermally protected for low current faults and shall be fused with surge-rated fuses. The surge-rated surge current passes and clears the circuit safely if the surge capacity is exceeded. Enhanced diagnostics shall continuously monitor the unit's status and shall include LEDs to signal a reduction in surge capacity or the loss of a suppression circuit. An audible alarm, with test and silence features, shall be furnished in diagnostic package.
5. Each phase or the entire unit shall be replaceable and have bolted-on, tin-plated copper connections. Unit to have UL witnessed fault current rating of 65,000 symmetrical amperes.
6. Surge suppression units shall comply with the following:
- a. UL certified.
 - b. UL 1283.
 - c. UL 1449.
 - d. IEEE C 62.45.
 - e. IEEE C 62.41.
 - f. Nationally Recognized Testing Laboratory (NRTL) or equal.

C. Panelboard Cabinets:

- 1. Panelboard cabinets shall be code gage galvanized steel or blue steel; fronts, doors, and trims shall be code gage furniture steel. Cabinets shall be furnished with at least six-inch high gutters at top and bottom where feeder cable size exceeds four gage or where feeder cable passes through cabinet vertically. Cabinets shall be furnished with top and bottom gutters sized as required by inspection department having jurisdiction, but never less than six inches where more than one feeder enters top or bottom of cabinets. Side gutters shall not be less than four inches wide. Width of cabinets shall be 20 inches, unless otherwise indicated on Drawings.
- 2. Doors shall be cut true, shall accurately fit opening and finish smooth across joints. Rabbets shall be inside. Hinges shall be entirely concealed except for barrels and pins. Hinge flanges shall be welded to door and trim. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors, keyed to Corbin No. 60 keys.

3. Where contactors, time switches, and control devices are specified or indicated to be installed within panelboard cabinets, a separate compartment and door shall be provided at top of cabinet for such devices. Door shall be sized as required to permit removal of contactor and other devices intact. Gutters shall be provided at sides and top of compartment. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors keyed to Corbin No. 60 keys.
 4. Provide and install panelboard manufacturer's permanent circuit number kit option.
 5. Panelboards with control devices in compartment shall arrive at the Project site completely assembled with control devices installed and wired.
 6. Outdoor cabinets shall be NEMA Type 3R. Construction shall be formed from code gage galvanized steel with ANSI No. 61 gray enamel finish. Provide heavy-duty, three point latching, vault type door handles with padlocking provisions. Provide stainless steel or galvanized butt hinges on doors. Padlocks shall be furnished, keyed to Corbin No. 60 keys.
 7. Self-tapping screws and bolts not permitted.
- D. Panelboard Schedule: Provide a neatly typewritten schedule with number or name of room or area, or load served by each panelboard circuit. Room numbers or names shall be determined at the Project site and shall not necessarily be those indicated on the Drawings. Schedule shall also indicate panel designation, voltage and phase, building and distribution panel or switchboard from which it is fed. Schedule shall be installed in a frame under transparent plastic 1/32 inch thick on inside of each panelboard cabinet door.
- E. Panelboard nameplate: Provide a nameplate identifying panelboard. Plates shall be black and white plastic nameplate stock, with character cut through black exposing white and shall bare designation of service. Name plate shall be mechanically fastened to switchboard.
- F. Provide additional labeling on dead-front of panelboard. Label shall be a P-Touch or equal with a minimum width of 3/8 inch with black letters on white background. Label shall re-identify panelboard and also identify name and location of power source feeding this panel. Location information shall include building name if located in different building and name or room location. If power source is installed in same room, label should indicate source name and "In this Room"
- G. Panelboard Standards: Panelboards shall be UL, or other NRTL listed and labeled. Panelboards shall meet latest revisions of following standards:
1. California Electric Code, Article 384.
 2. UL 67, Panelboards.
 3. UL 50, Cabinets and Boxes.
 4. UL 943, GFCI.
 5. UL 489, Molded Case Circuit Breakers.
 6. NEMA PB1.
 7. Federal Specifications W-P- 115C and WC-375B.
 8. Signal Terminal Cabinets:

- H. Signal terminal cabinets shall conform to the Specifications for panelboard cabinets, except as modified herein.
 - 1. Terminal cabinets shall be flush type, with two-inch trim or surface mounted type, as indicated on Drawings.
 - 2. Terminal cabinets shall be furnished with sections and barriers to separate each system. Sections over 24 inches in width shall be provided with double doors and locks. Terminal cabinets, or sections of terminals housing separate systems, shall measure 12 inches long by 18 inches high by 5 ¾-inch deep, unless otherwise indicated on Drawings. Trims for sectional cabinets shall be of one-piece construction.
 - 3. Terminal cabinets shall be furnished with ¾ inch thick plywood. Plywood shall be fastened in place with machine screws or factory installed mounting screws.
 - 4. Flush-mounted terminal cabinets shall be finished as specified for flush-mounted panelboard cabinets. Surface and semi-flush mounted terminal cabinets shall be finished as specified for surface-mounted panelboard cabinets.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Panelboards shall be manufactured by Siemens, W.A. Benjamin, General Electric, Cutler Hammer, Square D or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Panelboards shall be located so they are readily accessible and not exposed to physical damage.
- B. Panelboards installed outdoors shall be specifically listed for wet locations and shall be weatherproof in NEMA Type 3R cabinets.
- C. Panelboard locations shall provide sufficient working space around panels to comply with the California Electrical Code.
- D. Panelboards shall be securely fastened to structure and mounted on surface by at least four points.
- E. Unused openings in cabinets shall be effectively closed as required by the manufacturer.
- F. Cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
- G. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
- H. Lugs shall be suitable and listed for installation with the conductor being connected.

- I. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- J. Maintain the required bending radius of conductors inside the cabinet.
- K. Clean the cabinet of foreign material such as cement, plaster, and paint.
- L. Distribute and arrange conductors neatly in the wiring gutters.
- M. Use the manufacturer's torque values to tighten lugs.
- N. Before energizing panelboards, the following steps shall be taken:
 - 1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been provided.
 - 2. Remove shipping blocks from component devices and panelboard interiors.
 - 3. Manually exercise circuit breakers to verify they operate freely.
 - 4. Remove debris from panelboard interior.
- O. Follow manufacturer's instructions for installation.
- P. Do not install in highly corrosive environments, unless rated for the application.

3.2 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.3 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 26 53
ELECTRIC VEHICLE CHARGING EQUIPMENT - LEVEL 2

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes EV charging equipment that provides Level 2 EV charging.

1.3 DEFINITIONS

- A. EV: Electric vehicle.
- B. EV Cable: The off-board cable containing the conductor(s) to connect the EV power controller to the EV that provides both power and communications during energy transfer.
- C. EV Capable: Parking spaces that include nearby termination of raceway (conduit) to a power source with sufficient electrical panel capacity designed for simultaneous charging of electric vehicles in all planned EV parking spaces. Electrical wiring need not be pulled through raceway (conduit) until charging station is installed.
- D. EV Charger or EV Charging Equipment: See "EVSE".
- E. EV Connector: A conductive device that, when electrically coupled to an EV inlet, establishes an electrical connection to the EV for the purpose of power transfer and information exchange. This device is part of the EV coupler.
- F. EV Coupler: A mating EV inlet and connector set.
- G. EV Inlet: The device in the vehicle into which the EV connector is inserted, and a conductive connection is made for the transfer of power and communication. This device is part of the EV coupler.
- H. EV Make Ready: Parking spaces that include nearby termination of raceway (conduit) and electrical wiring pulled to a power source with sufficient electrical panel capacity for simultaneous charging of electric vehicles in all EV parking spaces.
- I. EVSE: Electric Vehicle Supply Equipment. It includes the EV charging equipment and conductors, including the ungrounded, grounded, and equipment grounding conductors and EV cables, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for transferring energy between the premise wiring and the EV.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at 8028 Pioneer Blvd, Whittier, CA 90606.

1.5 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 EV charging equipment.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Sustainable Design Submittals:
 - 1. Plan showing location and number of EV charging units, and distance from building.
 - 2. Plan showing "reasonable accessibility" to EV charging units.
 - 3. Plan showing location and number of EV charging units, charging levels and connectors, and ability of EV charging units to participate in a demand-response or time-of-use pricing program, as well as a power load management system that allows for an increased number of charging stations than would otherwise be feasible without power load management.
- C. Shop Drawings: For EV charging equipment.
 - 1. Include plans, elevations, sections, and mounting attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Detail fabrication and assembly of mounting assemblies for EV charging equipment.
 - 4. Include diagrams for power, signal, and control wiring.
 - 5. Include verification of wireless communications service at each location of EV charging equipment.
- D. Product Schedule: For EV charging equipment use as below:
 - 1. Single Port Pedestal Free standing EV charger – Use BTC Power L2P-30-240-16
 - 2. Single Port Pedestal Wall Mount EV charger – Use BTC Power L2W-30-240-16
 - 3. Dual Port Pedestal Free standing EV charger – Use BTC Power L2P-30-240-15
 - 4. Dual Port Pedestal Wall Mount EV charger – Use BTC Power L2W-30-240-15

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Area plans and details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural members to which equipment will be attached.
 - 2. Electrical service.
 - 3. Communications service

- 4. Items penetrating finished Floor
 - B. Qualification Data: For Installer
 - C. Seismic Qualification Certificates: For EC Charger, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - D. Field quality-control reports.
 - E. Sample Warranty: For manufacturer's warranty.
- 1.7 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For EV charging equipment to include in operation and maintenance manuals.
 - B. Software and Firmware Operational Documentation:
 - 1. Online training and help documentation.
 - 2. Station activation sticker.
- 1.8 QUALITY ASSURANCE
- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - C. Comply with UL 2231-1, UL 2231-2, UL 2594, and NEC Article 625.
 - D. Comply with SAE J1772.
 - E. Comply with FCC Part 15 Class A.
- 1.9 FIELD CONDITIONS
- A. Wireless Survey: Complete wireless survey to determine if wireless provider signals meet or exceed manufacturer's recommended minimum values.
 - B. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding minus 22 to plus 122 deg F (minus 30 to plus 50 deg C).

2. Altitude: Not exceeding 6600 feet (2000 m).

C. Rate Equipment for non-operation under the following conditions:

1. Ambient Temperature: Not exceeding minus 40 to plus 140 deg F (minus 40 to plus 60 deg C).
2. Altitude: Not exceeding 6600 feet (2000 m).

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of EV charging units that fail(s) in materials or workmanship within specified warranty period.

1. Standard Warranty Period: One year from date of Substantial Completion.
2. Extended Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Provide BTC Power family of electric vehicle charging stations for commercial applications;.
- B. Source Limitations: Obtain EV charging equipment from single manufacturer.

2.2 EV CHARGING EQUIPMENT DESCRIPTION

- 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 use.
- B. Comply with NFPA 70.
- C. ADA compliant.
- D. Metering: +/- 2 percent from 2 percent to full scale of output (30 A).
- E. EV Charging Equipment Mounting: Pedestal Mount or Wall Mount as noted on plans
- F. Enclosures:
 1. Rated for environmental conditions at installed location.
 - a. Indoor Locations: NEMA 250, Type 3R.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Aluminum and UV-resistant plastic.
 - d. Paint and Anodized.
 - e. Charging components protected by security screws.

- f. Charging connectors in locking holsters.
 - g. Meter, modem, and CPU, tamper resistant.
- G. EV Cable and Connectors:
 - 1. SAE J1772 connector.
 - 2. One or Two connectors as noted on plans with locking holster.
 - 3. Minimum **18-foot (5.5 m)]** cable with cable management system.
- H. Status Indicators:
 - 1. LEDs to indicate power, vehicle charging, charging complete, system status, faults, and service, as well as authorization.
- I. Display Screen:
 - 1. VGA-resolution, daylight-viewable LCD screen with UV protection. Daylight readable and fingerprint resistant.
 - 2. Displays power, charging, charging complete, remote control, system status, faults, payment and pricing details, and service.
- J. Networking:
 - 1. WAN Communications: Cellular GSM/GPRS and CDMA.
 - 2. LAN Communications: 2.4 GHz Wi-Fi 802.11b/g/n.
 - 3. Capable of remote configuration, diagnostics and reporting.
 - 4. Capable of remote software updates (future proof).
- K. Payment System:
 - 1. RFID (ISO 15693, ISO 14443), NFC, Contactless credit card reader.
 - 2. PCI (Payment Card Industry) compliant.
 - 3. Capable of remote control and authorization including mobile phone application or toll free phone number.
- L. Charging Network: Compatible with the Manufacturer EV charging network.
 - 1. Multiple units shall independently connect to charging network.
 - 2. Multiple units shall have one unit designated as a master unit that is configured as a gateway unit between the EV charging equipment and the charging network.
 - 3. Individual units shall be capable of indicating station status and availability providing or connecting user to customer support and remote control.

2.3 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
- B. Surge Withstand: 6 kV at 3000 A.
- C. Integral GFCI.
- D. Auto-GFCI fault retry.
- E. Input Power:
 - 1. **[40 A]**, 208/240-V ac, 60 Hz, single phase per charger per port.
 - 2. Dual circuits do not need to be interlocked.
- F. EV Charging Levels:
 - 1. Single vehicle: AC Level 2 at up to 7.2 kW per vehicle.
 - 2. Dual vehicles, AC Level 2 at up to 7.2 kW per vehicle.
 - 3. Multiple vehicles simultaneously charging at a site using Automatic Power Load Management may be charged up to 7.2 kW per vehicle.

2.4 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical 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

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for EV charging equipment electrical conduit to verify actual locations of conduit connections before equipment installation.
- C. Examine walls, floors, and pavement for suitable conditions where EV charging equipment will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 413.
- B. Concrete Base Mounting:

1. Install EV charging equipment on 6-inch (150-mm) nominal-thickness concrete base. Base should be 24"x24" , concrete base specs shall be per Architectural plans
 - a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - d. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - e. Secure EV charging equipment to concrete base according to manufacturer's written instructions.
 2. Install EV charging equipment on 24"x24"x6"D concrete base.
 - a. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - c. Secure EV charging equipment to concrete base according to manufacturer's written instructions.
- C. Wall Mounting:
1. Install EV charging equipment so that its receptacles or holders are not less than 18 inches (450 mm) and not more than 4 feet (1.2 m) above finished floor.
 2. Mount EV charging equipment to steel slotted supports **[5/8 inch (16 mm)] [1-1/4 inches (32 mm)]** in depth. Orient steel slotted supports vertically.
 3. Ensure that EV charging equipment is plumb and rigid without distortion of box.
 4. Secure EV charging equipment according to manufacturer's written instructions.
- D. Bollard Mounting:
1. Allow a minimum of 24 inches (600 mm) of clearance around EV charging equipment.
 2. EV charging equipment receptacles or holders shall be not less than 24 inches (600 mm) and not more than 4 feet (1.2 m) above finished grade.
 3. Mount EV charging equipment plumb and rigid without distortion of enclosure.
 4. Secure EV charging equipment according to manufacturer's written instructions.
- E. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

- F. Wiring Method: Install cables in raceways and cable trays. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- G. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- H. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- I. Secure covers to enclosure.

3.3 CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Comply with grounding requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Comply with requirements for installation of conduit in Section 260533 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections[**with the assistance of a factory-authorized service representative**].
- C. Tests and Inspections:
 - 1. For each unit of EV charging equipment, perform the following tests and inspections:
 - a. Unit self-test.
 - b. Operation test with load bank.
 - c. Operation test with EV.
 - d. Network communications test.

- D. EV charging equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ONGOING MANAGEMENT SERVICES

- A. Engage a station manufacturer that offers a service to manage the administration and policies of the electric vehicle charging stations on an ongoing basis.

3.8 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for the duration of an active ChargePoint Network Service Plan.
- B. Upgrade Service: At Substantial Completion, remotely update software to latest version. Install and program software upgrades that become available while an active ChargePoint Network Service Plan is maintained. Upgrading software shall include operating system and new or revised licenses for using software.

3.9 DEMONSTRATION

- A. Utilize ChargePoint Station Management Services and ChargePoint Assure Services, or Train Owner's maintenance personnel to adjust, operate, and maintain EV charging equipment.

END OF SECTION

**SECTION 26 50 10
SOLID STATE (LED) LIGHTING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: LED Luminaires, LED modules, drivers, wiring, and lighting controls.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 4. Section 26 0526: Grounding and Bonding.
 - 5. Section 26 0519: Low-Voltage Wires (<600 Volt AC).
 - 6. Section 26 0923: Lighting Controls Systems.
 - 7. Section 26 5200: - Emergency Power Systems.
 - 8. Section 32 1313 - Site Concrete Work..

1.2 REFERENCES

- A. American National Standards Institute/American National Standard Lighting Group
ANSI/ANSLG – C78.377-2008 Specifications for the Chromaticity of Solid State Lighting Products.
- B. American National Standards Institute/American National Standard Lighting Group
ANSI/ANSLG – C82.77-2002 Harmonics Emission Limits.
- C. Federal Communication Commission (FCC) 47 CFR Part 15 – Radio Frequency Devices.
- D. Illuminating Engineering Society of North America (IESNA) LM-79-, LM-80-15, and TM-21.
- E. National Electrical Manufacturers Association (NEMA) SSL-1-2010 Electronic Drivers for LED Devices, Arrays, or Systems.
- F. SSL-3-2010 Solid State Lighting High Power LED Binning for General Illumination.
- G. SSL-4-2012 Solid State Lighting Retrofit Lamps.
- H. National Fire Protection Association (NFPA) NEC-70-2011
- I. Underwriters Laboratories (UL) 8750-Light Emitting Diode (LED) Equipment for Use in Lighting Products.

- J. Underwriters Laboratories (UL) 1598C- Light Emitting Diode (LED) Retrofit Luminaire Conversion Kits

1.3 SUBMITTALS

- A. List of Materials: Submit a complete list of proposed materials.
- B. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of sockets, size of lamps, and complete details of method of fitting suspension and fastening luminaires in place. Provide wiring diagrams for lighting control equipment. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.
- C. Prior to start of construction; provide photometric calculations with graphic of lighting foot-candle levels at work plane, ceiling and walls. Calculations shall comply with IESNA recommendations.
- D. Installation Instructions: Submit manufacturer's written installation instructions for luminaires and accessories.

1.4 SUBSTITUTIONS

- A. Luminaires that deviate from the requirements of this specification shall not be accepted without written approval from OWNER. When deviating or substituting luminaires, the following information shall be submitted:
- B. Substitutions: Submittals must comply with contract general provisions.

1.5 QUALITY ASSURANCE

- A. Design of lighting luminaires, accessories, supports, and method of luminaire installation shall comply with requirements for earthquake-resistant construction of the State of California.
- B. Provide suspension points at no more than two feet from luminaire ends. Spacing between supports shall not exceed eight feet.
- C. Components and luminaires shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes, including those mentioned under article 1.02 – References.

1.6 WARRANTY

- A. Provide the following warranties:
 - 1. One year labor warranty.
 - 2. Material warranty:
 - a. LED modules: five years minimum.
 - b. Drivers: five years minimum.
 - c. Lighting Pole (Standards): five year minimum.

- B. Warranty period shall begin at substantial completion or at project acceptance for beneficial occupancy, whichever occurs first.
- C. CONTRACTOR shall warranty Luminaires, including drivers, LED modules and ancillary components via a single warranty source. Multiple warranty sources is not acceptable.

PART 2 - PRODUCTS

2.1 MATERIAL AND FABRICATION

- A. Luminaires of same type shall be of one manufacturer.
- B. Manufacturer and model number references are indicated as a standard of performance and quality; other manufacturers' models may be submitted for review, provided the product meets or exceeds the product's specified requirements
- C. Conductors that pass over edges or through metal opening(s) shall be secured from contacting the edges, and be protected from cutting and abrasion. This requirement shall be met through one of the following:
 - 1. Rolling the edge of the metal not less than 120 degrees.
 - 2. A bushing or grommet of a material other than rubber at least 1.2 mm (0.047") thick.
 - 3. Glass sleeving at least 0.025 mm (0.010") thick.
- D. Lighting luminaires shall meet the following requirements:
 - 1. Industry standards as indicated under Article 1.02.
 - 2. Luminaire shall be from a manufacturer who has been in the business of manufacturing LED lighting luminaires for interior and exterior applications for a minimum of 5 years.
 - 3. Luminaires shall comply with the California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act, or be in compliance with the European Restriction of Hazardous Substances (RoHS), whichever is more stringent.
 - 4. Luminaires shall be baked-on enamel or powder-coated, unless otherwise specified in this section.
 - 5. The luminaire(s) lens, including end caps shall be 0.187 nominal thickness.
 - 6. Drivers shall be easily accessible without the use of special tools.
 - 7. Wiring cavity shall be field accessible for service or repairs.
 - 8. Luminaires shall be capable of being operated by standard motion/ vacancy sensors, daylight sensors, and dimmers.
 - 9. Luminaires shall be provided with a manufacturer's stencil or permanent legible sticker that states manufacturer business information and date of delivery.

10. Temperature rating; -20 degrees Celsius minimum starting temperature. Luminaire accessories including LEDs and drivers shall be able to withstand temperatures in excess of 110 Fahrenheit degrees.
11. Color Rendering Index (CRI):
12. Interior Applications: +82 CRI.
13. Exterior Applications: +70 CRI
14. Power factor: Greater than 0.9 at 120V and 277V.
15. Total Harmonic Distortion: Less than 20% at 120V and 277V.
16. Color Correlated Temperature: 4000K minimum \pm 275K degrees.
17. LEDs and drivers life expectancy: 50,000 minimum projected hours at 6,000 hours testing for both LEDs and drivers.
18. Luminaires in contact with insulation materials shall be IC rated.

2.2 DRIVERS and LED MODULES

A. Drivers:

1. Approved Drivers Manufacturers:
 - a. Osram – Optotronic.
 - b. Philips – Advance and Xitanium.
 - c. Universal Lighting Technologies – Everline.
 - d. General Electric – Ligttech.
 - e. Thomas Research Products
 - f. Kenall – Low Profile LED Driver
 - g. EldoLED
 - h. Approved Equal
2. Driver Type and Characteristics:
 - a. Comply with the state of California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act, or be RoHS compliant, whichever is more stringent.
 - b. Dimming for 0-10 volt DC control circuits. Drivers shall be specifically compatible with the lighting control system being provided.
 - c. Comply with applicable state, federal, and industry standards listed under References article.

- d. Wattage as stated in Luminaire's LM-79 test report.

B. LEDs:

1. Approved Manufacturers:

- a. Cooper Lighting
- b. Acuity Brands
- c. Hubbell
- d. Philips
- e. CREE
- f. Approved equal.

2. LEDs Characteristics:

- a. Color Correlated Temperature (CCT):
 - 1) Chromaticity target Duv and tolerance 0.001 plus/minus 0.006.
 - 2) Nominal CCT for 4000K, target CCT 3985K \pm 275K.
 - 3) CCT measurements in compliance with ANSI C78.377-2008.
- b. Lumen Maintenance: Greater than 90% at 500 C degrees.
- c. LEDs must be from same manufacturer and batch.
- d. TM-21 and LM-80 reported hours of no less than 50,000 with a minimum of 6000 hours testing.
- e. LM-79 reported CCT and CRI in compliance with articles 2.01.D.11 and 14.

2.3 LUMINAIRES

A. Luminaires types and minimum requirements:

1. Ceiling Recessed Troffer Luminaires:

- a. Luminaire shall be 20 gage cold rolled steel housing with no exposed fasteners or hardware.
- b. Approximately 4 ½-inch maximum depth housing with full length die-formed stiffeners, and contoured ballast wireway cover.
- c. Positive cam action steel latches and safety lock T-hinges to allow hinging and latching on either side.
- d. Baked white enamel finish.
- e. Trim shall be painted to match ceiling color.

- f. Reflector reflectance shall equal or exceed 89 percent.
 - g. Flat non-glare acrylic panel.
 - h. Minimum lens thickness 0.187 inch.
 - i. Furnish luminaires with LED strips as indicated on drawings. Mounting shall be compatible with standard or slot T-grid systems.
 - j. Furnish mounting frames on recessed luminaires in plaster and tile surfaces.
 - k. Approved luminaires: Per Plans, or approved equal.
2. Recessed Linear Wall Washer:
- a. Luminaire shall be minimum 20 gage steel with integral adjustable hanger clamps.
 - b. High performance luminaire with low iridescent specular aluminum reflector.
 - c. One piece body with integral hangers.
 - d. Approved luminaires: Per Plans or approved equal.
3. Linear Suspended or Wall Mounted Wall Washer:
- a. Luminaire shall be 20 gage die formed steel.
 - b. Reflector shall be die-formed white and/or semi specular.
 - c. Luminaire shall be an asymmetric distribution.
 - d. Luminaire shall come with the option for prismatic lens or louver.
 - e. Luminaire shall have an option to be wall mounted or suspended.
 - f. Approved luminaires: Per Plans, or approved equal.
4. Ceiling Surface-mounted or Recessed Troffer Luminaires:
- a. 22 gage extruded aluminum doorframes, white baked enamel finish. Spring loaded and half recessed with flush latches and T-handle hinge, accessible from bottom to drivers and wiring. Clear prismatic 100 percent pure virgin acrylic Pattern 12.
 - b. Recessed Troffer Housing minimum depth shall be 4 ½-inch to eliminate lamp images in lens.
 - c. Minimum lens thickness 0.187 inch.
 - d. Furnish mounting frames on recessed luminaires in plaster and tile surfaces.
 - e. Manufacturers and catalog numbers: Modify catalog numbers for mounting in gypsum drywall ceilings, as required.

- f. Approved luminaires: Per Plans, or approved equal.
- 5. Recessed Indirect Luminaire:
 - a. Housing shall be made of die-formed 20 gage steel with a minimum depth of 5 ½-inch.
 - b. Lamp shield shall be made of 22 gage perforated mesh with white acrylic overlay.
 - c. Approved luminaires: Per Plans, or approved equal.
 - d. Luminaire shall provide the option to be hinged from either side..
- 6. Enclosed and Vandal Resistant Luminaires:
 - a. Luminaire shall be 20 gage extruded aluminum with die cast end caps.
 - b. Luminaire shall have opal polycarbonate lens.
 - c. Furnish luminaires with LED strips as indicated on drawings. Luminaire shall have tamper resistant hardware.
 - d. Luminaire shall have the ability to be in continuous rows with seamless appearance.
 - e. Luminaire shall be listed for wet location.
 - f. Approved luminaires: Per Plans, or approved equal.
- 7. Enclosed, Gasketed Luminaire:
 - a. Luminaire shall be 20 gage steel.
 - b. Lens enclosure shall be heavy duty vapor tight enclosed gasketed with closed-cell foam gasketing permanently attached to luminaire housing.
 - c. Luminaire shall have tamperproof latches.
 - d. Luminaire shall be furnished with minimum one watertight hub kit for top or end conduit entry.
 - e. Luminaire shall have option for cable mount and safety strap
 - f. Wet Location listed.
 - g. Approved luminaires: Plans, or approved equal.
- 8. Surface, Wall or Recess Mounted fixtures
 - a. Luminaire shall be 20 gage extruded aluminum with die cast end caps.
 - b. Opal polycarbonate lens.
 - c. Furnish luminaires with LED strips as indicated on drawings.

- d. Luminaire mounting as indicated on drawings.
 - e. Luminaire shall be listed for damp and wet location.
 - f. Approved luminaires: Luminaire Per Plans, or approved equal.
9. Down Lights:
- a. 4 to 6 inch round LED downlight.
 - b. Color trim as specified in construction drawings.
 - c. Trim attachment to frame-in kit via push-in connector on frame.
 - d. Removable cover for access.
 - e. Complete luminaire including all peripheral devices including frame-in kit, light engine, trim kit, etc. shall be provided.
 - f. Approved luminaires: Per Plans, or approved equal.
10. High Abuse Surface Luminaires:
- a. Lens shall be extruded polycarbonate, clear prismatic refractor, nominal thickness 0.125 inch, UV stabilized.
 - b. Base-plate shall be 18 gage prime cold-rolled steel with corrosion-resistant, 92 percent reflective, white polymer finish.
 - c. End caps shall be 16 gage prime cold roll steel with corrosion-resistant, white polymer finish and shall be spot welded to the base-plate.
 - d. Lens/housing shall be furnished with a minimum of two large or four small stainless steel fasteners to secure lens/housing to base plate.
 - e. Listed for wet and damp locations.
 - f. Approved luminaires: Per Plans, or approved equal.
11. Wall Mounted Vaportite Luminaire:
- a. Luminaire housing shall be die cast aluminum with corrosion resistant polyester powder coated finish.
 - b. Luminaire shall be heat and shock resistant, with prismatic glass optical chamber with neoprene gasketing.
 - c. Luminaire shall be 15 or 20 watt LED; LEDs and drivers as indicated on drawings.
 - d. Luminaire shall be equipped with lens guard.
 - e. Approved luminaires: ,Per Plans or approved equal.
12. Ceiling-Mounted Luminaires:

- a. Separate ceiling and reflector pans with foil-backed fiberglass between pans and 1/8 inch thick neoprene gasketing between ceiling pan and ceiling.
 - b. White polyester finished 18 gage cold-rolled steel back-plate with clear prismatic injection molded polycarbonate lens, UV stabilized heavy gage aluminum back-plate and four tamper-proof screws.
 - c. Provide luminaire wattage as indicated on drawings.
 - d. Luminaire shall be listed for damp locations.
 - e. Approved luminaires: Per Plans, or approved equal.
13. Ceiling Mounted Luminaires:
- a. Luminaire shall be die-cast aluminum.
 - b. Luminaire shall have reinforced four-point mounting system construction to resist breakage from impact and prying.
 - c. Luminaire finish shall be as indicated on drawings.
 - d. Lens shall be Injection molded UV stabilized, high impact resistant opal polycarbonate.
 - e. Luminaire shall have option trim ring to fit between housing and inside lip of trim ring for a smooth transitional look.
 - f. Provide luminaire with input watts as indicated on drawings.
 - g. Ceiling luminaires shall be supplied without eye lid option, wall mounted luminaires shall be supplied with eye lid option.
 - h. Approved luminaires: Per Plans, or approved equal.
14. Recessed Interior/Exterior Vandal Resistant Luminaires (Square):
- a. Housing/door shall be fabricated from 16 gage cold-rolled steel, and polyester powder coated after fabrication.
 - b. Fully gasketed for exterior installation.
 - c. 0.187 inch clear polycarbonate UV stabilized safety lens.
 - d. Provide luminaire wattage as indicated on drawings.
 - e. Approved luminaires: Per Plans, or approved equal.
15. Recessed Interior/ Exterior Vandal Resistant Downlight Luminaire :
- a. Luminaire shall have a die cast aluminum mounting frame suitable for dry or wet plaster ceilings of a minimum thickness of 1 1/8 inches.
 - b. Luminaire shall be UL listed for damp locations.

- c. Lens shall be vandal resistant acrylic with flat or drop diffuser. (Refer to luminaire schedule in drawings for type of diffuser).
 - d. Die formed aluminum reflector.
 - e. Luminaire shall be provided with input wattage as indicated on drawings.
 - f. Approve luminaires: Per Plans, or approved equal.
16. Outdoor Wall-Mounted Luminaires (Vandal Resistant):
- a. Seamless, one-piece, injection molded polycarbonate lens/housing, 0.187 inch, UV stabilized polycarbonate lens. The wraparound lens design encloses and protects the interior of unit.
 - b. Die cast aluminum mounting plate.
 - c. One-piece, full size, closed cell neoprene rubber gasket.
 - d. One stainless steel tamper-proof screw.
 - e. Luminaire shall be UL listed for wet locations.
 - f. Luminaires shall be provided with input watts as indicated on drawings.
 - g. Approved luminaires: Per Plans, or approved equal.
17. Wall Mounted Full Cutoff Exterior Wall.
- a. Luminaire shall be mounted at no less than nine feet above finished grade, or as indicated in drawings.
 - b. Housing shall be made of 20 gage die cast aluminum, and be equipped with hinged doors.
 - c. Luminaire shall have Stainless steel tamperproof hardware.
 - d. Luminaire shall be provided with input watts as indicated on drawings. Luminaire Optics shall be full 90 degree horizontal cutoff on all distributions. Reflector shall be specular aluminum. Luminaire shall have tempered glass lens with optional wire guard.
 - e. Approved luminaires: Per Plans, or approved equal.
18. Recessed Low Level Light:
- a. Housing shall be die cast aluminum with captive stainless steel hardware.
 - b. Luminaire shall be gasketed with a single piece of molded silicone.
 - c. Lens shall be Louver and completely sealed to prevent water, dust and insect infiltration.
 - d. Luminaire shall be equipped with drivers and LED strips wattage as indicated in drawings.

- e. Approved luminaires: Per Plans, or approved equal.
- 19. Explosion-Proof Luminaires:
 - a. Designed for Class I, group CD location, ceiling-mounted.
 - b. Approved manufacturers : Per Plans, or approved equal.
- 20. Wall-Mounted Luminaires (Vandal Resistant):
 - a. One-piece prismatic refractor held by cast metal door, hinged to die-cast anodized aluminum weatherproof housing with visor to limit light pollution.
 - b. Die-cast aluminum housing of 1/8 inch minimum wall thickness. Luminaire shall be provided with tamper-proof screws.
 - c. High impact resistant, UV stabilized injection molded polycarbonate lens.
 - d. High power LEDs.
 - e. Approved manufacturers: Per Plans, or approved equal.
- 21. Wall Mounted Full Cutoff – Luminaires:
 - a. Luminaire shall be injection molded, impact resistant polycarbonate lens, with optional wire guard.
 - b. Luminaire shall have Tamperproof hardware.
 - c. Reflector shall be hydro-formed anodized aluminum.
 - d. Lens shall be injection molded UV stabilized high impact acrylic.
 - e. Drivers and LED strips as indicated on drawings.
 - f. Housing shall be 20 gage die cast aluminum with hinged doors.
 - g. Luminaire Optics shall be full 90 degree horizontal cutoff on all distributions.
 - h. Approved Luminaires: Per Plans or approved equal

B. EXIT ILLUMINATION

- 1. Lighting Luminaire
 - a. Ceiling or wall-mounted, vandal-resistant type, LED EXIT, consisting of:
 - b. LED board, green exit lettering and directional arrows as indicated on drawings.
 - c. Face plate and polycarbonate shield.
 - d. Number of faces, voltage, and emergency power source shall conform to design requirements indicated on drawings.
 - e. Area of refuge listing is required when luminaires are used in such locations.

- f. Utilize a flag mount luminary with additional support from the ceiling or wall for canopy or pendant mounted exit signs. This option shall be exercised only if a wall is not available.
 - g. Approved Products: Per Plans, or approved equal.
2. Low Level Exit Signs:
- a. Approved products: Per Plans or approved equal.
 - b. Luminaires shall be:
 - c. L.E.D. boards, green lettering, or as indicated on drawings.
 - d. Die cast aluminum body and face plate with white finish.
 - e. Polycarbonate shields.
 - f. Area of refuge listing is required when luminaires are used in such locations.
 - g. Emergency battery pack operation shall be as indicated on Drawings.

2.4 LIGHT POLES (STANDARDS)

- A. Mounting Height shall be per plans, tapered galvanized steel.
 - 1. Starting at the base, a minimum of 12 inches of the light standards interior and exterior surfaces shall be treated with water repellent or barrier coatings to prevent moisture contact with galvanized surface.
- B. Aluminum poles are not acceptable.
- C. Pole shaft shall conform to ASTM A595 Grade A and be 11 gage thickness, unless otherwise indicated on Drawings. Shaft shall be one piece construction with a full length longitudinal high frequency resistance weld.
- D. The anchor base shall be constructed from structural quality hot rolled carbon steel plate conforming to ASTM A36.
- E. Anchor bolts shall be fabricated from commercial quality hot rolled carbon steel bar with minimum yield strength of 55,000 PSI. Bolts shall have an L bend on one end and threaded on the opposite end. Anchor bolts shall be hot dipped galvanized with a minimum length of 12 inches on the threaded end. Four properly sized bolts furnished with two hex nuts, and flat washers, shall be provided for each pole. Contractor to obtain manufacturer required base bolt pattern prior to concrete installation.
- F. A two piece base cover shall completely seal the entire base plate and be securely fastened.
- G. Each pole shall have a three-inch by five-inch handle. A nut holder shall be provided near the hand-hole and shall include a ½ inch – 13 UNC HE by Head bolt and nut for grounding. The hand-hole shall be welded in the pole shaft and shall include a steel cover with attachment screws. The hand-hole shall be located 18 inches above the base of the pole.
- H. Finish of pole and accessories shall be electrostatically applied, and thermally cured polyester powder coat. Color shall be selected by Architect.

- I. All structural fasteners shall be galvanized high strength carbon steel.
- J. Poles shall be designed to withstand wind velocity of 80 MPH and 100 MPH gusts. Concrete base shall be a monolithic concrete pour when installed.
 - 1. Standards shall be installed plumb and straight on concrete footings. Grout and dry-pack after leveling. Concrete, grout and drypack requirements and procedures are as specified in Division 02.
- K. Standards footings shall be provided with a moisture release channel to keep the interior of the standards dry and free from rain, dew or condensation. Refer to District's Standards Footing Detail. Engage a California Registered structural engineer to design the base.
- L. Provide in line fuse assembly in hand-hole of each light standard with breakaway receptacle Busmann HEY series, or approved equal. Fuse assembly shall easily disconnect power to light standard. Fuse type and rating shall be as required by each application.
- M. Provide all required fixture mounting accessories.
- N. Standards shall be provided by light fixture manufacturer or shall be as manufactured by Gardco, Alcastco, Lytepole, Valmont or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install a lighting luminaire for each lighting outlet indicated and label with day of installation.
- B. Luminaire voltage shall be as indicated on Drawings.
- C. Install recessed and surface-mounted luminaires, with plaster frames compatible with ceiling and wall systems employed; secure luminaires mechanically to frames.
- D. Align rows of suspended and surface-mounted luminaires to form straight lines at uniform elevations.
- E. Recessed luminaires shall fit snugly against ceilings to prevent light leakage.
- F. Luminaire installations shall comply with CBC Seismic requirements
- G. Support suspended recessed luminaires in T-bar ceilings as follows: Luminaires shall be attached to ceiling grid to resist a horizontal force equal to weight of luminaires. For heavy-duty grid systems, luminaires weighing less than 56 pounds must also have two 12 gage slack safety wires from diagonal corners to the structure above; luminaires weighing more than 56 pounds shall be independently supported by not less than four taut 12 gage wires capable of supporting four times the load. For intermediate duty grid systems, luminaires shall be independently supported by not less than four taut 12 gage wires capable of supporting four times the load. Luminaire hanger wire ends shall be twisted three tight turns within a 1 ½ -inch distance. Provide positive point of attachment to T-bar ceiling with four, #8 wafer head tek screws (one at each corner), avoiding conflict with operation of the lens. Luminaire installation shall be coordinated with acoustical ceiling installation.

- H. Emergency light luminaires shall be labeled "Emergency Luminaire" with one inch high letters produced with a P-touch or similar labeling system.
- I. Continuous suspended luminaires:
 - 1. Luminaire suspension device shall allow vertical adjustment of luminaire without the use of tools. Cable shall be minimum seven strand twisted stainless steel capable of supporting minimum four times the luminaire weight. For continuous linear suspended luminaires longer than eight feet, provide not less than three suspension points.
 - 2. Top of luminaire shall be suspended as shown on the Drawings, typically 24 inches below the ceiling and a minimum of 18 inches from the ceiling.
 - 3. Luminaire shall utilize factory furnished or approved hardware and canopy for either hard or T-bar ceilings.
 - 4. White Board Lights shall be suspended 24 inches from the wall unless specifically shown otherwise.
- J. Surface mount luminaires shall be attached to structure. Toggle bolts are NOT permitted. Provide backing where required.
- K. Low level exit signs shall be installed with the bottom of the sign not less than six inches, or more than eight inches above the floor level and shall indicate the path of exit travel. For exit and exit-access doors, the sign shall be on the door or adjacent to the door with the closest edge of the sign within four inches of the door frame.

3.2 TESTING

- A. Check and adjust luminaires for required illumination.
- B. Replace defective LED strips and drivers.
- C. Test and adjust lighting control equipment for proper operation.

3.3 SPARE PARTS

- A. Furnish ten percent spare LED strips with a minimum of one spare strip of each type.
- B. Furnish ten percent spare motion detectors of each type with a minimum of one spare detector of each type.
- C. Furnish ten percent spare drivers of each type with a minimum one spare driver of each type.

3.4 HAZARDOUS WASTE DISPOSAL

- A. Hazardous waste disposals shall be handled and disposed of by an approved, licensed contractor.
- B. Products with PCBs are not acceptable. Hazardous waste shall be placed in appropriate containers provided by hazardous waste contractor labeled clearly with:
- C. Project Name
- D. Quantity of materials

- E. Date materials became waste
- F. Store, remove, transport and dispose of hazardous materials in accordance with state and federal regulations.
- G. Provide Owner with copy of manifest and certificate of destruction.

3.5 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.6 CLEANUP

- A. Remove rubbish, debris, and waste materials from all areas of work each day.
- B. Clean luminaire surfaces of dirt, cement, plaster and debris. Furnish cleansers compatible with material surfaces being cleaned.

END OF SECTION

SECTION 26 56 17
PARKING LOT AND SITE LED LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Lighting fixtures, including LED lamps arrangements, drivers, wiring, and lighting controls.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 4. Section 26 0526: Grounding and Bonding.
 - 5. Section 26 0519: Low-Voltage Wires.
 - 6. Section 26 0533: Raceways, Boxes, Fittings and Supports.
 - 7. Section 26 0923: Lighting Controls Systems.
 - 8. Section 26 2416: Panel boards and Signal Terminal Cabinets.
 - 9. Section 26 5000: Lighting.
- C. Applicable Standards and Codes:
 - 1. EIA/TIA 569 Standards
 - 2. National American Standards Institute (ANSI)
 - 3. National American Standards Institute (ANSI)
 - 4. Nationally Recognized Testing Laboratory (NRTL)
 - 5. California Electrical Code (CEC)
 - 6. Uniform Building Code (UBC)
 - 7. Underwriters Laboratory (UL)

1.2 REFERENCES

- A. Publications are referenced within the text by their basic designation only. The most current version shall apply.
- B. American National Standards Institute (ANSI):

1. ANSI C82.SSL1 – SSL Drivers.
 2. ANSI C136.2 - American National Standard for Roadway and Area Lighting Equipment – Luminaire Voltage Classification.
 3. ANSI C136.3 – American National Standard for Roadway and Area Lighting Equipment – Luminaire Attachments.
 4. ANSI C136.10 – American National Standard for Roadway Lighting Equipment – Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.
 5. ANSI C136.15 – American National Standard for Roadway and Area Lighting Equipment – Luminaire Field Identification.
 6. ANSI C136.25 – American National Standard for Roadway and Area Lighting Equipment – Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures.
 7. ANSI C136.31 – American National Standard for Roadway Lighting Equipment – Luminaire Vibration.
- C. American Society for Testing and Materials International (ASTM):
1. ASTM A36 – Standard Specification for Carbon Structural Steel.
 2. ASTM A595 - Standard Specification for Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use.
 3. ASTM D1654 – Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
 4. ASTM G35 – Standard Practice for Determining the Susceptibility of Stainless Steels and Related Nickel-Chromium-Iron Alloys to Stress-Corrosion Cracking in Polythionic Acids.
- D. Federal Trade Commission (FTC):
1. Green Guides, 16 CFR Part 260, Guides for the Use of Environmental Marketing Claims.
- E. Illuminating Engineering Society of North America (IESNA):
1. IESNA DG-13 – Guide for the Selection of Photo controls for Outdoor Lighting Applications.
 2. IESNA LM-64 – Photometric Measurements of Parking Areas.
 3. IESNA LM-79 – IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
 4. IESNA LM-80 – IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources.
 5. IESNA TM-15 – Luminaire Classification System for Outdoor Luminaires

- 6. IESNA TM-21 – Projecting Long Term Lumen Maintenance of LED Light Sources.
- 7. IESNA RP-13 – Nomenclature and Definitions for Illuminating Engineering.
- F. National Electrical Manufacturers Association (NEMA):
 - 1. ANSI/NEMA/ANSI C78.377 – American National Standard for the Chromaticity of Solid-State Lighting Products.
 - 2. NEMA WD 7 – NEMA Guide Publication: Occupancy Motion Sensors.
- G. California Building Code (CBC):
- H. California Electrical Code (CEC).
- I. Next Generation Lighting Industry Alliance/Department of Energy:
 - 1. LED Luminaire Lifetime: Recommendations for Testing and Reporting – 1st Edition.
- J. Underwriters Laboratories (UL):
 - 1. UL – 1449 – Surge Protective Devices.

1.3 DEFINITIONS

- A. Lighting terminology used herein as defined in IESNA RP-16. See referenced documents for additional definitions.
- B. Exception: The term “driver” is used herein to broadly cover both drivers and power supplies, where applicable.
- C. Clarification: The term “LED light source(s)” is used herein in accordance with IES LM-80 to broadly cover LED package(s), module(s), and array(s).
- D. Support Assembly: Means a pole or other support structures, brackets, cross-arms, appurtenances, base, anchorage, and foundation.

1.4 SUBMITTALS

- A. List of Materials: Submit a complete list of materials proposed for this section.
- B. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of sockets, size of LED boards and drivers, and complete details of method of fitting suspension and fastening fixtures in place. Provide wiring diagrams for lighting control equipment. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.
- C. EDIT NOTE: Include paragraph C for projects to be designed by Contractor.
- D. Photometric calculations: Submit calculations with graphic of luminance levels of work and floor planes. Calculations shall comply with IESNA LM-64 recommendations.
- E. Performance Reports:

1. Luminaire photometric reports per IESNA LM-79 including: laboratory name, report number, date, luminaire catalog number, luminaire and light source specifications. Report shall contain lumen values in Backlight, Uplight, and Glare (BUG) zones per IESNA TM-15 and roadway type classifications luminous intensity, zonal lumen summary, and iso-footcandle diagrams, as well as documentation that specified standards and tests methods were followed.

F. Certified Statements:

1. Submit manufacturer's certified statement indicating that the manufacturer has been in the business of fabricating lighting fixtures for outdoor and general area illumination for a minimum of 10 years.
2. Establish compliance with the California Lighting Efficiency and Toxics Reduction Act requirements for the manufacturer to have in place a collection and recycling system of any end-of life general purpose light fixtures generated in the State of California.
3. Submit manufacturer's certified statement indicating that the manufacturer has local service with offices no more than 50 miles from Owner's central offices.
4. Certification of compliance that California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act shall not exceed the following allowed content in parts per million (ppm):
5. Lead content > 0.1% or 1000 ppm.
6. Mercury Content > 0.1% or 1000 ppm.
7. Cadmium Content > 0.01% or 100 ppm.
8. Hexavalent Chromium > 0.1% or 1000 ppm.
9. Polybrominated Biphenyls > 0.1% or 1000 ppm.
10. Polybrominated Biphenyls Ether > 0.1% or 1000 ppm.

- G. Installation Instructions: Submit manufacturer's written installation instructions for fixtures and accessories.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: 10 years in the fabrication of lighting fixtures.
- B. Listing and Labels: Light fixtures shall be Underwriters Laboratory (UL) or Nationally Recognized Testing Laboratory (NRTL) listed, and in compliance with applicable industry standards and codes. NRTL test laboratories shall be qualified by the DOE and listed in the DOE SSL website.
- C. Design of lighting fixtures, accessories, supports, and method of fixture installation shall comply with requirements for earthquake-resistant construction of the State of California.

1.6 WARRANTY

- A. Five years on-site replacement material, fixture finish and workmanship. On-site replacement includes transportation, removal, and installation of new products. Finish warranty shall include warranty against failure or substantial deterioration such as blistering, cracking, peeling, chalking or fading.
- B. Five years material replacement warranty for defective or non-starting LED source assemblies, drivers, and power supply units (PSU).
- C. LED source assemblies, drivers and power supplies that fail to maintain illuminance levels per Article 2.03.E shall be provided with an additional 10 years warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Lighting Fixtures:
 - 1. The following fixtures are approved for installation in modernization projects:
 - 2. General Electric – Evolve EAMM-EASM Series.
 - 3. Cree/Betalux – STR-LWY or ARE-EDG Series.
 - 4. McGraw Edison/Cooper Lighting – Galleon Series.
 - 5. Philips-Gardco – Pureform Series.
 - 6. Equal with mast arm adapter will be acceptable.
- B. The following fixtures are approved for installation in new construction projects:
 - 1. General Electric – Evolve EAMM-EASM Series.
 - 2. Cree/Betalux – STR-LWY or ARE-EDG Series.
 - 3. McGraw Edison/Cooper Lighting Galleon Series.
 - 4. Philips/Gardco Pureform Series.
 - 5. Weef
 - 6. Equal.
- C. Light Standards:
 - 1. Height shall be per plans, tapered galvanized steel, unless otherwise indicated on Drawings.
 - 2. Aluminum poles are not acceptable.

3. Pole shaft shall conform to ASTM A595 Grade A and be 11 gage thickness, unless otherwise indicated on Drawings. Shaft shall be one piece construction with a full length longitudinal high frequency resistance weld.
4. The anchor base shall be constructed from structural quality hot rolled carbon steel plate conforming to ASTM A36.
5. Anchor bolts shall be fabricated from commercial quality hot rolled carbon steel bar with minimum yield strength of 55,000 PSI. Bolts shall have an L bend on one end and threaded on the opposite end. Anchor bolts shall be hot dipped galvanized with a minimum length of 12 inches on the threaded end. Four properly sized bolts furnished with two hex nuts, and flat washers, shall be provided for each pole. Contractor to obtain manufacturer required base bolt pattern prior to concrete installation.
6. A two piece base cover shall completely seal the entire base plate and anchorage and it shall be securely fastened.
7. Each pole shall have a three-inch by five-inch handle. A nut holder shall be provided near the handhole and shall include a ½ inch – 13 UNC HE by Head bolt and nut for grounding. The handhole shall be welded in the pole shaft and shall include a steel cover with attachment screws. The handhole shall be located 18 inches above the base of the pole.
8. Finish of pole and accessories shall be galvanized. Color shall be selected by Architect.
9. All structural fasteners shall be galvanized high strength carbon steel.
10. Poles shall be designed to withstand wind velocity of 80 MPH and 100 MPH gusts. Concrete base shall be a monolithic concrete pour when installed.
11. Standards shall be installed plumb and straight on concrete footings. Grout and dry-pack after leveling. Concrete, grout and drypack requirements and procedures are as specified in Division 2.
12. Provide in line fuse assembly in hand hole of each light standard with breakaway receptacle Bussmann HEY series, or equal. Fuse assembly shall easily disconnect power to light standard. Fuse type and rating shall be as required by each application.
13. Provide all required fixture mounting accessories, including round tubular arm brackets supplied with pole.
14. Standards shall be provided by Light fixture manufacturers or shall be as as manufactured by Gardco, Alcastco, Lytepole, Valmont or equal.

2.2 EQUIPMENT

- A. Fixtures shall meet the minimum performance requirements of efficiency and quality specified on Article 2.03.
- B. Fixtures of same type shall be of one manufacturer and shall meet the following requirements:
 1. Finish: Baked-on enamel or powder-coated.
 2. Luminaire Attachments in compliance to ANSI C136.3.

3. Lens: Injection molded UV stabilized high impact acrylic in compliance to ANSI C136.31 requirements for luminaire vibration.
4. Fixture Optics: Capable of full 90 degree horizontal cutoff on all distributions, and in compliance with the chromaticity of solid-state lighting products per ANSI/NEMA/ANDLG C78.377.
5. Luminaire housing: Constructed of metal of sufficient thickness to meet or exceed the rated life of the luminaire LED's. Finish color as indicated in drawings. Powder-coated and rust resistant for the life of the luminaire in compliance with ASTM D1654 requirements.
6. Driver shall be replaceable and mounted within luminaire housing.
7. Screws shall be stainless steel. Captive screws shall be provided for any components that require maintenance after installation.
8. Driver surge protection in compliance to UL 1449.
9. Approved drivers: Philips, General Electric, Cree, Osram, Nichia, or approved equal.
10. No parts of the luminaire shall be constructed of polycarbonate, unless it is ultraviolet (UV) stabilized (lens discoloration shall be considered a failure under warranty).
11. Luminaire shall be "Dark Sky" compliant.
12. Luminaire shall have an option for individual LED's optical shield for house-side light control.
13. LEDs shall be Philips, Osram, Nichia, Illumitex, General Electric, Cree, or approved equal.
14. Luminaire door shall remain securely and safely linked to luminaire body, through a hinge design, when in the door open "down" position during inspection or maintenance.
15. Luminaire shall be capable of being operated by standard plug-in photoelectric cell, facing north, and shall not draw more than 1 watts of power in the off state. Photoelectric design shall comply with IESNA DG-13.
16. Shorting cap shall be provided with luminaire.
17. Luminaire shall have the option for motion sensor controls and 0-10V step dimming. Motion sensors shall comply with the requirements of NEMA standard WD 7 and photocell controllability per ANSI C136.10.
18. Luminaire shall include a heat dissipating sink with no fans, pumps, or liquids.
19. Luminaire shall be designed so that debris buildup or bird droppings do not degrade heat dissipation performance.
20. Luminaire shall meet the requirements of ANSI C136.25 and C136.31 for resistance to dust, solid objects and moisture.
21. Luminaire shall weigh no more than 40 pounds. 80% of the luminaire material by weight shall be recyclable at the end of life.

- 22. Fixtures shall be UL or NRTL listed for wet locations.
- 23. Fixtures shall be labeled in accordance with the Federal Trade Commission Green Guides, 16 CFR Part 260, Guide for the Use of Environmental Marketing Claims.
- 24. Lighting fixtures shall be classified in accordance with IESNA TM-15.
- C. Luminaire shall have a manufacturer's stencil, or a permanent legible sticker, with the month and year of delivery.

2.3 PERFORMANCE REQUIREMENTS

- A. Luminaire must be subject to 100,000 cycles of 2 Gs at the resonant frequency of the luminaire (between 5 and 30 Hz) applied at the center of gravity per ANSI C136.31 without damage to the luminaire.
- B. Wiring cavity shall be field accessible for service or repairs.
- C. Coating shall be capable of surviving ASTM B117 salt environment for 500 hours minimum without blistering or peeling.
- D. Gloss retention shall be greater than 90% for the 500 hours exposure QUV test. Results shall conform to ASTM G35, 4 hours UV-B60°/4 hours condensation 50°C.
- E. Provide a minimum 6,000 hours of integral lamp operating data (not just LED data) and documented projection for 50,000 operating hours. Testing procedures and results documentation shall comply with the Department of Energy LED Luminaire Lifetime Recommendations for Testing and Reporting 1st Edition.
- F. LED shall comply with the requirements set forth in UL-1449.
- G. Lighting fixtures shall be rated for -20°C to +50°C.
- H. Color Rendering Index shall not be less than 70.
- I. Lighting fixtures shall have a minimum luminaire efficiency rating (LER) equal or greater than 75, and an Initial Lumen Efficacy (ILE) equal or greater than 70. Fixtures with lower LER and ILE shall not be accepted.
- J. The acceptable Correlated Color Temperature (CCT) shall be 4500 degrees K +/- 500 degrees K.
- K. Lumen Maintenance (LM) at 6000 Hrs must be greater or equal to 95%. Provide tests reports and photometric data.
- L. Projected Lumen Maintenance (LM) at 50000 hrs greater or equal to 90%.
- M. The Power Factor (PW) shall not be less than 0.90.
- N. The Total harmonic Distortion (THD) shall be less than 20%
- O. Fixtures shall operate on 120, 208, 240, 277, or 480 Volts in compliance with the requirements set forth in ANSI standard C136.15.

- P. Power supply shall have a Class A sound rating in compliance with the requirements set forth in ANSI standard C136.15.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Drivers and LED boards shall be permanently labeled with the day of installation with one inch high letters produced with a P-touch or similar permanent labeling system.
- B. Installations shall comply with CBC Seismic requirements, California Electrical code and applicable ordinances and industry standards.
- C. Standards shall be installed plumb and straight on concrete footings. Concrete requirements and procedures are as specified in Section 32 1313.
- D. Emergency light fixtures shall be labeled "Emergency Fixture" with one inch high letters produced with a P-touch or similar permanent labeling system.

3.2 TESTING

- A. Check and adjust fixtures for required illumination.
- B. Replace defective drivers and LED boards.
- C. Test and adjust lighting control equipment for proper operation.

3.3 SPARE PARTS

- A. Furnish ten percent spare drivers with a minimum of one spare LED board of each type.
- B. Furnish five percent spare motion detectors of each type with a minimum of one spare detector of each type.

3.4 HAZARDOUS WASTE DISPOSAL

- A. Hazardous waste disposals shall be handled and disposed of by licensed contractor.
- B. Store, remove, transport and dispose of hazardous materials in all accordance with state and federal regulations.
- C. Provide Owner with copy of manifest and certificate of destruction.

3.5 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.6 CLEANUP

- A. Remove rubbish, debris, and waste materials from all areas of work each day.
- B. Clean fixture surfaces of dirt, cement, plaster and debris. Furnish cleansers compatible with material surfaces being cleaned.

END OF SECTION

**SECTION 27 00 00
LOW-VOLTAGE REQUIREMENTS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Items of work included in this Section, described in detail in PART 3.
- B. Furnish and install a complete and functional system consisting of the following components/sub-systems as indicated below:
 - 1. Main Communications Room (MDF)
 - 2. System & Auxiliary Equipment Pre-installation
 - 3. Intrusion Detection and Alarm
 - 4. CCTV
 - 5. Station (Voice/Data)
 - 6. Workstation Outlets
 - 7. Wireless Network Access Point Data Cables-
 - 8. Patch Cables
 - 9. Voice Cabling
 - 10. Cable Testing (Copper)
 - 11. Wi-Fi (Wireless) Networks
 - 12. Equipment Racks/Mountings
 - 13. Training

1.2 SPECIAL CONDITIONS

In addition to all stipulations in other portions of the general specifications, all trades concerned shall comply with the following special conditions that directly pertain to communications and security systems:

A. Contractor Qualifications

The specified equipment shall be furnished and installed by a contractor who can show proof of having satisfactorily engineered and installed comparable systems within the past five (5) years, and who holds all legally required licenses, including General Electrical C-10 and or a Communication C-7 licenses if required to install the systems mentioned herein.

1. Security and Access Control systems contractors must be authorized, certified installer/dealer for DMP or approved equal security. The contractor must be regularly engaged in the supply of security and access control systems and must have occupied an established office for a period of not less than five (5) years prior to bid date within the Project's geographic market area. The system certified dealership letters must be provided to the city of Ridgecrest at time of bid and may at the City's discretion verify with the manufacturers prior to commencement of work. The dealer/contractor responsible for the installation of the security systems must be the dealer who holds all required dealership letters and has attended all the manufacturer's training certification courses prior to bid date.

B. Parts Availability

1. The contractor shall confirm that within a reasonable distance of the job site, there is an established agency which stocks a full complement of parts, offers service during normal working hours on all equipment to be furnished and will supply parts to the City without delay and at reasonable cost. The contractor shall review the specifications and provide the latest equipment and devices applicable for approval. The contractor shall be responsible for submitting the latest parts and/or equipment as part of the submission process for approval based on manufacturers listed. All parts submitted shall be no more than 3 years in circulation in order to ensure longevity and support of the products installed.

C. Continuous Duty Operation

1. All individual components and composite systems shall be designed for continuous operation without undue heating or changing in rated values and shall be properly fused.

D. Compliance with Codes

1. All work shall be done in accordance with latest applicable edition of National Electrical Code and all regulations, laws, safety orders, ordinances, or codes of State and local authority, whichever exceeds, having the jurisdiction. Wherever requirements in the specifications exceed those of the ordinances or codes, specifications shall govern. Nothing in the plans and specifications shall be deemed as authority to violate any of the ordinances or codes.

1.3 SYSTEM RESPONSIBILITY

- A. The contractor shall furnish and install all non-specified equipment required to make each system fully functional as per stated intent and description, without additional cost to the City.

1.4 WARRANTY

All equipment and systems shall be warranted by the contractor for a period of one year following acceptance by the City. The warranty shall include parts, labor, prompt field service, and pick-up and delivery at no cost to the City. If repair of a defect cannot be affected during the initial response, every effort shall be made by the contractor to promptly correct the defect including air shipment of repair parts and replacement of the next larger assembly. Response to the initial call shall be accomplished within four (4) hours.

- A. Routine non-warranty maintenance shall be performed by the City. Neither this maintenance nor emergency repairs made by qualified City technicians shall void the warranty.

- B. During the warranty period, the contractor shall respond only to calls for service made by designated Department of Parks and Recreation Representative and/or city's IT personnel and shall keep the Department fully informed as to problems which develop equipment or systems and as to steps the contractor have taken to rectify those problems. Response to the initial call shall be accomplished within four (4) hours.

1.5 DATA TO BE SUBMITTED BY THE CONTRACTOR

A. Submittal Format

1. Submittal shall be furnished in an 8 ½" x 11" format in PDF format. The cover and the title page shall bear the project name, capital project numbers specification number, name of contractor and date. The document shall have a table of contents and page numbers on each of the pages including brochures and drawings.
2. Provide PDF Shop drawings for review and approval prior to start of work. Drawings shall be no larger than 30" x 42". Consultant plans shall not be used as Shop drawings as these may be diagrammatic only for contractor reference.
3. Reproduced material shall not be subject to fading by light or heat and shall have high contrast for easy reading.

B. Preliminary Submittal

Within 30 days after the contract award and prior to the purchase of any equipment, the contractor shall submit five (5) copies of a Preliminary Submittal for review and approval. The submittal shall consist of the following:

1. Proposed material list including manufacturer's name, model number and technical data for all equipment the contractor proposes to install. Items shall be identified by specification section and paragraph number. The technical data shall consist of copies of factory issued catalog sheets or brochures, which give ratings and specifications for the proposed items.
2. Single line system diagram identifying and showing interrelationships between equipment items and how they are interconnected.
3. Shop drawings showing details of fabricated items, rack elevation drawings, console arrangements and schematics of custom designed items.
4. Statement describing exceptions being taken, if any, to the specifications wherein the submitted equipment or design varies from that originally specified.
5. If the contractor fails to list a particular variance and his submittal is accepted but subsequently it is deemed by the city to be unsatisfactory because of an unlisted variance, the contractor must replace or modify such equipment at once and without additional cost to the City.
6. For any exceptions that are not approved by the City, the contractor shall resubmit the information in complete compliance with the specifications and drawings.

C. Record (As-Built) Drawings

1. Record drawings shall be made on separate clean bond prints of the electrical drawings issued by the City or Architect and shall be reserved for the purpose of showing work as actually installed, including accurately dimensioned locations of all conduit stub-outs and pull boxes, routing of all conduits extending from or between buildings and locations of all telecommunications equipment not installed according to drawings.
2. Drawings shall be kept up to date with neat and legible annotations made thereon daily as work proceeds, showing work as actually installed. Additional sheets may be attached to show greater detail. Drawings shall be available at all times for inspection and shall be kept on the job at a location designated by the City.
3. Contractor at his option may use an additional set of drawings for daily field annotations. This set of drawings shall be kept at the site.
4. Final record drawings shall be submitted with floor numbers, room numbers, panel directories and all other identification necessary to conform to number designations for occupancy rather than to construction numbers. All buried conduit and/or underground conduits stubs intended for future extension shall be accurately shown as to depth and exact measurement from a permanently established landmark, such as building or structural features.
5. On completion, record drawings shall be signed, dated and returned to the City for inspection and approval before acceptance of any work.
6. Provide three (3) sets of drawings to the city, provide a PDF copy and a USB copy for record keeping.

D. Final Submittal

1. Three (3) complete sets of the Final Submittal including a full set of drawings on bond paper shall be delivered to the city's Telecom Project Manager prior to acceptance tests and as a condition for final payment for the project to the contractor. It shall include all the information necessary to maintain each system, and shall consist of the following:
2. Operators Instructions (as applicable).
3. Factory-issued Service Manuals for each piece of equipment installed. The manuals shall contain complete parts lists, detailed schematics, circuit descriptions, maintenance procedures and trouble-shooting methods. In the event such manuals are not available from the factory, it shall be the responsibility of the contractor to compile and submit the required information.
4. A System Manual for each system furnished. This manual shall complement the above service manuals with all necessary additional information unique to the system that is not otherwise provided, such as a list of applicable service manuals, options selected, jumper or strapping choices, modifications, and detailed wiring information. All manuals shall be bound in a 3-ring binder with tabs identifying each system.

E. Record Drawings.

1. Two (2) clean electronic copies of all communications drawing in PDF and/or AutoCAD 2012 or the latest version or format shall be provided. Contractor to confirm with City.

1.6 TELECOMMUNICATIONS ROOM

To complete the installation, testing and cut over of the telephone and other sub-systems in a timely manner, the contractor shall give high priority to completing All of the following as soon as possible and no later than eight (8) weeks prior to the scheduled completion target date. The city's Telecom Project Manager will also require immediate notification of any changes in the target date. Failure to comply with these conditions can and will result in communications systems in-service, and occupancy, delays. That may incur costs to the contractor.

A. Communication Rooms Designations

1. Main Communications Room or Main Distribution Frame (MDF/MDF). This room houses the Telephone system and main data communications equipment. The telecommunication cables from the BEFR, close workstations, and TR's (if necessary), are terminated here. Intrusion Alarm equipment, Power Supplies Panels, CCTV, CATV distribution equipment, etc. are also housed in this room. Locations of the equipment, component, cabinet or panels in the MDF shall be coordinated with the city's Project Manager.
2. The MDF shall be located in the building in such a way that it is accessible from the Staff Area. Additionally, it shall be placed such that no data cabling, when installed and terminated, will exceed the 300-foot limitation or current EIA/TIA Standard.
3. The MDF shall be equipped with furniture to provide a work surface for technical staff. This shall be in the form of a fully supported dropdown work surface. This should be at a height that is comfortable to work at standing. A "bar-type" stool shall be provided for sitting when necessary.
4. The MDF will also be equipped with an 18" deep bookshelf about the work surface. The length may be determined in the field. If the size of the room permits, a desk and chair should be provided in place of the dropdown work surface.

B. Air Conditioning

1. The MDF shall be provided with 24-hour 7-day air conditioning. Under normal operating conditions, a separate duct zone connected to the main building system shall provide COOL AIR ONLY in the MDF. If the main system fails to operate or maintain the required ambient temperature, a standby emergency system shall be automatically activated. Both systems shall be provided and installed with separately controlled thermostats. As an option, stand-alone air conditioning separate from the building's central HVAC system may be provided. The MDF shall NOT be under the control of any building energy conservations systems. A temperature of 65 degrees Fahrenheit and a relative humidity range of 40% to 60% shall be maintained at all times. Heat dissipation for the communication equipment is approximately 25,000 BTU. Before ANY communications equipment can be activated, a live test of the air conditioning system shall be conducted in the presence of the designated staff or his/her designee. NO air conditioning units (HVAC), condensate lines, water heaters, or other types of water lines other than fire sprinklers (with the highest temperature head and pre-action type only) as required by code, may be mounted directly above any MDF unless otherwise approved in writing by the Dept of a Control Systems Engineer.

C. Electrical Requirements

1. Install "twist lock" (L5-30R or L6-30R as required) and QUAD (NEMA 5-20R) power receptacles mounted on the designated locations in the equipment racks. Install QUAD (NEMA 5-20R) electrical outlets in MDF walls. Refer to MDF power layout requirements for further details. Where the receptacle may be required to mount on Cable tray above the racks, the contractor must coordinate with electrical to provide as part of their scope.
2. Intrusion Detection/Alarm System, Fire Alarm Control (Notifier) panel and Fire Alarm Communicator (dialer) panel must be provided with dedicated hard-wired circuits.
3. Power receptacles/outlets shall be on dedicated circuits with isolated ground.

D. Fire Protection

1. Provide a smoke detector and a high temperature sensor at the MDF room. Connect the detector or sensor to the Fire Alarm panel as two different zones. A fire extinguisher of the type recommended to be use for electrical fires shall be installed on the wall adjacent to the Telecommunications Room door where it can be reached without completely entering the room. If the Telecommunications Room is to be equipped with fire protection/sprinkler heads, it shall be of the highest temperature and "Pre-Action" type.

E. Backboards

1. Install fire-retardant, ¾" inch x 8 feet plywood backboards covering all 4 walls of the MDF with the bottom mounted at 12 inches above the floor. Backboards shall be painted off-white. Backboard shall be anchored on the wall and capable of supporting installation of communications equipment/panels. Fire rated labeling Shall not be painted over. Where the backboard fire rating label is painted, It shall be the at the City's discretion to have it be removed and reinstalled and painted correctly at no cost to City.

F. Door Locks

1. Install a door lock mechanism keyed separately from all other doors or in all Telecommunications Rooms. Where access control is provided and approved by the city, provide per access control requirements.

G. Grounding

1. The grounding in MDF shall be a #2/0 AWG insulated ground cable from main building ground and terminate on a ground bus bar (Chatsworth Standard Bus Bar P/N: 10622-010).

H. Lighting

1. Lighting intensity in all Telecommunications Rooms shall be 90-100 foot-candles at 36 inches above finished floor. The bottom of lighting fixtures shall be 9 feet above the finished floor.

I. Flooring

1. Coordinate with Architect and architectural plans to provide Anti-static vinyl flooring, Armstrong Static Dissipative Tile (SDT) Excelon Resilient Tile Flooring, or approved equivalent, in all Telecommunications Rooms. Anti-static vinyl flooring must be grounded to the MTGBB (Main Telecommunications Ground Bus Bar) through a flat copper strap or sheet at least 0.022 inches thick x 2 inches wide.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. All materials and equipment shall be new, unused and manufactured within eighteen months prior to installation. All materials and equipment shall be listed by Underwriters Laboratories.
- B. All materials submitted for approval shall be no more than 3 calendar years in production. The contractor shall submit the latest equivalent part list and equipment as required.

2.2 EQUIVALENT MATERIALS AND EQUIPMENT

- A. Manufacturers' names and model numbers are used herein only as a means of establishing standards of quality and performance. Contractors must provide current equipment and devices that are no more than 3 years in production, where required for a complete functional system. Where the following are not per the latest standards or obsolete. Provide Comparable equipment of standard manufacture and established reputation, which meets the requirements outlined above, to be submitted to the city's IT Telecom Project Manager for approval. Equipment of the following manufacturers may be used if it meets or exceeds parameters of the specified equipment. Submit manufacturer listed as recommendation or Approved Equal as required for consideration and approval.

1. Intrusion Alarm - DMP
2. Door/Window Sensors – DMP
3. Glass Break Sensors – DMP
4. Sirens – DMP
5. Cable – Superior Essex, Belden, West Penn, Berk-Tek, General Cable, or approved equal.
6. Panduit or approved equal.

PART 3 - SYSTEMS

3.1 SYSTEM & AUXILIARY EQUIPMENT PRE-INSTALLATION REQUIREMENTS

- A. Electrical contractor shall install station conduits, riser conduits, cable trays and conduit hardware according to procedures Set by the Ridgecrest City's IT Standards. Contractors must work closely with the city to provide complete and functional systems per the City's requirements.

- B. The MDF shall be constructed according to procedures described under heading Part 1.6. HVAC system in the MDF. The HVAC shall be operational 24 hours, 7 days a week. The heat dissipation of the communications equipment in the MDF is about 25,000 BTU. This value is based on the average size of the animal shelter and should be lower for small animal shelters.
- C. The Communications or Low Voltage contractor shall coordinate all cable installations and/or work with the General Contractor in accordance with the Construction schedule.
- D. The installing contractor shall be responsible for removal and replacement of ceiling tiles to accommodate the telephone/data/security cables installation where ceilings are installed prior to the telecom installation.
- E. Electrical contractors shall coordinate with the communication contractor to install conduits as required for all the systems and the 120V-24VDC transformer for electronic door lock devices locations as necessary.
- F. Low Voltage contractors shall furnish and install Caddy J-Hook Cable Support System to support the voice, data and security cable runs in the ceiling space (4 hangers per 16 square feet) as required by codes. All cable installation shall be completed prior to the installation of the ceiling grid, if possible. The Low Voltage contractor shall be responsible for any damage, physical or cosmetic, to ceiling tiles and grids. The Communications or Low Voltage contractor shall be responsible for coordinating with the General/Electrical contractor regarding the cable pathway in the ceiling space as required.

3.2 BUILDING SYSTEMS

3.2.1 INTRUSION DETECTION AND ALARM

- A. System Description and Installation Requirement
- B. The intent and purpose of this system shall be to provide a security/intrusion detection entry alarm system in the building. All perimeter doors, roof hatches, or other external entry points shall be equipped with dedicated, concealed magnetic contact switches. All perimeter entry/exit point locations with keypads shall have a motion sensor located in the immediate entry/exit area. All perimeter windows shall be protected by glass break sensors. Interior protection shall be provided by combination of passive infrared/microwave detectors located in hallways, corridors, walkways as indicated on the plans.
- C. The alarm siren(s) shall be installed in the plenum above the keypad(s) or as indicated or detailed on the plans. Each alarm device shall report to the City Central Station as a separate point. Use point expander Octopoid module(s) for the point expansion of the alarm panel and a separate enclosure(s) to house the expansion device(s). Install alarm cables home run from each alarm device to the panel. Appropriately sized "end of line" resistors shall be placed at the device end only.
- D. Installation of modules, devices and wiring shall be in accordance with current system design, installation, and engineering standards. Where required, Additional power supplies, batteries, Octopoid's, Octo Relays, Battery Charger and associated cables shall be mounted in additional cabinet(s). Maximum build out per D8103 or enclosure shall be 5 modules and/or two (2) 12Volts - 7AH batteries.

- E. The intrusion alarm cables shall be installed horizontally through the ceiling area in a neat and orderly fashion and supported by approved cable hangers at appropriate intervals. The cables shall be positioned at least six (6) inches from electrical equipment, electrical wiring, telephone cabling, and intercom cabling and data wires. Exposed wiring shall only be permitted above ceiling level or ten (10) feet from floor level. The installation shall comply with the City of Ridgecrest Building Safety and Fire Codes. The contractor shall furnish, at his expense, all permits issued for scope of work. The contractor shall supply copies of all permits acquired.
- F. The system alarm communicator panel shall be provided with the latest version software and associated equipment enclosures to be installed as per approved drawings (Contractor to Submit shop drawings including devices, equipment and wiring diagrams for approval) and for approval of MDF equipment layout. Clearance in front of all alarm panels shall be a minimum of 36 inches. The alarm system shall be programmed by Ridgecrest to report to the Sheriff Central Station. If required, the installation contractor shall be responsible for obtaining an alarm permit from the local law enforcement authority.
- G. The Alarm Communicator panel shall power all peripheral alarm devices for 24 hours of standby time with 5 minutes in alarm condition conforming to NFPA 72 central station requirements in the event of power failure. load calculation, standby battery requirements and standby battery calculations. Standby power on battery back-up should be at least one (1) hour. If required, additional battery charger modules(s) and batteries shall be installed in an enclosure unless the building has generator power. In this case, the power receptacle circuit where the alarm panel is connected should be included on the standby generator power circuit. All power transformers shall be mounted in enclosures.
- H. The intrusion alarm panel shall have a dedicated hard-wired circuit (120V-20A) identified and labeled with panel and branch circuit number at the electrical panel and at the alarm panel.
 - 1. Alarm panels and equipment enclosures shall not be used as pull boxes or raceways.
 - 2. All low voltage cabling or conductors running between panels and enclosures shall be in approved raceways.
 - 3. Plenum-rated, shielded, stranded 18/4, 18/2 cables shall be used and installed for all intrusion alarm systems cabling. Cables lower than 18-gauge shall not be accepted.
 - 4. Plenum-rated, shielded, stranded (minimum of 18 gauge), PVC insulated, 18/4 cable for keypads, glass break sensors and passive infrared/microwave detectors.
 - 5. Plenum-rated, shielded, stranded (minimum of 18 gauge), PVC insulated, 18/2 cable for door contacts/switches.
- I. All intrusion alarm field devices shall be wired normally closed (energized state) and will fault on open.
- J. All intrusion alarm wiring must be appropriately identified with permanent wire markers. Copper conductors shall be used.
- K. The alarm contractor should provide all other cables and/or hardware required to ensure the system is fully functional at an optimum level.

- L. The intrusion alarm panels shall be grounded to the Telecoms Ground Bus Bar in the MDF with a #12AWG (solid) ground wire with green insulation. The ground wire shall be run inside a ½ - inch conduit.
- M. The intrusion alarm panels shall be provided with locks and four (4) sets of keys.
- N. Terminations and connections throughout the system shall employ terminal strips with rising wire clamp screws or solder terminals, all in cabinets, or enclosures. Telephone punch type blocks, and electrical wire nuts are not acceptable. The drain wire/drain shield in the shielded cable shall be properly addressed at both ends, and in most cases not used. In environments where it is used, all drain wire/drain shields shall be grounded. Shields shall be grounded in the alarm communicator panel/enclosure.
- O. The alarm contractor shall be responsible for programming and testing the alarm panel in the local mode. The alarm contractor shall furnish the Telecom Project Manager with the completed programming sheets or an alarm account data sheet document and As-Built (minimum 11"x17") drawings(s) that indicate each device/point location identified to reflect 16-character idle text in programming on not less than 12 font text on floor plan prior to the city's inspection, testing and programming of the alarm panel. The alarm contractor shall submit two (2) sets of As-built drawings to the city's IT Telecoms Project Manager.
- P. The Security zones shall be programmed in accordance to the requirements of Parks and Recreation or city requirements (contractor to verify with city Rep).
- Q. Status shall be configured in all Keypads or as designated by the city IT Project Manager.
 - 1. The alarm contractor shall be an authorized and current direct system dealer with contractor Qualifications. The contractor must provide proof of dealership with the system, as well as verification of prior experience with the Controllers and System design, Detection Systems and possess extensive knowledge of programming system features. The installer must provide proof of training via a valid training certificate prior to any work to be performed. The certificate must have been issued more than six (6) months and less than five (5) years prior to installation date. Proof of dealership must be attached to the contractor quotation.
 - 2. The alarm contractor shall consult with the city Project Manager and/or city's Telecoms Project Manager prior to system implementation.
 - 3. The alarm contractor shall provide hands-on training to city staff at a date and time to be determined by the city Project Manager in the operation of the system. A roster of attendees shall be documented.
- R. Intrusion Alarm System Materials and Equipment (provided where needed per plans) Contractor must submit the latest for approval prior to installation. Some models may not be required listed for reference where used.
 - 1. Digital keypad – DMP - or equivalent
 - 2. Alarm panel – DMP with latest version of software. - or equivalent
 - 3. Passive infrared/microwave 50'x50' wide angle motion detector - DMP or equivalent.
 - 4. Passive infrared/microwave 360-degree detector - DMP or equivalent
 - 5. Glass break sensor – DMP, Honeywell or equivalent.

6. Siren/Speaker – DMP Indoor/Outdoor or equivalent.
7. Magnetic door contact switch, flush mount – Sentrol or equivalent.
8. Magnetic door contact switch, surface mount, non-exposed wiring – Sentrol TW Series or equivalent.
9. Magnetic door contact switch, floor mount (high security) – Sentrol or equivalent
10. Transformer kit enclosure – DMP or equivalent
11. Lock and Key assembly – DMP or equivalent
12. Two (2) - (7Ah-12V) batteries
13. Transformer – DMP or equivalent
14. Keypad back boxes – DMP or equivalent
15. Aux relay – DMP or equivalent
16. OctoPopit eight zone expander – DMP or equivalent
17. OctoRelay – DMP or equivalent
18. Alarm cable – plenum (CMP) rated, PVC insulated, shielded, minimum 18- gauge 4 conductor stranded wire.
 - a. Battery Harness where needed
 - b. DD gLifeSafety Power Supply – FPO150-E1 or equivalent
 - c. EE LifeSafety Power Supply – FPO250-E1 or equivalent

3.2.2 CCTV System Description and Installation Requirement (IP Network)

A. General Requirements

1. The CCTV System shall be capable of integrating into the current City Milestone XProtect Professional Plus 2025 VMS system.
2. The specified unit shall be of manufacturer's official product line, designed for commercial and/or industrial 24/7/365 use.
3. The specified system shall be based upon standard components and proven technology using open and published protocols to meet the city's standards.

B. Sustainability

1. The specified unit shall be manufactured in accordance with ISO 14001.
2. The specified unit shall be compliant with the EU directives 2011/65/EU (RoHS) and 2012/19/EU (WEEE).

3. The specified unit shall be compliant with the EU regulation 1907/2006 (REACH).
4. The manufacturer shall have signed and supported the UN Global Compact initiative as defined by United Nations.

C. QUALITY ASSURANCE

1. The contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity and evidence that is completed at least three (3) projects of similar design and is Currently engaged in the installation and maintenance of systems herein described.
2. All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
3. The contractor or designated sub-contractor shall submit credentials of completed manufacturer certification, verified by a third-party organization, as proof of the knowledge.
4. The specified unit shall be manufactured in accordance with ISO9001.

D. WARRANTY

1. All system components and labor furnished by the contractor including wiring, software, hardware and custom parts, shall be fully warranted for parts, materials, labor and travel expenses for a minimum of three (3) year from the date of the final acceptance of the video surveillance system.
2. The manufacturer shall provide a warranty and optional extended warranty for the camera for a total period of a maximum of five years. If enacted as part of the contract, the contractor will repair or replace parts and/or labor per the warranty for the length of this warranty at no cost to the client.

E. QUALIFICATIONS

1. All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
2. The contractor or designated sub-contractor shall submit credentials of completed manufacturer certification, verified by a third-party organization, as proof of the knowledge.
3. The contractor shall provide four (4) current references from clients with systems of similar scope and complexity that have become operational in the past three (3) years. At least three (3) of the references shall utilize the same system components, in a similar configuration as the proposed system.

F. SOFTWARE UPGRADES

1. The manufacturer shall provide free upgrades to new software releases within the same major version for the lifetime of the version.

2. The software shall be backed by free support for the lifetime of the version.

G. The product shall be IP-based and comply with established network and video standards.

H. The video management system shall support integration with ONVIF Profile S conformant devices as defined by the ONVIF Organization that complies with relevant parts of IEC62676-2-3.

3.2.3 VIDEO SURVAILENCE

A. The unit types listed below describing various resolutions, form-factor and features shall be supplied by a single unit manufacturer video surveillance system.

B. The unit manufacture will be as follows:

1. Outdoor PoE switch shall be AXIS T8504-E or equivalent

3.2.4 VIDEO SURVEILLANCE UNITS

A. Per the city of Ridgecrest latest requirements, the PoE switches to be the latest Arista switches model 722XPM or above series at time of installation for CCTV system or approved equal to meet the city's standards.

1. The switch shall meet or exceed the following design specifications:

- a. Provide options for 10M to 2.5G PoE copper downlink and 25G SFP28 and 10G SFP
- b. Industry standard 802.1Q, VRFs and VXLAN/EVPN segmentation
- c. Cognitive real time Flow Trackers for CloudVision, IPFIX and sFlow
- d. Integrated MACsec encryption on all ports
- e. Cognitive, cloud grade reliability, in service maintenance and upgrades
- f. EOS programmability and cognitive management plane monitoring APIs
- g. Arista EOS cloud grade QoS, security, and reliability required for campus networks.
- h. The cognitive management plane, native in EOS, to provide real time telemetry to capture key performance metrics of infrastructure, device, application and user data for SLA monitoring and troubleshooting.
- i. The switch shall meet its output power support power over ethernet plus 10G/25G:
 - 1) Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 1
 - 2) Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 2
 - 3) Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 3
 - 4) Power over Ethernet Plus IEEE 802.3at Type 2 Class 4

- j. The switch shall support the CCS-722 power supplies.
- 2. Transmission
 - a. The switch shall allow for data to be transported over:
 - 1) HTTP (Unicast)
 - 2) HTTPS (Unicast)
 - 3) RTP (Unicast & Multicast)
 - 4) RTP over RTSP (Unicast)
 - 5) RTP over RTSP over HTTP (Unicast)
 - b. The switch shall support Quality of Service (QoS) to be able to prioritize traffic.
- 3. User Interface
 - a. Web server
 - 1) The switch shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
 - b. IP addresses
 - 1) The switch shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
 - 2) The switch shall provide support for both IPv4 and IPv6.
- 4. Protocol
 - a. The switch shall incorporate support for at least IPv4, IPv6, HTTP, HTTPS, Bonjour, SNMP v1/v2c/v3, DNS, TCP, UDP, IGMP, ICMP, ARP, SSH, RADIUS, TACACS, TELNET, Syslog, 802.1Q (VLAN)
- 5. Security
 - a. The switch shall support IEEE 802.1Q.
 - b. The switch shall provide support for restricting access to pre-defined IP addresses only, so-called IP address filtering.
 - c. The switch shall restrict access to the built-in web server by usernames and passwords.
- 6. Installation and maintenance

- a. The switch shall support the use of SNMP-based management tools according to SNMP v1, 2c & v3.
 - b. The switch shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.
- 7. Diagnostics
 - a. The switch shall be equipped with LEDs, capable of providing visible status information.
- 8. Network Hardware interfaces
 - a. PoE ports
 - 1) The switch shall be equipped with 4 10Base-T/100Base-TX/1000Base-T Fast Ethernet-ports, using standard RJ45 connectors and shall support auto negotiation of network speed and transfer mode (full and half duplex).
 - b. Uplink
 - 1) The network switch shall be equipped with one SFP port.
- 9. Power
 - a. The switch shall be equipped with a port providing connectivity for power.
- 10. Enclosure
 - a. The switch shall:
 - 1) Be manufactured with a rugged aluminum casing.
- 11. Power
 - a. 100 - 240 V AC, 50/60 Hz
- 12. Environmental
 - a. The network switch shall:
 - 1) Operate in a temperature range of -40 °C to 50 °C (-40 °F to 122 °F)
 - 2) Operate in a humidity range of 0-90% RH (non-condensing)

3.2.5 INSTALLATION

CCTV system shall be IP based, CCTV system shall include server with on board storage, VMS software, IP cameras, camera licenses, manufacturer support services, POE data switch, Cat 6 data cabling, and APC UPS. UPS to provide power to the CCTV system for a minimum of one hour in the event of building power loss. Video recording retention shall be for 365 days minimum, 24/7 continuous recording. Recording and live viewing resolution shall be a minimum of 4K resolution for exterior cameras, Quad HD resolution for fixed interior cameras, and 12MP for multi-lens/panoramic view cameras. Cameras shall be recording at a minimum of 15fps. Parks to confirm recording requirements. CCTV cameras shall be the minidome type with the appropriate mounting hardware for the camera location. CCTV system to be connected to the Parks data network for remote viewing and video exporting capabilities (Parks to confirm).

- A. The contractor's or subcontractor's main resources within the project shall carry proper professional certification issued by the manufacturer and verified by a third-party organization to confirm sufficient product and technology knowledge.
- B. The contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.
- C. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
- D. All firmware found in products shall be the latest and most up to date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA) or Network Video Recorder (NVR).
- E. All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.
- F. A proper installation shall meet NEC (National Electrical Code – US only) per the guidelines of that year's revision. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.

3.2.6 UNIFIED SECURITY PLATFORM

A. Acceptable Manufacturers

Provide CCTV by a major manufacturer (Axis IP or approved equal is preferred) or indicate to submit all for review.]

[List acceptable manufacturer/model for Servers, Workstations, Monitors, keyboards, etc. here or submit all for review].

B. General Product Description

1. Video Management System (VMS) including live viewing and archive recording, event/alarm recording and actions based upon events and alarms, full Control Center module for viewing and monitoring, Administration module for configuration and management, video clip or still image export, Quick Control Center module to view exported video clip on computer without full software installation, web client for monitoring live, playback, alarms and export files.
2. VMS shall support viewing and archiving unlimited number of cameras.
3. Software shall support upgrades from the previous major version.

4. Software should accommodate server/workstation or client/server application, depending on the number of cameras connected on centralized or distributed network architecture.
5. The software should support remote monitoring through the Internet, including transcoding image formats and frame-rate conversion to accommodate limited bandwidth network/internet connections.

C. Detailed Product Description

1. Purpose

- a. The software shall accommodate the monitoring of video images on one-to-many computer workstations and shall accommodate recording (archiving) of any or all images at user adjustable frame rates and resolutions.
- b. The software shall support events and alarms.
- c. The software shall facilitate integration with other 3rd party systems including alarm/access control systems, building automation systems, perimeter systems, etc.
- d. The software shall intrinsically accommodate two-way voice communication between the monitoring location and camera locations. Voice communication from the remote encoder shall be archived with video.
- e. The software shall support integration to intelligent video analysis devices.
- f. The software shall facilitate collection, storage and export of material relating to incidents, for external analysis.
- g. The software shall facilitate comprehensive situational awareness by integrating alarms and video in logical groupings related through system hierarchical maps (including both building plans and satellite views of campuses).
- h. The software shall permit "Video Guard Tours" by allowing users to "tour" a facility (or facilities) through sequences of several Layouts with cameras shown cyclically, each for a predefined amount of time, allowing the user to "walk" the facility using the video system.

2. Environment

a. Hardware

1) General Network

- 2) Ethernet Network: The software shall operate within a normal Ethernet IP network environment using Level 2 or Level 3 digital switches, routers, hardware firewalls, etc. for all communications between all digital cameras, encoders, monitor decoders, and the VMS software, including client and server applications.
- 3) All IP network equipment shall be based on the latest technology offered by a major brand name manufacturer (e.g. HP ProCurve, or similar quality)
- 4) The IP network shall support subnetting and Virtual Private Network (VPN) configurations
- 5) The IP network should support multicasting between all ports and shall allow for multicast streams to be routed between networks, subnets and VPNs
- 6) Protocols
- 7) The network shall be based on TCP/IP, UDP/IP, and RTP/IP network protocols
- 8) The network shall support multimedia streaming UDP, Unicast UDP, Unicast TCP, and HTTP
- 9) The network shall support SNMP and DHCP protocols
- 10) Quality of Service (QOS)

b. Operating System

- 1) The software shall operate in an open environment using Microsoft Windows Operating Systems.
- 2) Refer to manufacturer's release notes for supported operating system versions.

c. Databases

- 1) The VMS shall support Microsoft SQL server.

d. Software

- 1) Operating Framework

The software shall be based on Microsoft.NET® framework for both server and client applications.

- 2) Anti-Malware Software

The software shall allow the installation of anti-virus and network security software on the server and client machines.

- 3) Software Architecture

- a) The software shall adhere to multi-tier architecture with different layers for clients, server and database.
- b) The Client Software shall include the following applications:
 - i. Control Center for monitoring and viewing
 - ii. Admin Center for administration
 - iii. Operator screen recording and redisplay
 - iv. Quick Control Center – Self-contained version of Control Center which doesn't require installation and is used primarily as a stand-alone player
 - v. Web client primarily for viewing live and playback recorded video.
- c) Resiliency
 - i. The VMS software system shall be designed and implemented with Resilience as a key architectural principle. The system configuration shall offer optional failover and redundant components for critical systems functions such as the System Directory and the Archiving facilities so that the configuration can be brought to a 'no single point of failure' status.
- d) Backward compatibility
 - i. The system shall allow future versions to be backward compatible with all software updates within a major version.

3. System Attributes

a. Local/Regional/Global Architecture

- 1) The software shall be capable of servicing enterprise systems of any size, either located in a single campus or dispersed over many geographical locations.
- 2) The software shall support systems of all sizes from a single VMS to a global enterprise system, which is supported by multiple VMSs that are monitored globally.
- 3) The client application software shall support the notion of a Global Client. This allows the user to connect to multiple systems from a single application view and to operate them together (e.g. view cameras from different systems on the same screen, or receive and manage alarms from multiple different systems concurrently).
- 4) The administrator application shall support Central User Management for global enterprise systems, comprised of multiple directories, through integration with a single global service of Microsoft Active Directory.

- 5) The software shall support generation of global reports from multiple directories, using the Reporting Tool in the administrator application.

b. Scalability and Modularity

- 1) The VMS software shall comprise modular software services to facilitate scalability and resilience. The following functionality shall be supported:

- a) Directory
- b) Event Distribution Server (EDB)
- c) Archiver
- d) Gateway
- e) Transcoder
- f) Web Server
- g) Application Server
- h) Case management service
- i) Global Admin Server

(The functionality of these modules is described in more detail in Section 3 System Attributes above)

- 2) The VMS server software modules shall be based on the Microsoft .Net platform.

- a) The VMS system shall support the installation of its services on multiple PCs to support a truly distributed architecture and flexibility in allocation of hardware resources:
- b) Services may be installed together or separately
- c) The MS-SQL based databases can be installed on the same machine with the service to which they belong or on a different server

- 3) The VMS software shall support the configuration and deployment of the services above in the following additional roles:

- a) Failover Directory
- b) Failover EDB
- c) Failover Archiver
- d) Redundant Archiver

- 4) The VMS services shall be installed on a server computer or a workstation that complies with the manufacturer's current system specifications. Refer to manufacturer for most recent requirements.
- 5) Multimedia storage:
 - a) The software shall be capable of storing multiple video and audio sources on multiple Archiver servers.
 - b) The VMS shall offer RAID-5 and non-RAID solutions.
 - c) The multimedia storage solution shall be based primarily on internal hard drives and shall support Direct Attached Storage (DAS) systems if internal storage is not enough. The system shall also support Network Attached Storage (NAS) systems and Storage Area Network (SAN) systems.

c. Server software attributes

- 1) Directory Service
 - a) The Directory shall maintain a catalogued database of settings for all the entities in the system (cameras, users, alarms, rules, etc.) using an MS SQL server
 - b) The Directory shall perform the following roles:
 - i. Manage and authorize login and logout requests of clients and services
 - ii. Provide system configuration services
 - iii. Provide system configuration status and events
 - iv. Validate and perform configuration changes
 - v. Provide Alarm and Incident Management services
 - vi. Communicate with the Active Directory when this option is enabled in the VMS software
 - c) The Directory service shall support 10,000 cameras and 150 concurrent connections on a single directory provided physical machine with the following hardware specifications:
 - i. 2x AMD Epyc 9355 or better
 - ii. Minimum of 128GB DDR5 RAM
 - iii. Minimum of 128GB NVME
 - iv. 2 x 25Gbps network card
 - v. Minimum 12 drive bays for video retention

- d) The VMS architecture shall not rely on the Directory as a single point of failure with respect to video and audio monitoring. Logged-in users shall not be interrupted in viewing live and archived video, even in the event of Directory server failure or disconnection.
 - e) The VMS software shall support multiple Failover Directory service modules per system for improved system resiliency
 - f) Each Failover Directory shall regularly synchronize its database with the primary Directory database
 - g) The Failover Directory shall become active and act as a primary directory in the event of losing connectivity with the Primary Directory
 - h) The Failover Directory shall revert back to passive mode upon resuming connectivity with the Primary Directory
 - i) Failover functionality shall include a priority numbering mechanism to determine priority of each failover system
- 2) Event Distribution Service (EDB)
- a) The EDB service shall perform rule-based distribution of events and action
 - b) The EDB service shall redirect specific events and actions only to registered services and client applications rather than broadcasting them, in order to minimize network traffic
 - c) EDB service shall have the capability of recording events into an MS SQL database audit trail
 - d) The VMS software shall support multiple Failover EDB service modules per system for improved system resiliency
- 3) Archiver Service
- a) The VMS software shall not limit the number of Archiver servers in the system. This allows the installation of multiple instances of the Archiver service on different computer servers, which enables distributed architecture in diverse network topologies.
 - b) The Archiver shall manage and operate edge devices, such as IP cameras, video encoders, video decoders, audio devices, PTZ cameras, CCTV keyboards, and any other types of edge devices that the VMS controls

- c) The Archiver shall provide discovery services of edge devices, which simplifies the addition of new edge devices to the VMS
- d) The Archiver shall perform configuration and monitoring of the edge devices
- e) The Archiver shall support recording of video, audio, and related metadata
- f) The Archiver shall be capable of executing any recording task, including schedule, manual, alarm, motion- or event-based recording
- g) The Archiver shall support independent recording settings for each video or audio stream
- h) The Archiver software shall be capable of recording unlimited concurrent video streams from IP cameras and video encoders
- i) The Archiver's software recording technology shall prevent file fragmentation while writing to the multimedia storage
- j) The Archiver shall be capable of recording either stream of a dual-stream camera, according to user and system settings
- k) The Archiver shall support digital signature for recorded data in real-time
- l) The digital signature shall be based on SHA1 based hash function and 1024-bit RSA encryption key
- m) The Archiver shall support playback of recorded video, audio and related metadata
- n) The Archiver shall use only the native data generated by the encoding device and shall not transcode, re-encode, or otherwise destroy the media before saving to the associated hard drives for storage
- o) The Archiver shall support motion detection
- p) The Archiver shall provide edge device command and control services, including:
 - i. Commanding PTZ domes
 - ii. Operating CCTV keyboards
 - iii. Activating relay switches and output pins
 - iv. Serial communications via edge device serial ports
 - v. Notifications and status changes from edge devices, including input pins, video, and audio inputs, etc.

- q) The Archiver shall manage and transmit camera sequences
 - r) The Archiver shall support Proxy functionality, redirect video and audio to client applications or audio and video decoders as required, in all unicast and multicast topologies
 - s) The Archiver shall provide metadata services including:
 - i. Tagging and Bookmarks to describe recorded footage with text
 - ii. Motion information on recorded video
 - iii. Recording time stamps and Recording triggers
 - t) The Archiver shall provide query services for search of multimedia recordings and metadata
 - u) The Archiver shall manage and display alarms-related video in Control Center
- 4) Failover Archiver capability
- a) The VMS software shall provide the option of configuring every Archiver as a Failover Archiver (FOA). Each Archiver can serve as a primary Archiver and as a Failover Archiver or provide both functions concurrently.
 - b) The FOA shall take over units from a primary Archiver service in the event of the primary Archiver failure. The FOA shall assume all responsibilities of the primary Archiver regarding the Failover devices, including management, recording, playback, sequences, etc.
 - c) The FOA shall take over units only from primary Archivers in the same Failover group, as defined by the user
 - d) The FOA shall perform prioritized Failover based on the following conditions:
 - i. The unit's (edge device's) Failover priority, as defined by the administrator
 - ii. The Archiver's Failover priority, as defined by the administrator
 - iii. The Failover Archiver's available capacity
 - e) The VMS shall support any number of Primary and Failover Archiver servers. The VMS software shall support configuring an Archiver service as a Redundant Archiver, to provide users with one or more additional copies of the recorded footage, for data security purposes.

- f) It shall be possible to configure redundant recording on a Primary or Failover Archiver
 - g) It shall be possible to select any edge device (unit) from any Primary Archiver to be recorded on any Redundant Archiver in the system, as long as there is multicast connectivity between the edge device and the Redundant Archiver
 - h) The Redundant Archiver shall support the same or a different retention period than the Primary Archiver for each scene it records
 - i) In a Unicast environment an archiver failover shall result in no more than 2 minutes recording gap.
 - j) In a multicast configuration the system shall continue monitoring live video, un-interrupted, during the process of an Archiver failover. In the event that an Archiver is unable to respond, and requires failover to another Archiver, the users will not lose live video monitoring from of cameras that are currently being viewed.
- 5) Gateway Service
- a) The VMS software shall support a Gateway Server that shall allow users to connect and operate the VMS from remote locations, over the Internet, over firewalls, VPNs, and proxies
 - b) The Gateway Server shall mediate between incoming client requests to the VMS servers, thus allowing remote connectivity even when the VMS servers are not exposed to incoming traffic. The Gateway Server shall have only one TCP port exposed to external connections.
- 6) Transcoder Service
- a) The Transcoder Server shall allow clients to view good quality video streams from remote locations, over the Internet or limited bandwidth connections, over firewalls, VPNs, and proxies
 - b) The Transcoder Server shall transcode any video stream to MJPEG/MPEG4/H.264 stream in order to overcome the video compression issues related to limited bandwidth connections
 - c) The Transcoder Server shall support all incoming videos including live, archive, video sequences, and video on alarm
 - d) The Transcoder Server shall provide video services via only TCP port, thus masking the video servers, encoder and cameras from direct connections coming from clients on external networks

- e) The Transcoder Server shall provide remote users full functionality in a transparent way. The remote user will use the system normally, despite the fact that video streaming goes through the Transcoder.

7) Case management service

The VMS shall support a secure incident and/or evidence container that maintains Chain of Custody, allowing clips of recorded material, snapshots, information about alarms and other events, together with related externally-sourced material (documents, etc), to be securely packaged, stored and accessible for viewing and/or exporting, for later presentation as evidence.

d. Security

1) Password Security

The system shall allow defining user password policy, including minimum length, minimum number of letter and numbers.

2) Active Directory

The system shall be capable of integrating to Active Directory and sync users and users groups with AD.

3) Web Client Security

The system shall allow setting TLS certificate to be used for the web client application

4) Edge Device Security

Edge device security refers to securing the control channel between the archiver and edge devices, using Transport Layer Security (TLS) protocol.

- a) The system shall allow setup of policy to use secured connection with edge devices when connecting new units
- b) The system shall define whether to block edge devices with unsecured connection
- c) The system shall define whether to block edge devices with untrusted certificates

4. Functions

a. Video Display and Recording Functions

1) General

- a) The VMS shall support live viewing (monitoring), concurrent recording, viewing of previously and concurrently recorded video and management of an unlimited number of video sources.
 - b) The VMS software shall have the ability to receive video from IP cameras or any other video source connected to video encoders, as well as from Android-based and IOS handheld devices capable of video transmission.
 - c) The software shall support PAL and NTSC signals.
- 2) Encoding and Decoding
- a) The software shall support MPEG-4, MJPEG, H.264 and H.265 video formats.
 - b) The software shall sustain full operation using any resolution supported by approved edge devices, including but not limited to CIF, 2CIF, 4CIF, VGA and a range of HD and Megapixel resolutions including 720p, 1080p, 3MP, 5MP, 10MP and 4K.
 - c) The software shall support display and recording of frame rates from one frame per second (fps) to 30 fps.
 - d) The software shall support edge devices from multiple manufacturers including Axis, DVTel Legacy, IQeye, Mobotix, Pelco, Panasonic, Sony, Verint, and ONVIF-conformant devices.
 - e) The software shall support both IP cameras, encoders and Android-based and IOS handheld devices capable of video transmission.
 - f) The system shall be flexible supporting different configuration selections per video source, as supported by the edge devices, including, but not limited to:
 - i. Video format
 - ii. Bit rate
 - iii. Compression and quality
 - iv. Resolution
 - v. Frame rate
 - g) Dual-Streaming: The software shall support edge devices capable of transmitting multiple streams. The software shall support independent settings per stream including:
 - i. Independent resolution
 - ii. Independent frame rate

- iii. User may use one stream for live monitoring and the second stream for recording, or use just one of the streams for both live monitoring and recording
- iv. The software shall allow the administrator to split a dual-stream camera (from certain types of edge devices) into two separate, independent scenes, thus:
 - Allowing the configuration of each scene with different video quality schedules, for example one scene with high quality and the other scene with low quality
 - Providing the option to view live any of the scenes or both concurrently
 - Providing the option to record any of the scenes or both concurrently with different retention settings

3) Adaptive Streaming

- a) The VMS shall support a method of rationalizing bandwidth usage.
- b) The Adaptive Streaming component shall choose the most suitable stream to display on the client monitor according to the size of the current viewing tile. The component shall maximize the number of pixels that can be displayed in the tile according to the tile size and the maximum displayable resolution of the monitor.
- c) Adaptive Streaming shall improve the following functionality:
- d) Reduce bandwidth consumption
- e) Increase number of viewable video streams
- f) Reduce system resource load on client machine and Transcoder server
- g) The Adaptive Streaming mechanism shall react to the following user actions:
 - i. Dragging the video to a different sized tile or changing the layout
 - ii. Maximizing the tile size
 - iii. Using digital zoom
- h) The system shall use all available streams from the camera, based on its capabilities.

- i) In the case where a user is viewing MJPEG video via the Web or Mobile client, the Adaptive Streaming functionality shall be handled by the Transcoder service. The Transcoder itself shall request the most appropriate stream from the cameras in order to meet the requested resolution.
- 4) Recording
- a) Recording shall be available in any format, resolution, and quality supported by the system.
 - b) The recording of video and audio shall be performed by the Archiver service.
 - c) The Archiver shall support a total recording capacity of up to 500 cameras at 1Mbps each, all recording simultaneously at 30fps NTSC/25fps PAL and 4CIF video resolution on a single server.
 - d) The Archiver multimedia storage system shall be based on advanced recording methods that prevent disk fragmentation to maintain a constant writing performance over time.
 - e) The system shall deter unauthorized deletion of media from outside sources, have the ability to provide physical annunciation as required, and warn administration when such deletion is attempted in the form, including, but not limited to:
 - i. Text message
 - ii. Email message
 - iii. Event/Alarm Pop Up
 - f) The software shall facilitate Distributed, Redundant, and/or Failover recording as optional features.
 - g) The software shall support multiple recording triggers: manual, schedule, motion-based, alarm-based, and event-based. The software shall save the recording reasons as part of the video clip's metadata.
 - h) The software shall support Pre- and Post-Recording for alarm and for motion-based recording.
 - i) The software shall allow for easy control of recording retention period (how long clips remain archived before being overwritten).
 - i. The software shall support the configuration of different retention period rules for each camera

- ii. The software shall support the configuration of different retention period rules for different recording triggers (for example, alarm clips shall be retained for one month while other clips shall be retained for one week)
 - j) The software allow configuration of recording schedules which can be set individually per camera (audio recording schedule shall be derived from the camera).
 - k) The software shall support recording of either the live stream or the recorded stream when using edge devices that support dual streams.
- 5) Smooth Reverse Playback
- a) The VMS shall support smooth reverse playback, with the ability to display all video frames and not only the key frames.
 - b) Online video playback shall be performed in TCP/IP transport method by default.
 - c) The software shall allow configuration of the transport method for playback to be either TCP or UDP.
- 6) 360° Cameras
- a) The VMS shall support 360° panomorph-enabled edge devices.
 - b) The VMS shall support edge-side dewarped cameras.
 - c) The VMS shall be able to present each view independently and control its video settings
 - d) The VMS shall support client-side dewarping allowing the user to zoom in and view all aspects of panoramic area.
- 7) Handheld Device-Based Video
- a) The VMS shall support receiving real-time video streams from Android-based and iOS handheld devices.
 - b) The VMS shall handle the handheld-device based video similar to handling IP camera video, and provide similar functionality including, but not limited to, the ability to record it, bookmark it, display live video and playback from archive, as well as export the video.
 - c) The VMS shall support receiving the handheld-device based video over WiFi, 3G, 4G and LTE connections.

- d) The VMS shall support receiving the handheld-device based video in MJPEG or H.264 compressions, in various resolutions and frame rates.
 - e) The VMS shall support receiving a GIS location of the handheld-device and to be able to display its location over a GIS map.
 - f) The VMS shall allow the handheld device application user to freely connect and disconnect from the system using his user credentials, freely start and stop streaming video to the VMS, and use the handheld device to tag video clips that were recorded by the VMS.
 - g) The VMS shall allow many handheld devices to connect concurrently to the system.
 - h) The VMS shall allow multiple users to connect using the same physical handheld device, while creating a separate scene (logical camera entity) for each user on each device.
 - i) The VMS shall allow operators to easily search for recorded video from handheld-devices, according to any combination of the following parameters: username, device name, device id, date-time, and bookmark text tagging.
- 8) Video Export
- a) The software shall support the ability to export video and audio clips for investigative, prosecutorial, management, and training purposes.
 - b) The software shall support exporting the native format of video or audio recordings to tamper-proof files protected with SHA1-based digital signature and with 1024-bit RSA encryption, in order to comply with court of law evidentiary requirements.
 - c) The software shall support the ability to play exported, native format clips on a standard computer using a stand-alone player that shall verify the authenticity of the clips and indicate the verification results. The player shall run on any workstation and comply with the VMS standalone player requirements, with no need to install any software.
 - d) The VMS software shall also provide file export functionality for export of single frames of video (snapshot) in JPEG, PNG or BMP file formats. Exported JPEG and BMP files shall comply with standard image viewing software tools based on Windows OS.

- e) The software shall support export of video clips in MP4 and AVI file format, audio in WAV file format, and interleaved audio and video in AVI file format. Exported AVI or WAV files shall comply with standard audio and video playing software tools based on Windows OS.
 - f) Export shall be available from the Control Center and the Web Client applications.
 - g) The VMS software shall provide a Control Center function for advanced export management, supporting multiple concurrent exports from multiple cameras, and including the option to burn the exported clips on a DVD with the stand-alone player and an "autorun" file.
 - h) Export shall be supported within a module that builds collections of case material, allowing export of the case content to an offline storage location.
- 9) Mass Export
- a) The Mass Export feature shall allow users to export a large amount of data in the most efficient manner when backing up files from the Archiver storage directly to a different hard drive. The target hard drive shall be a local drive, an external drive, direct attached storage, Network Attached Storage (NAS), or Storage Area Network (SAN).
 - b) Mass Export jobs shall be executed on demand.
 - c) Mass Export jobs shall be processed by the Archiver Service.
 - d) Mass Export shall support copying the data directly from the Archiver to an external storage device, such as a USB hard drive, DAS, NAS, or SAN device
 - e) Mass Export shall arrange the exported footage in folders according to the recording source (camera or audio input) and name the exported clips with timestamps of the recording start times and end times
 - f) It shall be possible to open mass exported folders or files with the stand-alone player application and playback the footage offline
 - g) Users shall be able to configure each Mass Export job to be performed in one of two modes:
 - i. Normal Mode: The archiver shall perform the export while continuing to perform all other tasks, including recording and playback
 - ii. Emergency Mode: The archiver shall stop recording for the duration of the Mass Export

- h) The Mass Export data should be digitally signed the same way as regular export.
- 10) Web Client Video streaming
 - a) The web client shall stream live and recording video in MJPEG and H.264 format.
 - b) The web client shall use native html and shall not require Active X, or any other plug-in such as Adobe Flash Player, for displaying video.
- 11) Web Publishing
 - a) The VMS shall allow the administrator to easily publish live video to external systems, public web sites, web applications, or any 3rd party system that can receive video streams from standard streaming servers such as Microsoft Media Gateway or VLC.
 - b) The administrator shall be able to publish any set of cameras from the VMS by using the Transcoder server and by installing a common video streaming solution, such as VLC or Windows Media Encoder, which provides access to the video via URLs.
 - c) The Transcoder shall be able to individually or simultaneously serve (a) VMS clients with low bandwidth by using MJPEG streaming, and (b) non-VMS clients by using a standard streaming solution.
- 12) Live Viewing with TCP Streaming
 - a) The VMS shall support Live viewing with Unicast TCP on cameras that support this mode. The Unicast TCP allows the system to resend blocks that were lost or interrupted on the network, resulting in better-quality and smoother video viewing of live content.
- b. Other Monitoring Functions
 - 1) Events

Event Definition: An Event signifies a change of condition in the system.

 - a) The VMS software shall support intelligent, rule-based event communications. The EDB service shall distribute events only to subscribed services and client applications.
 - b) The VMS software shall listen for events from edge devices and distribute them in the system as needed. As a minimum, the following types of events shall be supported:

- i. Dry contact/Input pin events
 - ii. Motion detection events
 - iii. Video and audio signal lost/recovered events
 - iv. Unit status events
- c) The software shall be able to distinguish each possible event generated by the edge device, including but not limited to:
 - i. Each Area of Interest Motion on/off
 - ii. Each dry alarm contact state normal/abnormal
 - iii. Each analytic configured event normal/abnormal
- d) The software shall be able to take an action upon the occurrence of the event, according to the defined configuration of the action.
- e) The software shall produce software events and distribute them in the system as needed. As a minimum, the following types of events shall be supported:
 - i. Login/Logout events
 - ii. Server status events
 - iii. Server Activity events (Recording, Clip Locking, Discovery, Motion Detection)
 - iv. Client Activity events (PTZ, camera software switching, export, configuration)
 - v. Alarm situations
 - vi. Bookmark and Incident events
 - vii. Storage status events
 - viii. Server and edge device availability events
 - ix. Video Analytic events (such as intrusion, trip wire detection, object removed, loitering, etc.)
 - x. Radiometric events

2) Actions

Action Definition: An action is a function that the system can be configured to perform automatically in response to an event.

- a) The software shall support the configuration of automatic actions.
- b) The software shall provide means for the user to link specific actions to specific events, such that occurrences of the event will trigger the automatic execution of the action.
- c) The software shall support the following actions as a minimum:
 - i. Create an Incident
 - ii. Trigger an alarm
 - iii. Switch video, audio, camera sequence, layout, or a map onto a user client workstation
 - iv. Change Relay/Out-pin state

- v. Go to PTZ preset
- vi. Run PTZ pattern
- vii. Change recording settings
- viii. Start or stop recording
- ix. Send an email
- x. Execute external actions as defined in the system by SDK or other integration tools
- xi. Clear camera analytics

- d) The software shall support time triggered actions, where an action can be fired either as a single time occurrence or periodically; daily, weekly or monthly. As an example, the user can create a daily timer to change output pin that controls lights by end of workday.

3) Alarms

Alarm Definition: An alarm is a critical condition requiring personnel attention in response to an action by an edge device, by the system, or by a human operator.

- a) The VMS software shall provide alarm management capabilities.
- b) The software shall support the creation and configuration of an unlimited number of alarm types.
- c) The alarm management shall be able to set any monitor to automatically display cameras in response to alarm inputs.
- d) Alarm video may be displayed on dedicated monitors or may temporarily replace video that is otherwise being viewed until the alarm condition is accepted (acknowledged) or cleared (reset).
- e) Alarms shall be triggered manually by users or automatically as a response to an event according to the administrator's definitions or video analytics.
- f) Alarms may be configured to be automatically cleared after a certain duration.
- g) Alarm instances can be configured to be deleted from the database after a certain time interval.
- h) Alarms shall be configured to display video content (including live and archived footage) and audio content (when linked to video) to the recipient users.
 - i. The alarm management shall automatically clear alarmed video and other alarm content once the alarm is cleared and shall restore previous content.

- ii. The software shall provide methods to display multiple alarms (each with multiple videos) on any number of monitors.
 - i) The user shall be able to snooze, forward alarms to other users, and clear alarms.
 - j) Alarms shall be configured to trigger recording of video and audio with pre-alarm and post-alarm periods, if defined.
 - k) Alarm recording shall be marked with automatic bookmarks.
 - l) Recorded alarm clips shall be searchable by searching for alarm history, recording reason, or bookmarked text.
 - m) The VMS software alarm management shall maintain a history of alarms in an MS-SQL database.
 - n) The VMS software shall support searching the alarm history database by different search criteria, such as priority, user who cleared, etc.
- 4) Advanced Alarm Management

The VMS shall support Advanced Alarm Management including:

- a) Color coding alarms
- b) Alarm life-cycle: Alarm status instances shall include Triggered, Accepted, Snoozed, Forwarded and Cleared
- c) The VMS shall highlight the cameras which are part of the alarm when the alarm is triggered
- d) The VMS shall support the simultaneous display of multiple cameras associated with an alarm. Cameras shall be spread on available tiles armed for an alarm.
- e) The VMS shall allow alarms to be displayed on maps with color-coding based on alarm status. The software shall allow multiple maps with alarm zones to be created.
- f) Alarm feature shall support the following display modes:
 - i. Block mode: All scenes associated with an alarm type will be shown, in sequence, in one available tile.

- ii. Salvo mode: All scenes associated with an alarm shall be displayed in available tiles. If there are more scenes than available tiles, the remaining scenes shall be displayed before displaying the next alarm. Multiple alarms shall be displayed in cyclic mode on available tiles according to priority. Alarm Procedures shall be displayable with their associated alarms.
- iii. Flat mode: The scenes associated with an alarm are displayed simultaneously on the available 'Armed for Alarms' tiles. If there are not sufficient 'Armed for Alarms' tiles for the scenes of a particular alarm, only as many scenes as possible will be displayed. When one alarm is cleared, the scenes from the next alarm will be displayed by priority.

5) Motion Detection

- a) The VMS software shall support motion detection in the following modes:
 - i. Edge device (hardware)-based motion detection: Where the detection is performed by the edge device on full view or zones (Regions of Interest)
 - ii. Server-based: Where the detection is performed by the server for streams sent to a server from an edge device
- b) The software shall support the configuration of motion detection profiles, allowing the definition of sensitivity and threshold for Motion-on and Motion-off events.
- c) The software shall record and display motion indication values, allowing display of the motion level as histograms on the timeline of the recorded video.
- d) The software shall support motion smart search, allowing the user to define a Region of Interest to query the system for all the motion incidents that have occurred in that region during a certain time period.

6) Video Analytics

- a) The VMS software shall support three major methods of Video Analytics:
 - i. Full Edge-based (IOImage): The Video Analytics extraction shall be done and processed entirely at an edge device, such as an analytics-enabled video camera or encoder.
 - ii. Proxy Server-based: The Video Analytics extraction shall be done on a proxy server and processed on a central server.

- b) The software shall provide access to Video Analytics edge devices and/or proxy server(s) and shall be integrated for alarm management. Video Analytics shall be an available optional item.
 - i. The software shall not limit the number of analytic algorithms that can be applied per camera
 - ii. The software shall provide architecture that increases the number of algorithm options per camera and reduce the number of servers required to perform these analytics
- c) Analytics supported by the above and used with VMS typically include:
 - i. Video Motion Detection (VMD)
 - ii. Intrusion Detection, which include multiple trip-wire detection rules and multiple video detection zones,
 - iii. Unattended object, and stopped vehicle detection
 - iv. Video Analytics for people and vehicle counting
 - v. Video Analytics for crowd detection (crowd is defined by percentage of area covered)
 - vi. Video Analytics Object Removal detection
 - vii. Video Analytics PTZ Camera Control – PTZ camera control for automatic object/person tracking
 - viii. Video Analytics over PTZ camera presets
- d) The software shall support analytics over SD resolution as well as HD resolution.
- e) The software shall provide an ability to search large amounts of data quickly for relevant images (for example, Smart Search).
- f) Analytic encoder binding – the VMS shall support binding of analytic-enabled encoders such as IOI TRK-101 or TRK-101-P with suitable cameras such as Quasar or Ariel line cameras to enable encoder functionality that provides Video Analytics on the camera scene, or allows PTZ tracking of moving objects.
- g) The system shall support PTZ tracking for supported cameras when connected to an intelligent encoder such as a TRK-101-P PTZ Tracker.
- h) The system shall support Arm/Disarm of analytic cameras/encoders either manually or by schedule

5. Client software

- a. The VMS shall provide client applications for the following needs:
 - 1) Control Center – Viewing and monitoring application

- 2) Admin Center – System Administration and Configuration application
 - 3) Quick Control Center – Self-contained version of Control Center which doesn't require installation and is used primarily as a stand-alone player
 - 4) Web client used for viewing live, playback, alarms and export recorded video
 - 5) Operator Monitoring – An agent software that shall enable monitoring and recording the PC screen in the VMS
- b. The VMS client application shall communicate with the VMS server-side and handle the user requests without interfering with the background tasks of any of the VMS services, or impacting its ongoing operation
 - c. The VMS client applications that connect and communicate with the VMS server-side shall require the user to authenticate via the Login dialog box by providing username and password
 - d. The VMS client application shall provide multi-language support
 - e. The VMS client applications shall utilize GUI skinning technologies

1) Admin Center Client

All administrative functions shall be accessible through an Administration Client,

Administrative functions shall include:

- a) Setup and Configuration
 - b) User Management
 - c) Edge Device Configuration
 - d) General Configuration Tasks
 - e) General System Management Tasks
 - f) Audit Trail and Reporting
 - g) Metadata
 - h) Preparation of Case Material
- 2) Setup and Configuration:
 - a) Initial Configuration Wizard: The software shall provide setup wizards in order to simplify the deployment process. It shall walk the user through basic steps, such as time-zone, network settings, etc.

- b) Status Dashboard: The AC shall have a dashboard displaying a live and interactive summary of the VMS status. It shall include:
 - i. Camera status (online, recording)
 - ii. Storage status
 - iii. Database status summary
 - iv. Recorded stream quality
 - v. License information
 - vi. Logged in user information (name, application, IP/Hostname)
 - vii. Logged in user information shall include the ability for an authorized user to logout other users, from the AC dashboard.
- c) Administrator User Interface: The AC shall offer the administrator a task-oriented user interface for ease of use. The AC shall provide means for the user to quickly navigate to perform the most common tasks of system administration.
- d) Licensing: The AC shall provide a licensing interface to help the user install and review the system licenses and the license usage statistics.
 - i. Licensing must be associated with the system globally
 - ii. License for User connections must not be locked to a specific machine
 - iii. Integrations, add-ons, and options must be applied on a per-system basis and not be tied to a specific machine, which would require multiple licenses per-system

3) User Management

The AC shall provide a means for User Management, including:

- a) Management of users and user groups
- b) Management of both camera access rights and privileges
- c) Rights and Privileges may be assigned to individual users or to groups of users (individual users sharing common rights and privileges, thus a "Group")
- d) Management of passwords, including password policies
- e) Management of privileges and camera access right settings for groups and individual users:
 - i. The AC shall provide a simple user interface to create User Groups and assigning privileges to them

- f) Active Directory®: The AC shall support user management using optional integration with Microsoft Active Directory.
 - i. It shall be possible to import groups and users from Active Directory
 - ii. The VMS software shall communicate with Active Directory to verify and authenticate users
 - iii. The software shall support unified login with the user PC login using the Windows credentials
 - g) It shall be possible for a user to force logout a user (if authorized to do so).
- 4) Edge Device Configuration
- a) Utility Discovery Tool
 - b) The system shall include a Utility Discovery Tool to identify and set up the VMS supplier's proprietary edge devices
 - c) The system shall provide a discovery interface to initiate a broadcast discovery for edge devices that are connected to the local area network. Once discovered, the user shall be able to assign edge devices to an Archiver.
 - d) Replacing Devices: The AC shall support replacing a device when the device is malfunctioning. In such cases, the software shall store the camera settings and allow access to its recorded data, even after replacement with a new device.
 - e) Compound Scenes: The AC shall support the notion of Scenes to separate between logical configurations of cameras and the physical configuration of the unit. The AC shall support creation and management of simple scenes, such as cameras and microphones, as well as compound scenes, such as a camera with microphone, or a stitched scene containing video from multiple cameras.
 - f) Profiles: The AC shall allow the user to create and manage configuration Profiles, in order to reduce the configuration work by assigning one profile to multiple entities
 - g) Batch Operations: The AC shall support Batch Operations, thus allowing the administrator to perform certain configuration tasks (remove or move) concurrently on multiple entities

- h) Copy Configuration: The AC shall support a Copy Configuration feature to ease configuration by copying and applying configuration settings from one camera to other cameras

5) Edge Device Security

The system shall support secured connection between selected or all cameras and archivers, using Transport Layer Security (TLS) for control information (as a minimum):

- a) The system shall indicate which cameras are securely connected.
- b) The system shall allow changing the security mode for groups of cameras/edge devices, and allow switching between secured and unsecured mode.
- c) The system shall support generation of self-signed-certificate for groups of cameras, supported with ONVIF API.
- d) The system shall include the capability to bulk-change camera passwords (on camera side) (i.e. from the system, force changing passwords for all cameras, or all cameras of a particular supplier/model range)

6) General Configuration Tasks

The AC shall provide a means for the following additional configuration tasks:

- a) Mail server settings
- b) Storage setup (size allocation in the partition level)
- c) Recording lifespan
- d) Schedules and coverage
- e) Alarms
- f) Event-triggered actions
- g) Software services

7) Audit Trail

- a) The VMS software shall support the recording of all Events, Actions, and Alarms into an Audit Trail database
- b) The VMS shall automatically audit all events in the system
- c) The Audit Trail Database shall be based on MS SQL

8) Reporting

The VMS shall provide a reporting utility to allow authorized users to generate reports.

- a) Reports shall be filtered by time, date, types, and free text
- b) Reports shall be viewable on the AC screen as well as exported and printed as common file formats, such as PDF and RTF, Word® or Excel®
- c) As a minimum, the following reports shall be supported:
 - i. User Logon Report
 - ii. Alarm Report
 - iii. Equipment Failure Report
 - iv. Server Monitoring Report
 - v. User Activity Report
 - vi. External Events Report

9) Administering Failover Resources

- a) The Admin Center application shall support the configuration and deployment of the services in the following additional roles:
 - i. Failover Directory
 - ii. Failover EDB
 - iii. Failover Archiver
 - iv. Redundant Archiver
- b) The software shall support multiple Failover directory servers for uninterrupted user logins and other directory functions
- c) The distributed and resilient architecture shall support uninterrupted viewing of live and archived video for logged-in users, even in the event of directory server failure or disconnection, and even if a Failover directory is not configured in the system
- d) The software shall support multiple Failover EDB servers for uninterrupted event and action distribution in case the primary (default) EDB is not available
- e) The software shall support multiple Failover Archiver (FOA) servers to ensure that archiving tasks can continue in the event of a primary Archiver failing to provide its services
- f) The software shall support FOA groups to allow the administrator to set specific relationships between primary and Failover Archivers

- g) Each Archiver can be defined both as a primary and as a Failover Archiver, allowing it to use its extra resources to backup other Archivers
- h) Each Failover Archiver shall have a priority
- i) Each Unit shall have a Failover priority
- j) The software shall support automatic recovery from all the Failover scenarios (Directory, EDB and Archiver) and fallback to the primary server when possible

b. Control Center Client

- 1. All functions required by operators for monitoring and utilizing the system's surveillance functions and responding to real-time situations shall be provided by a fully-featured client application
- 2. Each instance of the CC shall support the option to connect up to four monitors
- 3. The CC shall provide the user with an interface to control the display. The User shall be able to define how many monitors CC will be opened and which one will be used as primary.
- 4. It shall be possible to operate the CC application using the PC mouse, the PC keyboard, a CCTV keyboard, a gaming joystick, or any combination thereof.
- 5. The CC Client shall provide the operator with a task-oriented user interface for ease of use and to assist with efficient management of different tasks.
- 6. The CC shall support Full Screen mode for video viewing, allowing hiding or minimizing all other GUI components in order to maximize the video display 'real-estate'
- 7. The CC GUI shall be flexible and customizable. The user shall have different ways to organize the GUI on all the monitors available on that CC instance and create application layouts to match different needs.
- 8. The user shall support the option to maintain, or not maintain, video aspect ratio per tile or for the entire CC, allowing the user to stretch video to fit the entire tile
- 9. The CC Client shall be able to connect to up to 45 sites with a maximum of 10,000 cameras in total.
- 10. Each CC Client instance shall have the power to decode and display 32 concurrent 4CIF H.264 video streams, each at 30fps, with a bit rate of 1Mbps each when using a workstation that complies with the relevant recommendations of the VMS specifications

c. Control Center Viewing Options

The CC Client shall provide the following viewing options:

1) Live/Archived simultaneous viewing

- a) The CC shall support live monitoring and playback of archived video and audio simultaneously, side-by-side, on any of the tiles on its screens
- b) The CC shall support live or archive video monitoring from any edge device supported by the VMS, regardless of the video compression method, the configured video profile, or the communication method.

2) Navigation Tree Pane

The Navigation Tree pane shall include the following capabilities:

- a) Representation for cameras, camera sequences, tile layouts, and maps
- b) Display a hierarchy of sites and system resources to which the user has access rights
- c) Present a hierarchical logical view, displaying the system resources (cameras, tile layouts, etc.). Cameras and other system resources may appear under sites if defined.
- d) Display all logical entity types, including but not limited to cameras, camera sequences, audio devices, users, Control Centers and their monitors, input pins, output pins, PTZ cameras, stitched scenes, layouts, maps, and external entities defined by third party plug-ins or SDK integrations.
- e) Allow the user to filter the view by entity type
- f) Allow the user to search and highlight or filter the tree by text

3) Viewing Pane (one per screen)

The Viewing Pane is a GUI component that contains one or more tiles for the display of any content supported by the CC application

a) Multiple Tile Layouts

It shall be possible to configure the default layout that the CC will display upon launching

- i. Each Tile Layout shall enable viewing of up to 32 video tiles simultaneously on a single SVGA resolution screen.
- ii. Each Tile Layout shall support the display of different tile patterns, including but not limited to:

- A single tile
- 2x2 (Quad)
- 3x3
- 4x4
- 5x5
- Other tile pattern combinations including patterns that are optimized for 16:9 aspect ratio monitors

b) The following indications and controls shall be available on the video tiles:

- i. The scene name and logical ID
- ii. The content type, (e.g. live, archive, alarm, sequence, etc.)
- iii. The Tile ID
- iv. Buttons to control the different functions according to the tile content

c) Picture in Picture (PIP) for Dual Sensor Cameras

- i. When viewing a dual sensor camera (thermal and visible sensor) the CC shall display the Visible and Thermal images in a single tile using a Picture-in-Picture layout, where one scene is displayed on the main tile area and the other scene is displayed on a smaller window in the corner of the main tile.
- ii. The CC shall allow toggling the images and switch between the visible/thermal scenes
- iii. The CC shall allow resizing and minimizing the small PIP window
- iv. The CC shall allow dragging the PIP scene to another tile to be displayed in full tile size

4) Search and Query Pane

The Query Pane shall provide for the search of recorded data including the following types of data:

- a) Video and audio recordings, alarms, incidents and bookmarks,
- b) using the following criteria:
- c) Text search
- d) Site and/or scene selection
- e) Date and time range
- f) Recording reason
- g) Thumbnail Search

- h) Thumbnail search shall support zoom functionality. Zoom on playback in thumbnail search shall zoom in to each thumbnail as it does in playback
 - i) Thumbnail search shall allow the ability to define a time interval by which to separate thumbnail images
 - j) User (when applicable)
 - k) Recording "Lock" state
- 5) Motion Query Pane
- The Motion Query Pane shall provide for the search of motion in video recordings by any of the following means:
- a) Smart Search – Based on a region of interest defined by the user
 - b) Motion Indication – Based on motion level recorded during a specified time
 - c) Motion Bookmarks – Based on bookmarks that were created automatically upon detected motion
- 6) Alarm Pane and Alarm Management
- The CC shall offer the user advanced alarm management capabilities
- a) Alarm Pane

The Alarm Pane shall provide for display and management of alarms

 - i. The Alarm Pane shall display all the alarms to the user in a grid-type list
 - ii. The user shall have the ability to view, sort, and filter the alarm list in the alarm pane and clear acknowledged alarms from the list
 - iii. The CC user shall receive all the alarms that are addressed to that user or to a group of which the user is a member
 - b) Alarm Notification

The CC shall notify the user of an alarm in the following ways:

 - i. Provide an red flashing alarm indicator that shows the number of active alarms on the screen
 - ii. Add the alarm to the Alarm Pane
 - iii. Pop-up a notification window in the corner of the screen

- iv. Optionally pop-up the alarm video in a tile and mark the tile with a red flashing border

c) Alarm Display

The alarm associated video streams shall be displayed in the CC in the following ways:

- i. The CC shall have the ability to simultaneously display multiple cameras associated with an alarm on available tiles
- ii. The user shall have the ability to designate a tile for automatic alarm display upon receiving the alarm, by arming the tile for alarms
- iii. The user shall have the ability to manually select a tile to display an active alarm by using the mouse drag-and-drop or double-click from the Alarm Pane

d) Alarm Management

The user shall have a means to manage alarms:

- i. The user shall have the ability to manually trigger alarms
- ii. The user shall have the ability to view, sort and filter the alarm list in the Alarm Pane
- iii. The user shall have a way to 'Snooze' alarms
- iv. The user shall have a way to forward alarms to other users
- v. The user shall have a way to acknowledge alarms and add an acknowledgement text description
- vi. The user shall have a way to display an Alarm Procedure (URL or Map Content)
- vii. The CC shall display alarm-related video according to alarm priority. In case a higher priority alarm is triggered, its associated video should override lower priority associated alarm videos.

7) Event Pane

- i. The Event Pane shall provide for display and management of events
- ii. The Event Pane shall display events to the user in a grid-type list
- iii. The user shall have the ability to view, sort, filter, and clear events in the Event Pane
- iv. The user shall have the ability to edit data that is being displayed in some events, such as the text description of bookmarks and incidents

8) Timeline Pane

- a) The Timeline Pane shall provide the user with an interactive timeline GUI for the active playback in focus
 - b) The Timeline Pane shall support the display of the playback timeline in different time resolutions (from seconds to months) that can easily be selected by the user using the mouse 'click-and-drag'
 - c) The Timeline Pane shall provide the user with a means to control the playback with features such as 'jump-to-time', speed, and direction
 - d) The Timeline shall display metadata related to the playback, including date and time information, playback speed and direction, motion indication, bookmarks, and recording reasons
 - e) The Timeline Pane shall allow the user to mark a timeframe selection for the purpose of either locking, exporting, or loop playback of the recording
 - f) The Timeline Pane shall allow the user to view and add bookmarks to existing recordings
 - g) The Timeline Pane shall allow the user to expose all of the different playback tracks in the timeline with color coding. The available tracks include: All recordings, manual, schedule, event, alarm, edge recording and protected
- 9) Export Status Pane
- For displaying export jobs and their status
- 10) Offline Playback Pane (OPP)
- a) The OPP shall allow the user to open and playback exported footage
 - b) The OPP shall allow the user to open specific exported clips or open folder which contains multiple clips
 - c) The OPP shall display the list of open clips as a simple list or arrange the clips by scene name
 - d) The OPP shall allow the user to select which clips or scenes to playback from the list of opened clips
 - e) The OPP shall support transparent continuous playback of clips from the same scene, assuming the clips represent a continuous timeframe
 - f) The OPP shall allow the user to validate the authenticity of exported clips

- g) The OPP shall allow the user to perform synchronized playback of exported clips from multiple video and audio sources
- 11) Case Management Module
- a) Case management module attributes:
 - i. The CC shall provide the user with a case management mode allowing the user to view and create cases for investigation and evidentiary purposes.
 - ii. This module shall allow the user to collect related pieces of data and metadata from the system and other sources, and organize them under a single file to create a case.
 - Video and Audio Clips
 - Still Snapshots
 - Alarms, Incidents and Bookmarks
 - Any other files
 - URLs
 - Maps
 - iii. This module shall allow the users to add text descriptions and time stamps to the case data
 - iv. This module shall allow the user to create, save, modify, and delete cases
 - v. This module shall allow the user to search for saved cases using various search criteria
 - vi. This module shall allow the user to export a case onto a portable device or media in order to display the case away from the system
- 12) Video export attributes
- a) The CC shall support export of recorded video to video clips
 - b) Export rights shall be assigned by individual User or at the User Group level
 - c) Export shall be performed from the timeline or from the Query Results Pane
 - d) The user shall have the ability to set the export properties, including file name, export path, codec type, including a copy of the standalone player, etc.
 - e) The user shall have the ability to export a sub-clip from an already exported clip by selecting a time segment on the timeline of the original clip
 - f) The CC shall provide the user with status information on export jobs, including progress and error messages in a special Export Status Pane

- 13) Global Client capability
- a) The CC shall support the Global Client capability, allowing the user to connect to multiple VMS systems concurrently, and operate them
 - b) Perform live and archived playback of any camera, sequence or audio source from multiple systems concurrently
 - c) Receive and manage alarms and events from multiple systems concurrently
 - d) Operate resources like Global (multi-system) maps, control PTZ domes, and control output pins from multiple systems concurrently
 - e) The user shall have the ability to select the subset of systems to connect to in the initial login, as well as choose to disconnect from a system and connect to a system after the initial login.
- 14) Live/Archived video stitching capability
- a) The CC shall support the display and operation of live and archived stitched video scenes, allowing for multiple cameras to be presented in a single tile as a panorama
 - b) The system shall allow viewing multiple live and archived stitched videos in any tile selection
 - c) The system shall support manipulation of the display of the stitched scene and use various zoom and preset capabilities of the PTZ control
 - d) Stitched Scene Handling - It shall be possible to record stitch scenes, search for stitched scenes recording, playback, and export stitched scene footage.
- 15) Supervisor Mode
- The Control Center shall provide an agent that shall enable monitoring and recording of operator client screens in the VMS
- 16) Guard Tour
- The CC shall support 'Guard Tour' mode where the Viewing Pane switches the display of selected Layouts in a round robin way, every few seconds, according to the user-defined Dwell Time parameter
- 17) On-Screen Display technology

- a) The CC shall use On-Screen Display (OSD) technology to provide specific indications and controls on the video tiles and other types of tiles
- b) The user shall have the ability to configure which OSD elements should be displayed and to set the level of transparency for the OSD controls and their background
- c) The following indications and controls shall be available on the video tiles:
 - i. The scene name and logical ID
 - ii. The content type, (e.g. live, archive, alarm, sequence, etc.)
 - iii. The Tile ID
 - iv. Buttons to control the different functions according to the tile content
- d. Web client

The web client shall provide an interface for the operator to view live video, as well as, playback and export recorded video. The web client shall provide the following viewing options:

- 1) Live Camera Layout – A GUI component that contains one or more tiles for the display of live camera scenes.
 - a) The Live Camera Layout shall support the display of up to 9 cameras in supported Chrome and Opera Browsers. It shall support up to 6 cameras in IE 11 and up.
 - b) The Live Camera Layout shall support the display of dynamic tile layout patterns which adjust accordingly as video scenes are added.
 - c) The Live Camera Layout shall allow users to rearrange the location of the tiles by drag and drop functionality
- 2) Camera Catalog – Includes representation for cameras and displays preview of scene being viewed
 - a) The Camera Catalog shall display online and offline cameras.
 - b) The Camera Catalog shall display snapshot previews of camera scene for all online cameras
 - c) The Camera Catalog shall allow the user to single-click a camera scene to select it for viewing in the Live Camera Layout
 - d) Camera/Site filter – Shall allow for searching and filter based on camera name and system/site names

- 3) Web client export - Shall allow for the export of recorded videos in AVI, MP4 and DVT format
 - a) The web client shall support the ability to export still images (snapshots) and video clips while maintaining the source video quality
 - b) The web client shall support exporting the native format of video recordings to tamper-proof files, protected with SHA1 based digital signature 1024-bit RSA encryption, to comply with court of law evidentiary requirements
 - c) The web client shall support export of video clip in DVT, MP4 or AVI file format. Exported AVI files shall comply with standard audio and video playing software tools based on Windows OS. Exported DVT
 - d) Notification Center
 - i. The Notification Center shall display export status and completed exported videos and snapshot downloads. The number of export jobs shall be displayed above the notification center.
 - ii. The notification Center shall allow for user to download completed exported videos and snapshots.
- 4) Alarm Management – the web client shall support incoming alarm functionality, providing the following functionality:
 - a) The user shall receive a popup alert when new alarm is triggered
 - b) The web client shall display list of alarms with thumbnail of the camera associated with the alarm
 - c) The user shall be able to perform basic operations with each alarm:
 - i. View the live or recorded cameras associated with the alarm
 - ii. Accept or delete and alarm
 - iii. View alarm information
- 5) Secured HTTPS Connection - the web client shall support secured (Transport Layer Security) TLS protocol, and allow the user to load TLS certificate for enabling HTTPS connection.
- 6) Picture in Picture (PIP) for Dual Sensor Cameras

When viewing a dual sensor camera (thermal and visible sensor) the web client shall display the Visible and Thermal images in a single tile using a Picture-in-Picture layout, where one scene is displayed on the main tile area and the other scene is displayed on a smaller window in the corner of the main tile.

- a) The web client shall allow toggling the images and switch between the visible/thermal scenes
 - b) The web client shall allow minimizing the small PIP window
- 7) Save site filters, live view layouts - the web client shall save session information specific to users so that a user can log in and pick up where they left off. The following items shall be persisted upon re-login by the same user, to the same system with the same browser: Sites Filter, Selected Cameras in Live, Viewed alarms and Export format.
- e. Mobile Device Support

The VMS shall support viewing live and recorded video through mobile devices with iOS or Android operating systems. The mobile apps shall be able to carry out the following functions:

 - 1) Store multiple site profiles – select which site to login to
 - 2) View live: digital zoom, PTZ control, maximize tile
 - 3) Search playback
 - 4) See status of camera
 - 5) See recording status
 - 6) Trigger an alarm on the VMS system that can be identified as originating for the mobile user, and which can include the mobile user's GPS location.
- f. Client Portal (Client Application Deployment)
 - 1) The VMS shall provide a web interface to enable deployment of the client software installation packages and a stand-alone player.
 - 2) Users may access the client portal from any location in their organization's network or through the Internet.
 - 3) Access shall be via any standard browser by typing in the URL address of the client portal and then downloading the desired software package.
 - 4) Once downloaded, the user can install the software on their client workstation or use the stand-alone player.
- g. Cloud-based Health Monitoring
 - 1) The VMS shall support a cloud-based system monitoring module.

- 2) The cloud shall be accessible from anywhere with Internet access via a web browser.
- 3) The cloud shall support real-time health status for:
- 4) Physical servers that comprise the security surveillance installation
- 5) Edge devices
- 6) Recording status
- 7) Database size
- 8) The cloud shall support proactive alerts when system thresholds are crossed (based on user definitions).
- 9) The cloud shall support system's database backup upload to the cloud.
- 10) The cloud shall be secured and access shall be granted only to authorized users.

6. System Integration Functions and Tools

Objective: The VMS manufacturer shall offer a Software Developer's Kit in order to facilitate functional interfaces to a variety of different types of software and systems and to perform extended custom functions that are not initially a part of the VMS software.

The VMS software shall offer integration tools, including Software Development Kit and plug-In technology, and provide the most popular environment for 3rd party systems (such as Access Control, Fire Alarm, Public Address, Aviation, Marine, Gaming Table, Point-of-Sale, etc.), developers and products (such as IP cameras, encoders, etc.) for rapid development and quick integration.

a. Software Development Kit (SDK)

- 1) The SDK shall provide Microsoft .NET libraries arranged as VMS Application Programming Interfaces (APIs) to achieve the following capabilities:
 - a) Monitor live and archived video and/or audio from the software in SDK applications
 - b) Configure the VMS software from SDK applications
 - c) Control and operate the VMS software resources
 - d) Create customized solutions on top of the VMS for specific needs
- 2) The SDK application shall be able to operate from any workstation that can communicate with the VMS software.
- 3) The SDK shall have comprehensive documentation with examples.

4) Infrastructure:

- a) .Net extended SDK
- b) Application plug-in technology – Shall provide the developers the infrastructure to be able to change the look and feel of the client applications for both the configuration and monitoring application. This shall include but not be limited to:
 - i. Adding buttons to the monitoring application based on customer needs
 - ii. Adding panes
 - iii. Displaying different content in video tiles, such as WinForms or a web application
 - iv. Adding new types of entities to the system, such as any sensor, reader, motion sensor, etc.
 - v. Changing GUI of existing entities in the configuration system (for example, color and icons)

5) Server plug-in technology

The SDK shall provide the developers with the infrastructure to be able to change the behavior of the server-side services and applications. This includes but shall not be limited to:

- a) When adding entities, assigning them parameters according to a pre-defined formula
- b) Adding additional types of validation
- c) Adding new types of privileges
- d) Direct Show Filter (DSF)
- e) Metadata – Save external information by utilizing the VMS database and synchronizing it with played video

6) Interfaces facilitated to other systems

The SDK shall facilitate interfacing to other systems to include (at a minimum):

- a) Designated Access Control systems
- b) Perimeter Detection systems
- c) Gunshot Detection systems
- d) IP interface
- e) Input/Output boxes
- f) Asset Management systems
- g) Alarm panels

- h) Video walls
- i) Video Analytics systems
- j) Situational Awareness software
- k) Audio systems
- 7) Interface types
 - a) Basic serial Interface
 - b) IP interface using XML
 - c) Metadata interface
 - d) SDK and APIs
- 8) Available SDK technologies
 - a) Microsoft Windows™
 - b) Microsoft SQL Server™
 - c) .Net and C++ support
 - d) ActiveX®
 - e) COM Objects
 - f) XML®
 - g) Plug-ins
 - h) Microsoft WMI
 - i) Microsoft Message Queue®
- 9) SDK Functions
 - a) The SDK shall facilitate access to and interfacing with all VMS features and functions
 - b) Every action that can be performed manually shall be available via the SDK. This includes, but is not limited to, adding entities, updating entities, removing entities, displaying entities in the monitoring system, and triggering alarms automatically.

- c) The SDK shall allow interfacing available features and functions from other related software and hardware products in order to extend the functionality of the VMS system, the other system or both, or to create entirely new functional systems out of a combination of any number of related systems.
- d) Examples of sample SDK functions shall include:
 - i. Facility Alarm Verification: Display video from the VMS on an Access Control system in response to unauthorized use of access credentials
 - ii. Vehicle Access Assistance: The VMS system shall automatically display video of a vehicle and car license plate in response to an intercom call from the parking gate
- e) The VMS software shall have an open architecture and support hosting software plug-in modules that were not developed with the original core software. Plug-in modules are software add-on components that can be added to the core software and become an integral part of the system.
- f) The VMS software shall support plug-ins to allow adding GUI components to the Control Center application as well as the Admin Center applications
- g) Application plug-ins shall have the ability to communicate with the application modules and the rest of the VMS as if they are an integral part of the system
- h) The VMS shall provide infrastructure for server-side plug-ins in order to allow separate development of new software capabilities that extend the original VMS software capabilities. Such plug-ins may allow the following options:
 - i. Development of additional edge device integrations
 - ii. Development of new entity types (extending the core VMS model)

3.2.7 CCTV IP Cameras

- A. Contractor shall be responsible to provide proper required PoE power and connectors for each camera listed below per manufacturers listed Data Sheet requirements, No Exceptions will be taken as each camera will have its own power consumption requirements and connector type.

- B. All Camera cables shall be General Cable GenSPEED 6000 Enhanced Category 6 plenum rated 23 AWG, 4-pair, Blue/Black jacket cables (contractor must obtain approval for color prior to installation). No substitutions will be allowed without prior written approval from the city IT Project Manager. All cables shall be installed from the camera jack directly to the appropriate Cat 6 patch panels in the MDF. All cable pairs or modular jacks shall be wired to ANSI/TIA/EIA568-B using T568-A wiring scheme at both ends. All cables shall be tested to minimum Cat 6 standards. Camera types listed below describing various resolutions, form-factor and features shall be supplied by a single camera manufacturer video surveillance system.

3.2.8 Cameras

- A. Provide high resolution digital video cameras by Axis or equivalent by a major manufacturer.
1. 12-megapixel quad-stream H.264/MJPEG, True (Shutter) WDR, IP66-rated day/night digital video camera with fixed 1.05mm, F2.4, 1.29mm hemispheric lens, within an IK10 vandal-resistant housing for wall mounting, ceiling mounting, or pendant mounting.
 2. The digital video camera shall support H.265/H.264/MJPEG compression on four (4) simultaneous video streams, up to 12-megapixels through a digital network.
 3. Resolution and bandwidth shall be scalable.
 4. The camera shall incorporate at minimum a fully digital 1/1.7", 4000 x 3000 (12MP) Progressive Scan BSI CMOS imaging system with IR illumination and electronic day/night ICR for infrared sensitivity.
 5. The camera shall utilize scene adaptive algorithms to provide a high image quality with low bandwidth and storage requirements (Smart Picture Quality to automatically adapt to wider range of changing conditions using advanced picture settings optimizations).
 6. The camera shall provide bi-directional audio via audio I/O.
 7. The camera shall accommodate one (1) alarm input and provide one (1) relay output.
 8. The camera shall provide a micro-SDXC card slot with support for up to 128GB (Class 10) devices.
 9. The camera may be powered by 12VDC or IEEE 802.3af PoE (Class 0 to Class 3).
 10. The camera shall be IEEE-compliant utilizing the multicast networking protocol such that a single camera may be transmitted to multiple viewers/archivers on the network simultaneously, further reducing bandwidth and providing greater flexibility in network monitoring/recording configurations.
 11. Resolution shall be scalable between D1 (720 x 576/480) to 12MP (4000 x 3000) on CM-6212 for selected digital streams which may be set to unicast or multicast.
 12. Bandwidth shall be scalable between 64Kbps and 20,480Kbps.

13. The audio capabilities shall support either half-duplex or full-duplex audio on two-way connections.
14. The camera shall support G.711, G.726, and AAC audio compression.
15. The camera shall accommodate one (1) digital alarm input and provide one (1) digital alarm relay output.
16. The camera shall provide a web Interface for viewing, configuration, and control.
17. Motion Detection:
 - a. The camera shall provide intelligent multi-zone video motion detection with the following configurable parameters:
 - 1) Sampling pixel interval (1-10)
 - 2) Detection level (1-100)
 - 3) Sensitivity level (1-100)
 - 4) Time interval(sec) (0-7200)
18. Storage and Bandwidth Efficiency:
 - a. Motion Compensation and Processing:
 - 1) The camera shall employ industry-standard motion compensation methods as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce the storage and bandwidth consumption associated with scene motion.
 - 2) Compliant motion compensation shall employ a block-matching algorithm covering an area of at least 256 macro-blocks surrounding each block to be processed.
 - 3) The motion compensation process shall output industry-standard H.264 compliant motion vectors as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce storage and bandwidth consumption associated with scene motion.
 - 4) The compliant motion vectors shall be compatible with and verifiable using Windows Media Player equipped with FFDSHOW or equivalent utility to visualize the motion vectors contained within the resulting H.264 video stream.
 - b. Compression Efficiency:
 - 1) The camera shall provide an effective rate control algorithm which maintains set frame rates of full 30fps (NTSC) or 25fps (PAL) at 12MP using no more than 45 (+/-10%) pixels per bit of storage with full screen (100%) motion including panning/tilting velocities of at minimum 25% of the camera field of view per second.

- 2) The images shall remain free of objectionable compression artifacts when operating as defined in paragraph "H.2.a" under recommended lighting conditions.
- 3) Pixels per bit (ppb) efficiency shall be defined as $ppb = (ppf) * (fps) / (bps)$ where:
 - a) ppb = pixels per bit
 - b) ppf = pixels per frame (= horizontal resolution x vertical resolution)
 - c) fps = frames per second
 - d) bps = bits per second. This is a bandwidth measurement which equals the Kb/s generated by the camera x1000

19. Camera:

- a. Image Sensor:
 - 1) CM-6212: 1/1.7" 12MP Progressive Scan CMOS
 - 2) Day/Night with IR sensitivity on all models
- b. Sensor Resolution:
 - 1) 12 megapixels (4000 x 3000)
- c. Scanning Mode: Progressive
- d. Sensitivity:
 - 1) Color (Day) Mode: 0.1 Lux @ F2.4
 - 2) B/W (Night) Mode: 0.1 Lux @ F2.4 with IR illuminator measured with DSS off at 30 IRE
- e. Applicable Lens Type:
 - 1) Fixed F2.4, 1.29mm lens
 - 2) Viewing angle: 180°
- f. IR Illuminator: High-power/high-efficiency SMD devices with wide-angle illumination.
 - 1) Effective IR range: 5m/16 ft. at 360°
 - 2) IR Compensation: Automatically adjusts the scene brightness to compensate for nearby bright objects. On/Off.
 - 3) IR LED illuminator: Auto/Off

- 4) Day/Night Threshold: 9 settings
- g. White Balance: Auto/ATW/One Push/Manual (On/Off)
- h. Shutter Speed: 1.0 to 1/10,000 sec. (Auto)
- i. Digital Slow Shutter: 1~30 fps (NTSC)/1~25 fps (PAL)
- j. Noise Reduction: 2DNR,3DNR, ColorNR On/Off (3 levels)
- k. Exposure Modes: Auto/Manual
- l. Day/Night Mode: Auto/On/Off/Smart. Smart mode eliminates erroneous switching back to day mode when used with high levels of IR lighting.
- m. True (Shutter) Wide Dynamic Range: On/Off (3 levels)
- n. Tamper Detection (On/Off)
- o. Privacy Zone: On/Off (5 zones)
- p. Video Motion Detection: Up to 4 independent zones
- q. Digital Zoom: 10x
- 20. Video:
 - a. Compression: H.264 Baseline/Main/High Profiles (MPEG-4 Part 10) and MJPEG compression; quad-streaming
 - b. Performance:
 - 1) 12MP (4000 x 3000) @ 20 FPS
 - 2) Quad-stream: 12MP @ 15 FPS + HD 720p @ 12/15 FPS + HD 720p @ 12/15 FPS + D1 @ 12/15 FPS
 - c. Resolution Range: Up to 5 user selectable resolutions from D1 to 12MP (CM-6212).
 - d. Bandwidth:
 - 1) Configurable between 64Kbps to 20,480Kbps
 - 2) Rate Control: CBR/VBR
 - e. Video Motion Detection (VMD):
 - 1) Intelligent multi-zone VMD
 - 2) Up to four independent zones
- 21. Audio:
 - a. Bidirectional Audio:

- 1) Line-In for using line-level audio inputs
- 2) Line-Out to feed any single-ended line-level audio input, such as an amplified bullhorn, amplified speakers, or public address system

22. Alarms:

- a. Input: One (1) 5V, 10K Ω dry contact
- b. Output: One (1) relay contact, 300VDC/300VAC @ 130mA maximum

23. Network:

- a. Ethernet: 10/100/1000Base-T auto-sensing, half/full-duplex (RJ45)
- b. Protocols: IPv4, IPv6, TCP/IP, UDP unicast/multicast, RTP, RTSP, HTTP, HTTPS, ICMP, FTP, SMTP, DHCP, PPPoE, UPnP, IGMP, SNMP, QoS, ONVIF Profile S, IEEE 802.1X
- c. Digital Streams: The camera shall provide four digital streams plus bi-directional audio on one Ethernet connection
- d. Operating Systems: Windows 7, 8, and 8.1 (64-bit)
- e. Web Browsers: Internet Explorer 9 and above (32-bit)

24. Management:

- a. Configuration: Remote (via web interface or supported Video Management Software)
- b. Firmware Updates: Flash memory for upgrade of camera firmware over the network

25. Power:

- a. Input Voltage:
 - 1) 12VDC \pm 10%
 - 2) PoE (IEEE 802.3af (Class 0 to Class 3))
- b. Power Consumption:
 - 1) 12VDC: 8W
 - 2) PoE: 10W with heater and IR operating

26. Connections:

- a. Network: RJ45
- b. Power:

- 1) 12VDC (Through 2-pin terminal block connector)
 - 2) PoE: Through the RJ45 connector
 - c. Audio In/Out:
 - 1) Line-In/Line-Out: 1.5mm audio jack
 - d. Alarm In/Alarm Out: Through terminal block connector
 - e. microSDXC card drive: For recording up to 128GB, Class 10 (card not included)
- 27. Physical and Mechanical:
 - a. Physical:
 - 1) Dimensions: \varnothing 163 x 104mm (6.43 x 4.1 in.)
 - 2) Unit Weight: 2.1 lbs. (0.95kg)
 - 3) Enclosure: IP66 with IK10 vandal-resistant
 - b. Mechanical:
 - 1) Bubble Rating: K10 Vandal Resistant Polycarbonate
 - 2) Bubble F-Stop Clear Bubble: F0.0, Optional Smoke Bubble: F1.0
 - 3) Pan/Rotate/Tilt: 355° pan, \pm 100° rotate, 80° tilt
- 28. Environmental:
 - a. Operating Temperature: 14°F to 122°F (-10°C to 50°C) with heater, -13°F to 122°F (-20°C to 50°C) for cold start with PoE
 - b. Storage Temperature: -4°F to 158°F (-20°C to 70°C)
 - c. Humidity: Up to 90% (non-condensing)
 - d. Ratings: IP66
 - e. Internal Heater: Automatic
- 29. Regulatory:
 - a. USA: FCC 47 CFR Part 15, Subpart B, Class A; UL (UL 60950-1)
 - b. Worldwide: CE (EN 55032 Class A; EN50130-4; IEC 60950-1, EN 61000-6-4)
 - c. RoHS
- 30. Optional Accessories, where required for camera mounting:

- a. Indoor Wall Mount Kit with Wall Bracket:
- b. Indoor Pendant Kit: (Supports 1.5" female threaded wall brackets as well as 3/4" EMT Conduit Pendant)
- c. Outdoor Pendant Mount Kit with Wall Bracket: (Adds Short Wall Bracket to CM-CAPX-IND-P kit)
- d. Outdoor Pendant Kit: (Includes 1-1/2" male pipe threaded mount and 3/4" female EMT conduit compatibility)
- e. Recessed Kit
- f. Smoked Bubble
- g. Mini-Dome Conduit Backbox
- h. electrical box mounting adapter
- i. Pole Mount. Includes CX-ARMX-1 mounting bracket,

B. Provide 4 megapixel, Quad HD, shutter WDR, 30 / 25 frames per second high-resolution digital video mini-dome camera or approved equivalent by a major manufacturer.

- 1. Quad HD Definition 2K/4 megapixel (2560 x 1440) triple-stream H.264 / H.265, shutter WDR, IP67/NEMA 4-rated day/night mini-dome digital video camera with integrated 2.8mm to 8.5mm (CM-3304-11-I) / 9mm to 22mm (CM-3304-21-I) motorized auto-focusing, vari-focal P-iris lens, within an IK10 vandal-resistant bubble and housing for surface mounting (standard), recessed mounting, or pendant mounting (options).
- 2. The digital video camera shall support H.265 / H.264 compression on three (3) simultaneous video streams (Ultra HD 2160p, Full HD 1080p, HD 720p and D1) through a digital network.
- 3. Resolution and bandwidth shall be scalable.
- 4. The camera shall incorporate a fully digital Ultra HD (8.3 megapixel) backside illumination CMOS imaging system with IR illumination and day/night IR cut filter for infrared sensitivity.
- 5. The camera shall provide enhanced low light performance using binning mode in Full HD 1080p resolution, increasing the light sensitivity of the sensor during low light conditions
- 6. The camera shall utilize scene adaptive algorithms to provide a high image quality with low bandwidth and storage requirements (Smart Picture Quality to automatically adapt to wider range of changing conditions using advanced picture settings optimizations).
- 7. The camera shall provide bi-directional audio via audio I/O.
- 8. The camera shall accommodate alarm inputs and provide a relay output.

9. The camera shall provide a microSDXC card slot with support for up to 128GB (Class 10) devices.
10. The camera may be powered by AC/DC or 802.3af Class 0 Power over Ethernet (PoE).
11. The camera shall fit on a standard 4S electrical box.
12. The camera shall be IEEE-compliant utilizing the multicast networking protocol such that a single camera may be transmitted to multiple viewers/archivers on the network simultaneously, further reducing bandwidth and providing greater flexibility in network monitoring/recording configurations.
13. The digital video camera shall provide the user with H.265 and H.264 video compression on up to four digital streams simultaneously.
14. Resolution shall be scalable between CIF to 1440P Quad HD (2560 x 1440) on selected digital streams which may be set to unicast or multicast.
15. The camera shall be capable of producing 30 frames per second (NTSC) and/or 25 frames per second (PAL) 1440P Quad HD (2560 x 1440) video stream.
16. The camera shall be capable of producing 60 frames per second (NTSC) and/or 50 frames per second (PAL) Full HD / 1080P (1920 x 1080) video stream.
17. Bandwidth shall be scalable between 64Kbps and 20,480Kbps.
18. The audio capabilities shall support either half-duplex or full-duplex audio on two-way connections.
19. The camera shall accommodate alarm inputs and provide a relay output.
20. The camera shall provide a web Interface for viewing, configuration and control.
21. Motion Detection:
 - a. The camera shall provide intelligent multi-zone video motion detection with the following configurable parameters:
 - 1) Sampling pixel interval (1-10)
 - 2) Detection level (1-100)
 - 3) Sensitivity level (1-100)
 - 4) Time interval(sec) (0-7200)
22. Storage and Bandwidth Efficiency:
 - a. Motion Compensation and Processing:
 - 1) The camera shall employ industry-standard motion compensation methods as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce the storage and bandwidth consumption associated with scene motion.

- 2) Compliant motion compensation shall employ a block-matching algorithm covering an area of at least 256 macro-blocks surrounding each block to be processed.
- 3) The motion compensation process shall output industry-standard H.265 and H.264 compliant motion vectors as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce storage and bandwidth consumption associated with scene motion.
- 4) The compliant motion vectors shall be compatible with and verifiable using Windows Media Player equipped with FFDSHOW or equivalent utility to visualize the motion vectors contained within the resulting H.265 / H.264 video stream.

b. Compression Efficiency:

- 1) The camera shall provide an effective rate control algorithm which maintains set frame rates of full 30fps (NTSC) or 25fps (PAL) in 4K Ultra HD using no more than 45 (+/-10%) pixels per bit of storage with full screen (100%) motion including panning/tilting velocities of at minimum 25% of the camera field of view per second.
- 2) The images shall remain free of objectionable compression artifacts when operating as defined in paragraph "H.2.a" under recommended lighting conditions.
- 3) Pixels per bit (ppb) efficiency shall be defined as $ppb = (ppf) * (fps) / (bps)$ where:
 - a) ppb = pixels per bit
 - b) ppf = pixels per frame (= horizontal resolution x vertical resolution)
 - c) fps = frames per second
 - d) bps = bits per second. This is a bandwidth measurement which equals the Kb/s generated by the camera x1000.

C. Provide 8 megapixel, 4K Ultra HD, shutter WDR, 30 / 25 frames per second high-resolution digital video bullet camera or approved equivalent by a major manufacturer. Housing to be Minidome as required.

1. Ultra High Definition 4K/8 megapixel (3840 x 2160) triple-stream H.264 / H.265, shutter WDR, IP67/NEMA 4-rated day/night bullet digital video camera with integrated 3.4mm to 9mm motorized auto-focusing, vari-focal P-iris lens, within an IK7 vandal-resistant housing for wall and pole mounting options.
2. The digital video camera shall support H.265 / H.264 compression on three (3) simultaneous video streams (Ultra HD 2160p, Full HD 1080p, HD 720p and D1) through a digital network.
3. Resolution and bandwidth shall be scalable.

4. The camera shall incorporate a fully digital Ultra HD (8.3 megapixel) backside illumination CMOS imaging system with IR illumination and day/night IR cut filter for infrared sensitivity.
5. The camera shall provide enhanced low light performance using binning mode in Full HD 1080p resolution, increasing the light sensitivity of the sensor during low light conditions
6. The camera shall utilize scene adaptive algorithms to provide a high image quality with low bandwidth and storage requirements (Smart Picture Quality to automatically adapt to wider range of changing conditions using advanced picture settings optimizations).
7. The camera shall provide bi-directional audio via audio I/O.
8. The camera shall accommodate alarm inputs and provide a relay output.
9. The camera shall provide a microSDXC card slot with support for up to 128GB (Class 10) devices.
10. The camera may be powered by AC/DC or 802.3af Class 0 Power over Ethernet (PoE).
11. The camera shall fit on a standard 4S electrical box.
12. The camera shall be IEEE-compliant utilizing the multicast networking protocol such that a single camera may be transmitted to multiple viewers/archivers on the network simultaneously, further reducing bandwidth and providing greater flexibility in network monitoring/recording configurations.
13. The digital video camera shall provide the user with H.265 and H.264 video compression on up to four digital streams simultaneously.
14. Resolution shall be scalable between CIF to 4K Ultra HD (3840 x 2160) on selected digital streams which may be set to unicast or multicast.
15. The camera shall be capable of producing 30 frames per second (NTSC) and/or 25 frames per second (PAL) 4K Ultra HD (3840 x 2160) video stream
16. The camera shall be capable of producing 60 frames per second (NTSC) and/or 50 frames per second (PAL) Full HD / 1080P (1920 x 1080) video stream
17. Bandwidth shall be scalable between 64Kbps and 20,480Kbps.
18. The audio capabilities shall support either half-duplex or full-duplex audio on two-way connections.
19. The camera shall accommodate alarm inputs and provide a relay output.
20. The camera shall provide a web Interface for viewing, configuration and control.
21. Motion Detection:
 - a. The camera shall provide intelligent multi-zone video motion detection with the following configurable parameters:

- 1) Sampling pixel interval (1-10)
- 2) Detection level (1-100)
- 3) Sensitivity level (1-100)
- 4) Time interval(sec) (0-7200)

22. Storage and Bandwidth Efficiency:

a. Motion Compensation and Processing:

- 1) The camera shall employ industry-standard motion compensation methods as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce the storage and bandwidth consumption associated with scene motion.
- 2) Compliant motion compensation shall employ a block-matching algorithm covering an area of at least 256 macro-blocks surrounding each block to be processed.
- 3) The motion compensation process shall output industry-standard H.265 and H.264 compliant motion vectors as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce storage and bandwidth consumption associated with scene motion.
- 4) The compliant motion vectors shall be compatible with and verifiable using Windows Media Player equipped with FFDSHOW or equivalent utility to visualize the motion vectors contained within the resulting H.265 / H.264 video stream.

b. Compression Efficiency:

- 1) The camera shall provide an effective rate control algorithm which maintains set frame rates of full 30fps (NTSC) or 25fps (PAL) in 4K Ultra HD using no more than 45 (+/-10%) pixels per bit of storage with full screen (100%) motion including panning/tilting velocities of at minimum 25% of the camera field of view per second.
- 2) The images shall remain free of objectionable compression artifacts when operating as defined in paragraph "H.2.a" under recommended lighting conditions.
- 3) Pixels per bit (ppb) efficiency shall be defined as $ppb = (ppf) * (fps) / (bps)$ where:
 - a) ppb = pixels per bit
 - b) ppf = pixels per frame (= horizontal resolution x vertical resolution)
 - c) fps = frames per second

- d) bps = bits per second. This is a bandwidth measurement which equals the Kb/s generated by the camera x1000

23. Camera: voice

- a. Image Sensor:
 - 1) 1/2.5" Progressive Scan BSI (Backside Illuminated) CMOS
 - 2) Day/Night with IR sensitivity on all models
- b. Sensor Resolution: 3840 x 2160
- c. Scanning Mode: Progressive
- d. Sensitivity:
 - 1) Color (Day) Mode: 0.07 Lux measured at 30 IRE
 - 2) B/W (Night) Mode: 0.01 Lux measured at 30 IRE
- e. Lens Type
 - 1) UHD quality, auto-focusing, motorized vari-focal 3.4~9mm F1.5 P-Iris lens
 - 2) Horizontal viewing angle: 42-104 degrees
- f. Digital Slow Shutter Speed (DSS): 1/1.75(6.25) to 1/60(50) NTSC(PAL)
- g. IR Illuminator: Twelve high-power/high-efficiency SMD devices with wide-angle illumination.
 - 1) Effective IR range: 30m/98 ft.
 - 2) IR Compensation: Automatically adjusts the scene brightness to compensate for nearby bright objects.
- h. White Balance: Auto/indoor/outdoor/manual (On/Off)
- i. Automatic Electronic Shutter (AES): 1/1.75 to 1/10,000 sec. (Auto)
- j. Digital 3D Noise Reduction: On/Off (0-100)
- k. Iris Control: P-Iris
- l. Day/Night Mode: SmartIR/Auto/On/Off. SmartIR eliminates erroneous switching back to day mode when used with high levels of IR lighting.
- m. Shutter Wide Dynamic Range: On/Off and additional Digital Wide Dynamic Range
- n. Tamper Detection (On/Off, 3 levels)
- o. Privacy Zone: On/Off (8 zones)

- p. Video Motion Detection: Up to 4 independent zones
- q. Mechanical IR Cut Filter: Yes
- r. IR Peak Emission Wavelength 850nm
- s. Signal to Noise Ratio (SNR): +-50 dB

24. Video:

- a. Compression: Enhanced H.265 Main Profile + Enhanced H.264/H.265 Main/High/Baseline Profile: (MPEG-4 Part 10) + MJPEG, triple-streaming
- b. Performance:
 - 1) Single stream 30/25 FPS @ 4K Ultra HD (3840 x 2160) (NTSC/PAL) or
 - 2) Triple-stream: 4K @ 15/12 FPS + HD1080P @ 15/12 FPS + D1 @ 15/12 FPS (PAL/NTSC) simultaneously or
 - 3) Triple-stream: HD 1080P @ 60/50 FPS + 720P @ 30/25 FPS + D1 @ 30/25 FPS (PAL/NTSC) simultaneously
- c. Resolution Range: Scalable from D1 to 4K UHD
- d. Bandwidth:
 - 1) Configurable between 64Kbps to 20,480Kbps
 - 2) Rate Control: CBR/CVBR/VBR/MJPEG
- e. Video Motion Detection (VMD):
 - 1) Intelligent multi-zone VMD
 - 2) Up to four independent zones

25. Audio:

- a. Bidirectional Audio:
 - 1) Line-level In for using line-level audio inputs
 - 2) Line-level Out to feed any single-ended line-level audio input, such as an amplified bullhorn, amplified speakers, or public address system
- b. Compression: G.711

26. Alarms:

- a. Input: One (1) dry contact
- b. Output: One (1) relay contact

- 27. Network:
 - a. Ethernet: 10/100 IEEE 802.3, auto sensing 1 x RJ45
 - b. Protocols: TCP, UDP, ICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTSP, RTCP, PPPoE, NTP, UPnP, SMTP, SNMP, IGMP, 802.1X, QoS, IPv4, IPv6, SSL, LDAP
 - c. Digital Streams: The camera shall provide up to three digital streams plus bi-directional audio on one Ethernet connection
 - d. Web Browsers: Internet Explorer 10+, Firefox 50+, Chrome 55+
- 28. Management:
 - a. Configuration: Remote (via web interface or supported Video Management Software)
 - b. Firmware Updates: Flash memory for upgrade of camera firmware over the network
- 29. Power:
 - a. Input Voltage:
802.3af Power over Ethernet (PoE) Class 0
 - b. Power Consumption: 8 Watts indoor or 13 Watts outdoors with heater and IR on
- 30. Connections:
 - a. Network: RJ45
 - b. Power:
PoE: Through the RJ45 connector
 - c. Audio In/Out:
1) Line In/Line Out: 1.5mm audio jacks
 - d. Alarm In/Alarm Out: Through terminal block connector
 - e. microSDXC card drive: For recording up to 128GB, Class 10 (card not included)
- 31. Physical and Mechanical:
 - a. Physical:
1) Dimensions: 215 x 86 x 80 mm (8.48 x 3.39 x 3.15 in.)
2) Unit Weight: 1.3 lbs. (0.59kg), 4 lbs. with packaging

- 3) Volume Weight: 3 lbs., (1.35kg)
 - 4) Enclosure: IP67/NEMA 4 with IK7 vandal-resistant rating
- b. Mechanical:
 - 1) View Port Rating: IK7 Vandal Resistant Polycarbonate
 - 2) View Port F-Stop:
 - a) Clear: F0.0
 - 3) Pan/Rotate/Tilt: 360 degrees Pan/360 degrees rotate/80 degrees tilt
- 32. Environmental:
 - a. Operating Temperature:
 - 1) Unified Indoor/Outdoor Model: -40°F to 122°F (-40°C to 50°C)
 - b. Storage Temperature: -40°F to 140°F (-40°C to 60°C)
 - c. Humidity: Up to 90% (non-condensing)
 - d. Ratings: IP67 and NEMA 4
 - e. Internal Heater: Automatic
- 33. Regulatory:
 - a. USA: FCC 47 CFR Part 15, Subpart B, Class A; UL (UL60950)
 - b. Worldwide: CE (EN55022-1998 Class A; EN50130-4; EN60950),
RoHS, RCM
- 34. Warranty: Four-years
- 35. Ordering Information: Model numbering legend for cameras or use information from other approved alternate manufacturer.
 - a. Type: CB = Fixed bullet video camera
 - b. Series: 33 = Ariel Series 3
 - c. MP Resolution: 08 = 8.3MP 4K Ultra HD
 - d. Lens Type:
 - 1 = D/N 3.4~9mm UHD quality, motorized, auto-focusing with P-Iris lens
 - e. Housing and IR illuminator options:

- 1) 1 = Indoor/Outdoor IP67 IK7 vandal-resistant housing with heater/IR day/night
- 2) – I = IR illuminator option

36. Other Options:

- a. Surface mount: CB-4S-31 4S Mounting Adapter
- b. Wall Junction Box: CB-WLBX
- c. Pole Mount: CB-PLBX

D. Provide indoor/outdoor 4x2K Convertible 180°/360° panoramic mini-dome H.265/H.264/MJPEG IP camera designed for operation in spaces that require video coverage of a wide area of interest, and able to be deployed interchangeably by the installation technician for both 360 and 180 mode mounting orientations, or approved equivalent by a major manufacturer.

1. Up to 4K (4 x 1080p image sensors), triple-stream H.265/H.264/MJPEG, True (Shutter) WDR support, IP67-rated, day/night mini-dome digital video camera with fixed F2.0, 3.6mm lens, within an IK10 vandal-resistant housing for overhead mounting or side orientation mounting, designed so that the same unit can be deployed with 360 or 180 mode orientations.
2. The camera shall be equipped with sensors and lenses that are field configurable, supporting both 360 and 180 modes
3. The camera shall automatically sense when it is being used in 360 or 180 mode deployment.
4. The camera shall provide a Mechanical Tilt capability in both 360 and 180 mode orientations
5. Mounting accessories shall be compatible with other dome cameras provided by the same vendor
6. In 360 mounting mode, the camera should provide up to three simultaneous single streams (with resolutions and frame rates selected by the user from the available options) containing four images, one in each direction.
7. In 180 mounting mode, the camera shall provide up to three simultaneous single streams (with resolutions and frame rates selected by the user from the available options) containing a blended stitching of the linear scene. User adjustment of the digital stitching shall be supported. In order to support the wide viewing angles required for 180 mode mounting, an aspect ratio of 24:9 shall be supported.
8. The three (3) simultaneous video streams (up to 4K) shall be delivered through a digital network.
9. Resolution and bandwidth shall be scalable.
10. The camera shall incorporate a fully digital 4 x 1080p Full HD CMOS imaging system with IR illumination and day/night IR cut filter for infrared sensitivity.

11. The imaging system shall incorporate Back Side Illumination to enhance pixel sensitivity to a level of at least 1/2.8" BSI.
12. WDR – the camera shall support multi-exposure, shutter based Wide Dynamic Range capability
13. The camera IR illumination shall be separately controllable for X and Y axis, so that the illumination can be optimized for the requirements of either 360 or 180 mode mounting.
14. IR illumination shall have a range of 25 m.
15. The camera shall utilize scene adaptive algorithms to provide a high image quality with low bandwidth and storage requirements (Smart Picture Quality to automatically adapt to wider range of changing conditions using advanced picture settings optimizations).
16. The camera shall provide bi-directional audio via audio I/O.
17. The camera shall accommodate alarm inputs and provide a relay output.
18. The camera shall provide a microSDXC card slot with support for up to 128GB (Class 10) devices.
19. The camera may be powered by 802.3at PoE+ or 24VAC
20. The camera shall be IEEE-compliant utilizing the multicast networking protocol such that a single camera may be transmitted to multiple viewers/archivers on the network simultaneously, further reducing bandwidth and providing greater flexibility in network monitoring/recording configurations.
21. The digital video camera shall provide the user with H.265 and H.264 video compression on up to three digital streams simultaneously.
22. Resolution shall be scalable dependent on operation mode, from D1 to 4K/3840x1440 which may be set to unicast or multicast.
23. The camera shall be capable of producing 30 frames per second (NTSC) and/or 25 frames per second (PAL) 4K Ultra HD (3840 x 2160) video stream
24. The camera shall be capable of producing (NTSC) or (PAL) Full HD / 1080P (1920 x 1080) video stream at 30 frames per second.
25. Bandwidth shall be scalable between 64Kbps and 20,000Kbps.
26. The camera shall support the functionalities required to implement mechanisms for automatic dynamic video streaming adaptation with supported VMSs. The camera shall showcase valid integrations, introducing such mechanism with one or more VMS products.
27. The audio capabilities shall support either half-duplex or full-duplex audio on two-way connections.
28. The camera shall accommodate alarm-input and alarm-output.

29. The camera shall provide a password protected web Interface for viewing, configuration and control. The web interface shall support the following web browsers: Internet Explorer, Chrome and Firefox.
30. Motion Detection:
 - a. The camera shall provide intelligent multi-zone video motion detection with the following configurable parameters:
 - 1) Sampling pixel interval (1-10)
 - 2) Detection level (1-100)
 - 3) Sensitivity level (1-100)
 - 4) Time interval(sec) (0-7200)
31. Storage and Bandwidth Efficiency:
 - a. Motion Compensation and Processing:
 - 1) The camera shall employ industry-standard motion compensation methods as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce the storage and bandwidth consumption associated with scene motion.
 - 2) Compliant motion compensation shall employ a block-matching algorithm covering an area of at least 256 macro-blocks surrounding each block to be processed.
 - 3) The motion compensation process shall output industry-standard H.265 and H.264 compliant motion vectors as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce storage and bandwidth consumption associated with scene motion.
 - 4) The compliant motion vectors shall be compatible with and verifiable using Windows Media Player equipped with FFDSHOW or equivalent utility to visualize the motion vectors contained within the resulting H.265 / H.264 video stream.
 - b. Compression Efficiency:
 - 1) The camera shall provide an effective rate control algorithm which maintains set frame rates of full 30fps (NTSC) or 25fps (PAL) in 4K Ultra HD using no more than 45 (+/-10%) pixels per bit of storage with full screen (100%) motion including panning/tilting velocities of at minimum 25% of the camera field of view per second.
 - 2) Pixels per bit (ppb) efficiency shall be defined as $ppb = (ppf) * (fps) / (bps)$ where:
 - a) $ppb = \text{pixels per bit}$

- b) ppf = pixels per frame (= horizontal resolution x vertical resolution)
- c) fps = frames per second
- d) bps = bits per second. This is a bandwidth measurement which equals the Kb/s generated by the camera x1000

32. The camera shall meet or exceed the following specifications:

Camera:

- a. Image Sensor:
 - 1) 4x 1/2.8" BSI CMOS
 - 2) Day/Night with IR sensitivity
- b. Sensor Resolution: 4 x 2.1 megapixels (1920 x 1080)
- c. Scanning Mode: Progressive
- d. Sensitivity:
 - 1) Color (Day) Mode: 0.02 lux @ 30 IRE
 - 2) B/W (Night) Mode: 0.1 lux without IR, 0 lux with IR @ 30 IRE
- e. Lens Type:
 - 1) F2.0, 3.6mm, fixed-focus lens
 - 2) H FoV 92°
- f. IR Illuminator: High-power/high-efficiency SMD devices with wide-angle illumination arranged to cover both installation modes.
 - 1) Effective IR range: Up to 25m (82 feet)
 - 2) Illumination Angle: 60 degrees
 - 3) IR Compensation: Automatically adjusts the scene brightness to compensate for nearby bright objects.
- g. White Balance: Auto/ATW/Manual
- h. Automatic Electronic Shutter (AES): 1.0 to 1/10,000 sec. (Auto)
- i. Digital Slow Shutter: 1~30 fps (NTSC)/1/1.5~25 fps (PAL)
- j. Noise Reduction: ,3DNR
- k. Digital Wide Dynamic Range: Low/Medium/High/Off
- l. Day/Night Mode: Auto/Color/B&Wa

- m. Tamper Detection (On/Off)
- n. Privacy Zone: On/Off (8 zones)
- o. Video Motion Detection: Up to 4 independent zones
- p. Mechanical IR Cut Filter: Yes
- q. IR Peak Emission Wavelength 850nm
- r. Signal to Noise Ratio (SNR): +-50 dB

33. Video:

- a. Compression: Enhanced H.265 Main Profile + Enhanced H.264/H.265 Main/High/Baseline Profile: (MPEG-4 Part 10) + MJPEG, triple-streaming
- b. Performance:
 - 360 Mode:
 - 1) Single stream 4K Ultra HD (3840 x 2160) (NTSC/PAL) @ 30/25 FPS or
 - 2) Dual Stream 4K @ 15/12 FPS + HD1080P @ 15/12 (PAL/NTSC) simultaneously or 4K Ultra HD (3840 x 2160) @ 25FPS + D1 @ 25 FPS or Full HD 1080p + HD 720p @ 25/30 FPS
 - 3) Triple-stream: 4K @ 15/12 FPS + HD1080P @ 15/12 FPS + D1 @ 15/12 FPS (PAL/NTSC) simultaneously 180 Mode:
 - 4) Single stream 3840 x 1440 (NTSC/PAL) @ 30/25 FPS
 - 5) Dual Stream 3840 x 1440 + 1920 x 720 @ 25/30 FPS
 - 6) Triple-stream: 3840 x 1440 + 1920 x 720 @ 15/12 FPS + D1 @ 20 FPS (PAL/NTSC) simultaneously
- c. Resolution Range: Scalable from D1 to 4K UHD
- d. Bandwidth:
 - 1) Configurable between 64Kbps to 20,000Kbps
 - 2) Rate Control: CBR/CVBR/VBR/MJPEG
- e. Video Motion Detection (VMD):
 - 1) Intelligent multi-zone VMD
 - 2) Up to four independent zones

- 34. Audio:
 - a. Bidirectional Audio:
 - 1) Line-level In for using line-level audio inputs or Mic-in
 - 2) Line-level Out to feed any single-ended line-level audio input, such as an amplified bullhorn, amplified speakers, or public address system
 - b. Compression: G.711 (uLAW/aLAW)/G.726/AAC/PCM
- 35. Outlet
Alarms:
 - a. Input: One (1) dry contact
 - b. Output: One (1) relay contact, 400VDC/250VAC @ 120mA maximum
- 36. Network:
 - a. Ethernet: 10/100 IEEE 802.3, auto sensing 1 x RJ45
 - b. Protocols: TCP, UDP, ICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTSP, RTCP, PPPoE, NTP, UPnP, SMTP, SNMP, IGMP, 802.1X, QoS, IPv4, IPv6, SSL, LDAP
 - c. Digital Streams: The camera shall provide up to three digital streams plus bi-directional audio on one Ethernet connection
 - d. Web Browsers: Internet Explorer 10+, Firefox 50+, Chrome 55+
- 37. Security
The camera shall support internal and end-to-end security features that limit access and make it more difficult for unauthorized control signals to be carried out. The following shall be supported at a minimum:
 - a. Direct camera support for:
 - 1) Password protection,
 - 2) IP address filtering,
 - 3) HTTPS encryption,
 - 4) IEEE 802.1X network access control,
 - 5) Digest authentication.
 - b. End-to-end support (when connected to a VMS system that supports security features, for User-configurable security policies that enable enforcement of the following:

- 1) Compulsory changing of the manufacturer's default unit passwords
- 2) Secured connections (TLS) for control messages, using unit self-certificates or downloaded third-party certificates

38. Management:

- a. Configuration: Remote (via web interface or supported Video Management Software)
- b. The and initial capabilities.
 - 1) Discover camera by connection to the camera network
 - 2) Display existing DHCP address (if there is a DHCP server), default IP address, MAC address.
 - 3) Display installed Firmware version,
 - 4) Reset camera to supplier defaults.
 - 5) Upgrade the firmware
 - 6) Assign a user-defined IP address
 - 7) Display camera uptime.
- c. Firmware Updates: Flash memory for upgrade of camera firmware over the network

39. Power:

- a. Input Voltage:
 - 1) 24VAC (+20%)
 - 2) IEEE 802.3at (PoE+)
- b. Power Consumption: 24.9W with IR and heater operating

40. Connections:

- a. Network: RJ45
- b. Power:
 - 1) 24VAC (through terminal block connector)
 - 2) PoE+: through the RJ45 connector
- c. Audio In/Out:
 - 1) Line In/Line Out: through terminal block connector

- d. Alarm In/Alarm Out: through terminal block connector
 - e. microSDXC card drive: For recording up to 128GB, Class 10 (card not included)
 - f. RS-485: PelcoD and PelcoP protocols
 - g. Analog Video: BNC (1V p-p), 75Ω
41. Physical and Mechanical:
- a. Physical:
 - 1) Dimensions: Ø 190 x 130 mm (7.5 x 5.1in.)
 - 2) Unit Weight: 3.44 lbs. (1.56kg)
 - 3) Enclosure: IP67 with IK10 vandal-resistant
 - b. Mechanical:
 - 1) IK10 Vandal Resistant Polycarbonate
42. Environmental:
- a. Operating Temperature: -40°F to 122°F (-40°C to 50°C)
 - b. Storage Temperature: -40°F to 140°F (-40°C to 60°C)
 - c. Humidity: Up to 90% (non-condensing)
 - d. Ratings: IP67
 - e. Internal Heater: Automatic
43. Regulatory:
- a. Safety: AS/NZS CISPR22 (Class B); EN50130-4; EN61000-3-2/3; EN61000-4-2/3/4/5/6/8/11; EN61000-6-3 (Class B); UL 60950-1
 - b. Electromagnetic Interference (EMC): ANSI C63.4: 2009 (FCC 47 CFR Part 15 Subpart B, Class B; CISPR Pub. 22); EN55022:1998 Class A; EN55032:2012; EN60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + A2:2013; EMC Directive 2004/108/EC; IEC 60950-1:2005 (Second Edition) + Am 1:2009 + Am 2:2013; ICES-003: Issue 5
 - c. Environmental: RoHS 2011_65_EU, excluding Pb in 2LI (lead on second level interconnect); WEEE Directive 2012/19/EU; REACH

3.2.9 CABLING SYSTEM Station Cables (DATA)

- 1. The Communications Contractor shall be responsible for obtaining a low voltage installation permit from the appropriate authority prior to start of installation.

2. The Communications Contractor shall be responsible for consulting with the building inspector to determine whether there are special local requirements for strapping the cables in the attic area.
3. The Communications Contractor shall be responsible for coordinating with the building's General Contractor to determine the cable routings, schedules for cable placement and ceiling inspection.
4. The Communications Contractor shall provide installation of the cable hangers and sleeves that will support the horizontal cables in the attic area per all applicable local building code(s).
5. The Communications Contractor shall furnish and install voice/data locations, voice only locations, and data only locations as required.
6. The Communications Contractor shall furnish and install whips, wall plate adapters and floor plate adapters.
7. All data outlets shall be furnished and installed complete with two (2) data jacks (Cat 6, RJ45) terminated with two (2) Cat6 plenum rated cables unless otherwise noted.

A. System Requirements

1. All data cables shall be General Cable GenSPEED 6000 Enhanced Category 6 plenum rated 23 AWG, 4-pair, blue jacket cables. No substitutions will be allowed without prior written approval from the Telecom Project Manager. All cables shall be installed from the station jack directly to the appropriate Cat 6 patch panels in the MDF. All cable pairs or modular jacks shall be wired to ANSI/TIA/EIA568-B using T568-A wiring scheme at both ends. All cables shall be tested to minimum Cat 6 standards.
2. The jack housings and faceplates shall have two (2) positions for jacks. Blank covers shall be installed in vacant jack positions. Jack housings and faceplates shall be compatible with the Panduit Mini-Com Jacks. The type and color is to be determined by the installed location. Some will be flush or non-flush. Modular furniture faceplates shall be color coordinated with the color of the furniture base plate. The Communications Contractor shall furnish and install the proper jack housings and faceplates. The Communications Contractor shall determine the type of faceplate prior to the scheduled installation and must be approved by the city's IT Telecom Project Manager prior to use.
3. Floor boxes or monuments shall be flush-mounted and fully adjustable with trade size conduit feeds (3/4", 1" and 1 1/4"). Depending on the number of floor box gang (required for power receptacles and data/voice jacks) required on the floor box, Legrand/Wiremold RFB2, RFB4 and RFB6 Series floor boxes shall be used. Specific type and model shall be specified depending on ground (i.e. tile, carpet or wood) type. FPCTCBZ (Bronze) or FPCTCBS (Brass) flanged cover shall be used depending on the choice of DPW Project Manager on a particular project. All conduit feeds shall be in accordance with the Conduit Sizes for Low Voltage Wires and Cables (to be provided by Telecom Project Manager).
4. Floor monument mounting plates shall be Panduit CF-1064EI.

5. The Communications Contractor shall furnish and install patch panels and wire managers or organizers.
 - a. Patch panels shall be provided for the STAFF areas. The patch panels shall be Panduit Mini-Com 48 port all metal modular, part number CP48BLY. The horizontal wire organizers shall be Panduit WMPH2E and WMPSE as required. Furnish one (1) horizontal wire organizer per patch panel plus one (1) additional wire organizer at the top of each row of patch panels. Be sure to include the Panduit Mini-Com Jacks on the patch panel. Vertical wire managers shall also be furnished and installed as required using Panduit WMPVHC45E as specified in the Equipment Rack Elevation layout.
6. The RJ45 data jacks shall be wired according to TIA/EIA 568-B using the T568-A wiring scheme.
7. All jacks (Cat 6, RJ45) shall be Panduit Mini-Com Jacks part number CJ6X88TGBU (blue). No substitutions will be approved.
8. All data jacks and patch panels shall be labeled according to Ridgecrest standards. Labels are to be typed or printed with a labeling device and permanently affixed. No hand-written lettering is acceptable. The labels shall be printed on white tape with black lettering for jacks. Patch panels shall be labeled both front and back. The patch panel labels shall be black tape with white lettering, four (4) labels per strip. See the Project Manager if further clarification is needed.
9. All jacks shall be modular Panduit, Panduit Mini-Com Jacks. All jacks (Cat 6, RJ45) shall be Panduit Mini-Com Jacks part number CJ688TGOB (Blue). Substitutions must be city approved. The STAFF areas shall use blue jacks.
 - a. All voice/data outlets shall be furnished and installed complete with two (2) data jacks (Cat 6, RJ45) terminated with two (2) Cat6 plenum rated cables unless otherwise noted.

Example: DXYYYYZZZ (Data jack) - D1001MDF, D1002MDF...

VXYYYYZZZ (Voice jack) - V1001MDF, V1002MDF...
10. D stands for data, V stands for Voice, X stands for floor level, YYY is jack number starting from 001, and ZZZ is the serving patch panel or MDF/TR room. Alpha (A&B) lettering of data jacks in not allowed. Data designation "D" and MDF shall not be required for the Patch Panel labeling.

Example: XYYY - 1001, 1002...
11. The MDF end of the voice cables (if applicable) shall be terminated on the 66 blocks mounted in the designated location in the MDF/TR backboard. 66 block label starts from 1001, 1002, and so on.
12. All wire and cable runs in the ceiling area shall be supported with ceiling hangers, supplied and installed by the selected Communications Contractor. Cables must be supported at a space interval that is allowable by code. At no point shall cable(s) rest on acoustic ceiling grids, panels or lighting support wires, electrical conduit or HVAC pipes or ducts.

13. Cable shall be installed in continuous lengths (no splices allowed) from origin to MDF, using the shortest route possible, and shall be tight bundled in groups of no more than six-around-one, and combined bundles of six-around-one of not greater than three bundles or a total of 21 cables.



Section DC D8 BSD – LOW VOLTAGE CRITERIA

14. The data cables shall be bundled with a Velcro type of tie, such as Panduit HLS, HLM, HLC or equivalent. Do not use plastic ties on data cables.
15. Furnish and install flexible tubing (Seal Tite) to conceal wire runs into modular furniture or where needed to secure multiple exposed cables.
16. It shall be the responsibility of the Communications Contractor to determine and furnish the quantity of voice/data wire needed.
17. The Communications Contractor shall furnish and install three (3) Category 6 cables with three (3) RJ45 jacks; two (2) adjacent to the Fire Alarm Monitor Panel and one (1) adjacent to the Intrusion Alarm System. The other end of the alarm cable should terminate on a 66 blocks (not on the relay rack patch panel) near the Telco blocks at the MDF. This will be used to provide Telco dial tone to the alarm systems. The mb lines to be used will be ordered by Project Manager. The Communications Contractor will cross-connect the alarm mb lines from the Telco block to the 66-block. The alarm contractor will terminate the lines into the alarm systems.

B. Workstation Outlets

1. Each outlet location installed in the wall, on the modular furniture system, or on the floor, shall be equipped with two (2) data jacks (CAT6, RJ45) terminated with two (2) CAT6 plenum-rated cables (UON). Provide and install jacks with a color to be determined by DPW Project Manager.
2. Each outlet location shall be provided with two (2) Cat 6 cables unless otherwise noted on the plan.
3. All jacks shall be Category 6, 8 position, 8 wire with termination cap color, wired to the ANSI/TIA/EIA 568-B using the T568-A wiring scheme. The jack faceplates shall have two (2) positions for RJ45 jacks. All jacks shall be manufactured by Panduit (CJ688TGBU). No brand substitutions will be accepted by the City.
4. Panduit (CFPE2) shall mount jacks on a two- (2) module, Electrical Ivory, faceplate for the wall.

5. Where outlet location is specified for a wall-mounted telephone, provide and install a voice cable terminated on a RJ45 jack with a single module faceplate by Panduit (Phone Plate with module – KWP3Y).
6. Provide and install appropriate faceplate, extender as determined by modular furniture brand. The jack faceplates shall have two (2) positions for RJ45 jacks. The Communications Contractor shall determine bracket type and color prior to scheduled installation.
7. If faceplates are mounted to double gang boxes, the Communications Contractor shall provide and install, as required, In-Wall box adapters as manufactured by Panduit.
8. The Communications Contractor shall be responsible to install cover plates or blank modules of the appropriate color on any unused single or double gang boxes. Modules by Panduit (CMB).
9. The Communications Contractor shall provide cross-connect jumpers for telephone lines as required from the MPOE to MDF, between MDF's and IDF's and for faxes, modems, elevator phones, fire alarm and security systems, etc. as required.
10. Any deviation/substitution must be verified and approved in writing by the DPW Project Manager prior to use.

C. Wireless Network Access Point Data Cables

1. Category 6 data cables will be used to provide connectivity between the Wireless Access Points (WAPs) and the data network switch in the MDF or Telecommunications Closets. Two (2) run of data cables terminated with RJ45 jacks shall be provided per AP location. The jacks shall be mounted on a biscuit with dual port mount or a junction box with a faceplate for dual jacks.
2. The Contractor shall run and position the data cables in the ceiling space and terminate the data cable on an RJ45 jack (orange color) mounted on the faceplate of a single gang box outlet installed below the ceiling). The Contractor shall patch the WAPs as required with "orange" patch cords (at device end) and "Yellow" patch cords on the patch panel.
3. The locations of the Aruba WAPs and Category 6 cable runs will be determined following an RF survey or as per layout drawings provided by the Telecom Project Manager.

4. The WAPs shall be installed per the manufacturer's installation guidelines, below ceiling and horizontally mounted with logo facing downward. Vertical installation of the WAPs will not be allowed. Any deviation will require prior approval of the DPW Project Manager. Oberon Model 1029 wall-mount bracket shall be used for wall-mounted WAP installations. The jacks shall be mounted on a dual port faceplate. When aesthetics is strictly required by the architect, Terrawave Model TWC-AC-BKT-L mounting bracket shall be used for above T-bar ceiling installations. For below suspended ceiling/T-bar ceiling installations, use Ceiling Grid Clip, Recessed (AIR-AP-T-Rail-R), if the ceiling tiles land below the ceiling grid. Use Ceiling Grip Clip, Flush (AIR-AP-T-RAIL-F) if the T-bar ceiling tiles are flush with the ceiling grid. For hard ceiling installations with data outlet boxes mounted on the ceiling, Universal Mounting Bracket (AIR-AP-BRACKET-2) shall be used.

D. Patch Cables

1. The Communications Contractor shall furnish patch cords per length, color and quantity as required by DBT's design and confirmed by Telecom Project Manager.
2. Patch cords shall be Panduit Category 6, 23 AWG stranded, 4-pair assemblies with RJ45 plugs on both ends, straight through (no pair reversals), and "slender strain" relief and "clear" boot type, Category 6, UTPSP, patch cords. The Communications Contractor shall be responsible for the installation and dressing of all patch cables in the MDF, TR and Workstations based on the Patch Schedule provided the Telecom Project Manager.

E. CABLE TESTING

1. All testing shall be per the Ridgecrest City STD-902 Testing Standard. An orientation with the Telecom Project Manager shall take place on site prior to the test. It shall be scheduled at least one week in advance. Telecom Project Manager shall certify prior to testing the following:
2. Test meters have been calibrated to TIA/EIA Standard within the last 12 months. With a Certificate of Compliance, meter serial number and dated.
3. Test meter shall be fully charged.
4. Test configuration set to the City Standards.
5. Manufacturer's warranty certification (if applicable) requirements shall be reviewed to ensure that all warranty requirements are met.
6. The Communications Contractor shall furnish one (1) printed copy and one copy on CD-ROM, with the complete set of test results. Copies of PC based software to view drawings and results shall also be provided to the DPW Project Manager.

F. Communications Contractor Requirements

1. Communications Contractor shall provide sufficient skilled labor to complete testing within the agreed upon test period.

2. Communications Contractor shall have a minimum of 3 years experience installing and testing structured cabling systems. All installers assigned by the Contractor to the installation shall have factory certification that they are qualified to install and test the provided products.
3. Communications Contractor is responsible for supplying all of the required test equipment used to conduct acceptance tests.
4. Communications Contractor is responsible for submitting acceptance documentation as defined in section 3.7.5 below.

G. Test Process

1. The City reserves the right to be present during any or all of testing.
2. Testing shall be of the Permanent Link. However, the Communications Contractor shall warrant performance (see Part 3) based on Channel performance and provide patch cords that meet channel performance.
3. All cabling not tested strictly in accordance with these procedures shall be re-tested at no additional cost to the City.
4. 100% of the installed voice and data cabling must be tested. All tests must pass acceptance criteria defined in 3.7.5.d.
5. Test equipment shall be fully charged prior to each days testing.

H. Standards Compliance & Test Requirements

1. Cabling must meet the indicated performance specifications:
_____ TIA 568B Category 6
_____ TIA 568A Category
2. All test equipment used must meet the performance specifications defined in section 3.7.6 below.

I. Documentation

1. Test reports must be submitted in hardcopy and electronic format. Hand-written test reports are not acceptable. Hardcopy reports are to be submitted in labeled 3 ring binders with an attached affidavit verifying passing execution of all tests. For large installations electronic reports with hardcopy summaries are preferred. Hardcopy summary reports shall contain the following information on each row of the report: circuit ID, test specification used, length, date of test, and pass/fail result.

2. Electronic reports are to be submitted by Electronic Copy. If proprietary software is required to view test results, the software shall be provided to DPW Project Manager. If the results are delivered in a standard format like Excel, Access, CSV files, etc. then software to read these files need not be provided. Electronic reports must be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.
3. Test reports shall include the following information for each cabling element tested:
 - a. Wiremap results that indicate the cabling has no shorts, opens, misfires, split, reversed, or crossed pairs, and end to end connectivity is achieved.
 - b. For Category 6 cabling: Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst-case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
 - c. Length (in meters), propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
 - d. Cable manufacturer, cable model number/type, and NVP
 - e. Tester manufacturer, model, serial number, hardware version, and software version
 - f. Circuit ID number and project name
 - g. Autotest specification used
 - h. Overall pass/fail indication
 - i. Date of test
 - j. Test reports shall be submitted within 7 business days of completion of testing.

J. Testing and Acceptance

1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions.
2. All copper pairs of each installed cable shall be tested and verified prior to system acceptance.

3. Any defect in the cabling system performance or installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
4. All cables shall be tested in accordance with this document, the ANSI/TIA Standards, the Panduit warranty guidelines, and industry best practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

K. Copper Channel Testing

1. All twisted-pair copper cable links shall be tested for compliance to the requirements in ANSI/TIA for the appropriate Category of cabling installed using a test unit meeting a minimum IEC IIIe level of accuracy.
2. All testers used must have been factory calibrated by the manufacturer within one year of use or according to factory calibration recommendations, whichever is more stringent.
3. Contractor shall set references according to manufacturer's recommendation prior to each day's testing and reset references anytime the tester unit shuts down due to inactivity.
4. Resetting references shall also be done whenever test results become sporadic or the tester demonstrates a consistent deterioration of test measurement performance.
5. Testing of any links that include field-terminated plugs shall follow the procedure outlined in Panduit document #PN614, available from the Panduit representative, or downloadable from www.panduit.com.

L. Testing Equipment

1. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years' experience in producing field test equipment. Manufacturers must be ISO 9001 certified.
2. All test tools of a given type shall be from the same manufacturer and have compatible electronic results output.
3. Test adapter cables must be approved by the manufacturer of the test equipment. Adapters from other sources are not acceptable.
4. Baseline accuracy of the test equipment must exceed TIA Level III, as indicated by independent laboratory testing.
5. Test equipment must be capable of certifying Category 6 links.
6. Test equipment must be capable of storing full frequency sweep data for all tests and drawing color graphical reports for all swept measurements.
7. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.

8. Test equipment must be capable of running individual NEXT, return loss, etc. measurements in addition to autotests. Individual tests increase productivity when diagnosing faults.
9. Test equipment must include a library of cable types, sorted by major manufacturer.
10. Test equipment must store Category 6 autotests in internal memory.
11. Test equipment must be able to internally group autotests and cables in project folders for good records management.
12. Test equipment must include DSP technology for support of advanced measurements.
13. Test equipment must make swept frequency measurements in compliance with TIA standards.
14. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.

3.2.10 VOICE COMMUNICATIONS SYSTEM

VoIP System

A. System Description and Installation Requirements

1. The City has directed that all new Voice Systems be part of a centrally administered, distributed processing system. City to install a WAN router at the site and as required. The city will insure connectivity is implemented to the Hosted VoIP systems.
2. The Contractor (if included in the scope of work) shall, at a minimum, test all newly installed equipment using the City of Ridgecrest LAN and IPT System Functionality and Cut-Over Test Plan (to be provided by the city IT Project Manager) as applicable or as directed by the Project Manager. The City reserves the right to require additional tests not listed on said Test Plan. The Contractor shall coordinate with Ridgecrest Project Manager as to which tests are applicable. The Project Manager shall be present and shall participate in all tests. Further, the Contractor shall certify to the IT Project Manager and Communication Services Analyst that the system is fully operational and functional.
3. The city's IT Project manager or personnel shall be responsible for password logon access to the Hosted system servers. No access shall be given to the Contractor.
4. The Contractor (if included in the scope of work) shall be responsible to perform the following tasks to ensure a successful and consistent installation:
 - a. Develop configuration documentation with input from the city.

- b. Develop an implementation-specific Network diagram with input from the City's design team.
 - c. Receive and inventory all equipment delivered at the site on the approved form provided by Project Manager where required. Record all pertinent information including but not limited to the model name/number, serial numbers, OS and/or IOS versions.
 - 5. Verify the operation of the programmed and installed Communications per the Project Implementation Plan.
 - 6. Document and deliver system completion certificates for the equipment installed.
 - 7. Develop project implementation test plans with input from the city.
 - 8. The Contractor shall utilize an IP address scheme furnished by the city. Separate VLANs shall be provided for data devices; VoIP telephone instruments, The Contractor shall permanently affix a machine printed label with the assigned IP address to each equipment component to which one has been assigned.
 - 9. The Contractor shall furnish, install, set-up and configure all equipment for use with the city's Operations Manager.
- A. No more than one (1) week after the telephone system is fully operational, the IT Project Manager, IT Supervisor or his/her designee and appropriate Staff will test all newly installed equipment. The city IT shall at a minimum test all newly installed equipment and configuration using the city of Ridgecrest LAN and IPT System Functionality and Cut-Over Test Plan, installation and configuration will be signed off by the Project Manager, VoIP Engineer, city IT Project Manager and the Communications Contractor. A Certificate of Acceptance will be signed by the IT Project Manager, Telephone Repair Shop designee, and City Staff, where available. The warranty of the telephone system infrastructure and cabling will start on the signature date.
 - B. The Communications Contractor shall cross-connect all PSTN facilities as required and determined by CITY Project Manager and DPR Staff. These may include but are not limited to PRIs, analog trunks, faxes, and modem lines. Physical locations for faxes and modems to be determined during installation.
- 3.2.11 WiFi Wireless Network
- A. Indoor access points shall be Aruba model 600 series (or approved equal) ceiling-mounted or wall-mounted. Exact location to be reviewed and verified with the city's Telecom Project Manager and as per provided access points layout.
 - B. Outdoor access points shall be Aruba (or approved equal). Exact location to be reviewed and verified with the city's Telecom Project Manager and as per provided access points layout.
 - C. Below are the three (3) standard Wifi networks which may be provided (contractor must coordinate with the city's IT project Manager or approval):
 - 1. An open, unauthenticated wireless network that provides access to the Internet only for the general public (access is subject to the standard city URL filtering policy).
 - 2. A secure wireless network that requires an RSA SecureID token or adaptive authentication in order to gain access to city resources.

3. A secure wireless network for mobile devices that requires each device to be registered prior to accessing the network. Access is to the Internet as well as a limited number of Intranet sites is provided.
- D. External access points shall be Aruba per project requirements as this is the city's Standard manufacturer used.

3.2.12 DISTRIBUTION CABLING (where applicable)

A. Voice Cabling

1. The Communications Contractor shall provide, install and terminate an appropriately sized, CMR or CMP rated CAT3 cable (as determined by the city Telecom Project Manager), to provide connectivity between the MPOE and MDF.
2. Backbone cables shall be installed separately from the station cables. Where both cables are installed in a cable tray or wire way, backbone cables shall be installed first and bundled separately from the station cables.

3.2.13 Cable Pulling and Termination

A. General

1. Contractor is responsible for installing systems according to all applicable codes and the standards cited in this document.
2. Contractor shall use grommets to protect the cable when passing through metal studs or any openings that can possibly cause damage to the cable.
3. Do not deform the jacket of the cable. The jacket shall be continuous, free from pinholes, splits, blisters, burn holes or other imperfections.
4. Install proper cable supports, spaced less than four (4) feet apart, and within manufacturer's requirements for fill ratio and load ratings.
5. Leave a pull string to the end of each conduit run. Replace pull string if it was used for a cable pull.
6. Note service loops may not touch the ceiling assembly and if so must be remedied at the Contractor expense.
7. Label every cable within 12 in. of the ends with self-laminating wire wrap cable appropriate to that cable size. Use a unique number for each cable segment as required by the project documentation and the labeling section of this document.
8. Dress the cables neatly with hook and loop cable ties in telecommunications rooms. Plastic ties are approved in pathways where cable bundles will not be reentered.
9. The contractor is responsible for using plenum-rated cable ties in plenum spaces.

B. Copper

1. All Greenfield (new) projects shall use Cat 6 cable.

2. Within all new (Greenfield) installations within Ridgecrest City, contractors shall use copper pinout T568B.
3. All four pair Category 6 cable runs shall be kept to a maximum of 295 feet / 90 meters for each run.
4. Use low to moderate force when pulling cable. Maximum tensile load may not exceed 25' lbs. maximum pulling force per 4 pair cable.
5. Patch cords in horizontal links (equipment side and work area side) shall total no more than 10 meters.
6. No pathway, including conduits, shall have greater than a 35% fill per TIA and BICSI fill charts. The contractor is responsible for bringing to the attention of the Ridgecrest City project manager any insufficiently sized conduit or cable pathways in project documentation.
7. Keep Category 6 cables as far away from potential sources of EMI (electrical cables, transformers, light fixtures, etc.) as required in cited TIA Standards.
8. All copper horizontal cabling shall have slack service loops no less than 12" at the work area (equipment outlet) and not less than 3 feet in the telecommunications room.
9. Slack at the work area may be stored in the ceiling and in the telecommunications room may be wall mounted or contained in pathways or racking systems if done in a neat, workmanlike fashion.
10. Maintain the twists of the pairs all the way to the point of termination, or no more than 0.5" (one half inch) untwisted.
11. All UTP patching shall be accomplished using Category 6 rated modular patch panels as indicated elsewhere in this document.

C. Fiber (where required per project See plans)

1. When installing fiber cable, Contractor shall maintain a minimum bend radius, both under pulling load and installed, per requirements outlined within TIA standards, or manufacturer's recommendations, whichever is the most stringent.
2. Fiber terminations shall be done according to recommendations of TIA, manufacturer's requirements, and accepted industry best practices.
3. All unjacketed fiber shall be contained within appropriate fiber enclosures. Exposed tight-buffered strands or loose-tube strands will not be tolerated and shall be remedied at Contractor's expense.

3.2.14 EQUIPMENT RACKS / MOUNTINGS

- A. The contractor shall provide and install equipment racks that are earthquake rated for Zone 4. All rack installations shall be in accordance with the Ridgecrest City Standard 902. This standard will require the use of a 3-inch spacer bar (B-Line P/N STD108DET4) or the Chatsworth Cable Tray Elevation Kit (P/N: CPI 10506-702) to attach the rack to the cable tray.

1. The contractor shall provide and install standard 4 posts relay racks, 19"W x 29"D x 7"H (Chatsworth P/N 50120-703, 45 RMU), black color, shall be used to mount the Network equipment, UPS and batteries. A 4 post rack, 22"W x 25"D x 74"H, black color, shall be used to house the audio video equipment where required.
 2. All equipment racks shall be augmented with horizontal and vertical wire management hardware, both front and back as required, to properly dress cables and patch cords. The horizontal wire organizers shall be Panduit WMPH2E and WMPSE. Furnish one (1) horizontal wire organizer per patch panel plus one (1) additional wire organizer at the top of each row of patch panels. Be sure to include the Panduit Mini-Com Jacks on the patch panel. Vertical wire managers shall also be furnished and installed using Panduit WMPVHC45E as required. Refer to the Equipment Rack Layout provided by the City Project Manager for further details.
 3. The number of equipment racks shall be determined by the contractor and approved by City Telecom Project Manager. The number of racks required shall be dependent on the size of the facility or the number of data ports and computer stations.
 4. All data cables shall be terminated on separate patch panels in the MDF. The cables shall be terminated and labeled sequentially on the patch panels. The Equipment Rack Layout will be provided by the contractor and shall obtain approval of DPW Project Manager. Voice cables are normally terminated on the 66 blocks mounted on the designated backboard space as shown in the MDF layout. Confirm with CITY Project Manager regarding voice cable termination in the MDF/TR.
- B. Structural cable tray, relay racks, cabinets, systems, attachments and earthquake bracing shall comply with Zone 4 earthquake, NEMA, NEC and TIA/EIA-569 standards. Floor mounting hardware shall be a 3/8" bolt, lock washer, flat washer, with anchor in the floor, quantity as required.
- C. Mount equipment racks to the floor slab so that no electrical connection is made between the racks and building steel.
- D. Provide a minimum of 36 inches of clearance in the front and the back of equipment racks. Where rear clearance cannot be maintained, equipment racks that have pull out rack interiors shall be used.
- E. Cable trays shall be Chatsworth Products, INC. (CPI) P/N 11252-713, black color.
1. All structural ironwork shall be UL-certified, providing the best bonding for static and grounding. Painted structural ironwork is not allowed.
 2. Cable tray shall be of the tubular type construction. The tray shall be installed with the rungs on the topside of the tray. All attachments to drywall shall be on 3/4" plywood.
 3. Cable tray shall be mounted at 7'3" above the finish floor. This will require the installation of a 3" (Black) spacer manufactured by B-Line Systems, INC., P/N STD108DET4 or the Chatsworth Cable Tray Elevation Kit (P/N: CPI 10506-702). The B-Line part number is not cataloged and requires special order. The 7'3" allows for the cable tray to be positioned over the 7' doorway.
 4. Structural cable tray, relay racks, cabinets, systems, attachments and earthquake bracing shall comply with Zone 4 earthquake, NEMA, NEC and TIA/EIA-569 standards. Floor mounting hardware shall be a 3/8" bolt, lock washer, flat washer, with anchor in the floor, quantity as required.

5. All exposed cut and sharp edges shall be deburred and filed to a safe finish. Cable tray runway ends shall be capped with a black rubber cap.
6. Relay racks shall be high strength aluminum construction with universal 5/8"-5/8"-1/2" tapped mounting hole #12-24 thread pattern on both front and rear. Designed and seismic built to the EIA-310C Standard.
7. All cable tray and racks shall be individually grounded to the Telecoms Ground Bus Bar using the standard ground lug and #6 AWG stranded ground copper wire with "Green" jacket or insulation. Daisy chaining the ground wire between racks is not allowed.
8. The Communications Contractor shall install, position, reposition, or remove racks and equipment as required without disruption of ongoing services. The Communications Contractor shall furnish extension cables, power taps, or temporary racks if needed.

F. AC power and grounding

1. Use isolated ground 120V AC power circuits for all audio and video equipment. AC power circuits shall comply with National Fire Protection Association 70-2005 (NEC), paragraphs 250.96(8), 250.146(0) 250.96(8) and 408.40.
2. Power and grounding shall comply with IEEE Std 1100-1999, Recommended Practice for Powering and Grounding Electronic Equipment.
3. Equipment racks and their AV power shall be installed per National Fire Protection Association NEC 2005 Handbook paragraph 250.96(8) and Exhibits 250.41 and 250.42.
4. The Communications Contractor shall install, position, re-position, or remove racks and equipment as required with-out disruption of ongoing services.

G. Selection of electronic equipment:

1. No discontinued or end-of-life equipment will be acceptable.
2. No used equipment will be acceptable.

H. Methods:

1. Conduit
 - a. Maximum 40 percent fill rate.
 - b. Fill each conduit with only cables carrying like signal levels and types.
 - c. Limit each conduit run to no more than two ninety-degree bends. Between pull-boxes there shall be no more than an accumulated bend of one hundred and eighty degrees
 - d. Install pull-boxes where and as required.
 - e. All conduits containing like cable or signal types shall route to collector junction boxes, which will connect to equipment racks with single large conduits, one for each signal type.

I. Wiring and cabling

1. Label each wire or cable to match labeling on approved shop drawing wiring diagram.
2. Physically separate cables of different signal types and levels to minimize interference and magnetic induction.
3. Do not install any telecom cables adjacent to power cables.
4. Where cables of differing signal type must cross each other, the cables shall cross perpendicularly.
5. Install edge protection material where cables cross metallic edges.
6. Seal cabling or conduit passing through acoustically rated partitions, ceilings and floors.

PART 4 - EXECUTION

4.1 INSTALLATION

- A. The contractor's or subcontractor's main resources within the project shall carry proper professional certification issued by the manufacturer and verified by a third-party organization to confirm sufficient product and technology knowledge.
- B. The contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.
- C. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
- D. All firmware found in products shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA) or Network Video Recorder (NVR).
- E. All firmware found in products shall be the latest and most up-to-date version as specified by the manufacturer, or by the product component provider.
- F. All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.
- G. A proper installation shall meet NEC (National Electrical Code – US only) per the guidelines of that year's revision. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.
- H. All equipment shall be installed in accordance with the published practices of the equipment manufacturer, applicable FCC regulations, generally accepted industry standards, cited codes and standards, and these specifications.
- I. Temporary Installation
 1. The contractor shall temporarily install all electronic equipment for the final tests of the equipment and the systems, and then shall remove and store all equipment which is not built-in until occupancy by City personnel. The contractor shall then return and make complete and final installation and check-out.
- J. Equipment Not Installed

1. Equipment not meant for installation and all spares shall be delivered on site, to CITY Telecom Project Manager and secured.

K. Wiring

1. Terminations and connections throughout all systems shall employ one of the following methods:
 - a. Solder terminals, telephone-type punch terminal strips or machine wire-wrapped terminals in all cabinets.
 - b. Crimp connectors at outlet boxes and screw type or plug and socket connections at all equipment. Note that crimp-type connections are approved only for stranded wire.
2. 66-Type blocks shall only be used for voice distribution cables. They are not permitted for any other installation.

L. Labels

1. All controls, function switches, etc. shall be clearly labeled on all equipment panels. This labeling shall be permanently etched or engraved. Neat nameplates engraved on two-layer plastic and affixed with epoxy glue may be used.

M. Flexible Wire

1. Stranded wire and flexible cable shall be used for all connections to equipment not permanently attached to walls, floors or racks.

N. Conduits

1. Thin wall conduit shall be used for conduits 2" in diameter or less. For conduits over 2" in diameter, rigid steel galvanized shall be used. However, if it is necessary to use flex duct or plastic PVC, prior approval must be obtained in writing from DPW Project Manager and the next larger size flex duct or PVC shall be used. The flex shall be anchored at all bends and runs between bends must be straight and non-zigzagging through studding, joints, etc. If PVC conduit is to be used, use steel galvanized conduit for all bends over 15 degrees.
2. All communications conduit shall be one (1) inch inside diameter unless otherwise noted on the drawings.
3. A ¼" inch nylon pull line shall be installed in each conduit. For conduits over two (2) inch in diameter, provide three-eighth (3/8) inch nylon pull line.
4. All conduits shall be clearly and permanently identified at all terminals or cabinet as to its terminating end.
5. Individual communications conduit runs shall not have more than the equivalent of two (2) 90-degree bends, the DPW Project Manager and CITY Telecom Project manager shall be contacted to determine the size, type and location of a pull box that must be installed. Pull boxes shall not be used for transitions in conduit runs.
6. The radius of any conduit bend shall not be less than ten (10) times the inside diameter of the conduit.

7. Open ends of conduit shall be plugged during construction to prevent the entrance of moisture or foreign material. If moisture or foreign material is found at the time telephone and data cables are being installed, it shall be the responsibility of the contractor to thoroughly clean the conduit before the cable installation proceeds.
8. All conduits shall be securely fastened in place and shall be free from burrs, defects or obstructions that could interfere with the installation of cables.
9. All conduits, unless otherwise noted on drawings, shall terminate on designated communications backboards either three (3) inches above the floor or six (6) inches below the ceiling.
10. All conduits shall be reamed and secured by locknut where applicable. All conduits shall have bushings on both ends.
11. All conduit not terminating in terminals, cabinets or outlet boxes shall be capped.
12. Conduit and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign objects or other defects.
13. Empty conduit/sleeves, unless noted otherwise, shall be run to and between respective communications rooms and/or closets.
14. All underground communications conduit shall be PVC and shall have a minimum earth cover of eighteen (18) inches, except where subject to vehicular traffic (including road right-of-way) the PVC conduit shall be concrete encased with a minimum of thirty (30) inches of earth cover. Telephone conduit may be buried in the same trench as power (480 Volts or less) if separated by a minimum of three (3) inches of concrete or twelve (12) inches of dirt.
15. The number of outlets included in each home run shall be specifically limited, as shown on the plans, and shall not be exceeded.
16. The CITY Telecom Project Manager is responsible for duct assignments and shall be contacted before the installation of cables in the conduits.
17. Any deviation/substitution must be verified and approved in writing by the CITY Telecom Project Manager prior to use.

O. Outlets

1. All communications outlets shall be installed at the same height above the finished floor, unless otherwise noted on the drawings, as the electrical outlets, and shall be:
2. For single conduit entrance, 4 11/16 inches x 2 1/8 inches x 2 1/8 inches.
3. For two (2) or more conduit entrances, 4 11/16 inches x 4 11/16 inches x 2 1/8 inches.
4. Plaster rings are required. Tiger Box rings may not be used.
5. All core-drilled holes in counter tops shall be three (3) inches in diameter. A removable/reusable grommet and cover shall be installed.

4.2 FUNCTIONALITY TEST AND INSPECTION

The following functionality test and inspection deliverables are required where applicable to this project.

- A. The City's IT Project manager shall, at a minimum, test all newly installed equipment and configuration using the City of Ridgecrest LAN and IPT System Functionality and Cut-Over Test Plan developed (as stated on Section 2.02 paragraph 17 above) prior to the test date. The Communications Contractor shall work with appropriate City staff to incorporate any required tests that are not already included in the attached sample. The City reserves the right to require additional tests not listed on the Test Plan. The Communications Contractor and Telecom Project Manager shall be present and participate in all tests. Further, the Communications Contractor shall certify that the system is fully operational and fully functional.
- B. The City shall test all the newly installed equipment and verify that the system is fully operational and fully functional.
- C. The City shall accept the various systems installed and authorize payment to the Communications Contractor only after the City has received all deliverables specified and the Communications Contractor has fulfilled all obligations. This shall require, among other things, that the Communications Contractor:
 - 1. Has provided all materials and services included in the Original (or Adjusted, if applicable) Bid Schedule of Materials & Services and all change orders.
 - 2. Has provided to the CITY Telecom Project Manager a final "As Built" Schedule of Materials & Services. This schedule is the net result of compilation of the Original (or Adjusted, if applicable) Bid Schedule of Materials and Services and all change orders and reflects the actual materials and services delivered to the City.
 - 3. Has tested all systems and provided test results to the CITY Telecom Project Manager indicating operability in accordance with the specifications.
 - 4. Has completely provided to the CITY Telecom Project Manager the documentation as required above.
 - 5. Has cleared all deficiencies (Punch List items).
 - 6. Has turned over to the city any spare parts as specified.
 - 7. Has restored to original condition any damaged City premises, premise facilities, or equipment caused by Contractor personnel
 - 8. Has cleared all material and debris from the work site and generally restored the work site to an orderly condition.
 - 9. Has removed all abandoned or non-working equipment, wiring and mountings from the TRs, ducts, and conduits.
 - 10. Has contacted and made arrangements for the DPW Project Manager to determine the disposition of existing equipment.
 - 11. Has dressed all cables, patch cables, and power cords after user migration.
 - 12. Has fire stopped required conduits and pathways.

13. Has completed all required training sessions.
 - a. Written procedures for the tests not included above shall be prepared by the contractor and submitted for review and approval by the CITY Telecom Project Manager at least 30 days prior to the test. The contractor shall supply personnel and, wherever required, auxiliary equipment for the test, without cost to the City.
 - b. The City reserves the right to conduct, using contractor equipment and labor, a random re-test of up to five (5) percent of the cable plant to confirm documented results. Random re-testing, if performed, shall be at the expense of the contractor, using standard labor rates. Any failing cabling shall be re-tested and restored to a passing condition. In the event more than two (2) percent of the cable plant fails during re-test, the entire cable plant shall be re-tested and restored to a passing condition at no additional cost to the City.

4.3 TRAINING

- A. The CITY Phone Trainer shall provide phone and Unity Connection Voice mail familiarization and usage classes training on the VoIP telephone system. All other products in PART 2, the Communications contractor shall furnish the services of a competent trainer or instructor for classroom and hands-on instruction in the operation and maintenance of the equipment supplied. The training shall be sufficient to qualify City technicians to maintain the equipment and systems.
- B. All training plans and materials shall be submitted by the contractor for review and approval by city's staff at least 30 days prior to acceptance tests.
- C. Classroom space for training will be provided by the City. All training classes shall be conducted on a mutually agreeable schedule prior to system acceptance.
- D. Operator training curriculum, if required, shall be comprehensive enough to enable City personnel receiving initial training to independently conduct training classes and instruct other operators. The contractor shall conduct training and furnish training materials for up to 20 students, as determined by City.
- E. Maintenance training. The Communications Contractor, if required, shall include in his maintenance training plan the recommended duration of maintenance training necessary to thoroughly cover the subject matter. This plan is subject to revision based upon City review.
- F. The contractor shall furnish training materials to each student, which they shall keep. The training material shall include the Systems Manual, less appendices. Maintenance training shall be conducted twice to provide training for up to 10 students in each session.
- G. The contractor shall provide one formal, technical training seat for each product installed.
- H. Training shall be conducted on-site as follows:
 1. End-User's Training. The CITY Trainer shall provide IP telephone and Unity Connection voice mail familiarization and usage classes for all newly assigned end-users at thirty (30) people or less per class. User guides reflecting implanted features and access shall be provided for all end-users as follows:
 2. Review how to use an IP phone b. Review main IP Phone features (hold, transfer, conference, etc.)

3. Review how users can access the CM User Options page and use the various features (Speed dials, address book, etc.)
4. When feasible during the installation or configuration of any equipment that may be required, the Contractor will contact the City's Maintenance Supervisor and invite him/her to send a technician to accompany the Contractor's technician. This will permit the City's maintenance staff to become familiar with the equipment being installed and configured. This "over the shoulder" training should be conducted as may be deemed feasible to do so.
5. Training shall also include overall system configuration, software programming, equipment and cabling interconnects and locations, purpose and function of each piece of equipment, troubleshooting and repair of each piece of equipment and troubleshooting and repair of the systems as a whole. The Contractor shall furnish training and obtain manufacturer's certification for City technicians to install, maintain, troubleshoot and repair the systems and equipment. The Contractor shall also provide training manuals detailing the training session concepts. Estimated number of technician training participants is ≤10.

END OF SECTION

**SECTION 27 00 00
LOW-VOLTAGE REQUIREMENTS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Items of work included in this Section, described in detail in PART 3.
- B. Furnish and install a complete and functional system consisting of the following components/sub-systems as indicated below:
 - 1. Main Communications Room (MDF)
 - 2. System & Auxiliary Equipment Pre-installation
 - 3. Intrusion Detection and Alarm
 - 4. CCTV
 - 5. Station (Voice/Data)
 - 6. Workstation Outlets
 - 7. Wireless Network Access Point Data Cables-
 - 8. Patch Cables
 - 9. Voice Cabling
 - 10. Cable Testing (Copper)
 - 11. Wi-Fi (Wireless) Networks
 - 12. Equipment Racks/Mountings
 - 13. Training

1.2 SPECIAL CONDITIONS

In addition to all stipulations in other portions of the general specifications, all trades concerned shall comply with the following special conditions that directly pertain to communications and security systems:

A. Contractor Qualifications

The specified equipment shall be furnished and installed by a contractor who can show proof of having satisfactorily engineered and installed comparable systems within the past five (5) years, and who holds all legally required licenses, including General Electrical C-10 and or a Communication C-7 licenses if required to install the systems mentioned herein.

1. Security and Access Control systems contractors must be authorized, certified installer/dealer for DMP or approved equal security. The contractor must be regularly engaged in the supply of security and access control systems and must have occupied an established office for a period of not less than five (5) years prior to bid date within the Project's geographic market area. The system certified dealership letters must be provided to the city of Ridgecrest at time of bid and may at the City's discretion verify with the manufacturers prior to commencement of work. The dealer/contractor responsible for the installation of the security systems must be the dealer who holds all required dealership letters and has attended all the manufacturer's training certification courses prior to bid date.

B. Parts Availability

1. The contractor shall confirm that within a reasonable distance of the job site, there is an established agency which stocks a full complement of parts, offers service during normal working hours on all equipment to be furnished and will supply parts to the City without delay and at reasonable cost. The contractor shall review the specifications and provide the latest equipment and devices applicable for approval. The contractor shall be responsible for submitting the latest parts and/or equipment as part of the submission process for approval based on manufacturers listed. All parts submitted shall be no more than 3 years in circulation in order to ensure longevity and support of the products installed.

C. Continuous Duty Operation

1. All individual components and composite systems shall be designed for continuous operation without undue heating or changing in rated values and shall be properly fused.

D. Compliance with Codes

1. All work shall be done in accordance with latest applicable edition of National Electrical Code and all regulations, laws, safety orders, ordinances, or codes of State and local authority, whichever exceeds, having the jurisdiction. Wherever requirements in the specifications exceed those of the ordinances or codes, specifications shall govern. Nothing in the plans and specifications shall be deemed as authority to violate any of the ordinances or codes.

1.3 SYSTEM RESPONSIBILITY

- A. The contractor shall furnish and install all non-specified equipment required to make each system fully functional as per stated intent and description, without additional cost to the City.

1.4 WARRANTY

All equipment and systems shall be warranted by the contractor for a period of one year following acceptance by the City. The warranty shall include parts, labor, prompt field service, and pick-up and delivery at no cost to the City. If repair of a defect cannot be affected during the initial response, every effort shall be made by the contractor to promptly correct the defect including air shipment of repair parts and replacement of the next larger assembly. Response to the initial call shall be accomplished within four (4) hours.

- A. Routine non-warranty maintenance shall be performed by the City. Neither this maintenance nor emergency repairs made by qualified City technicians shall void the warranty.

- B. During the warranty period, the contractor shall respond only to calls for service made by designated Department of Parks and Recreation Representative and/or city's IT personnel and shall keep the Department fully informed as to problems which develop equipment or systems and as to steps the contractor have taken to rectify those problems. Response to the initial call shall be accomplished within four (4) hours.

1.5 DATA TO BE SUBMITTED BY THE CONTRACTOR

A. Submittal Format

1. Submittal shall be furnished in an 8 ½" x 11" format in PDF format. The cover and the title page shall bear the project name, capital project numbers specification number, name of contractor and date. The document shall have a table of contents and page numbers on each of the pages including brochures and drawings.
2. Provide PDF Shop drawings for review and approval prior to start of work. Drawings shall be no larger than 30" x 42". Consultant plans shall not be used as Shop drawings as these may be diagrammatic only for contractor reference.
3. Reproduced material shall not be subject to fading by light or heat and shall have high contrast for easy reading.

B. Preliminary Submittal

Within 30 days after the contract award and prior to the purchase of any equipment, the contractor shall submit five (5) copies of a Preliminary Submittal for review and approval. The submittal shall consist of the following:

1. Proposed material list including manufacturer's name, model number and technical data for all equipment the contractor proposes to install. Items shall be identified by specification section and paragraph number. The technical data shall consist of copies of factory issued catalog sheets or brochures, which give ratings and specifications for the proposed items.
2. Single line system diagram identifying and showing interrelationships between equipment items and how they are interconnected.
3. Shop drawings showing details of fabricated items, rack elevation drawings, console arrangements and schematics of custom designed items.
4. Statement describing exceptions being taken, if any, to the specifications wherein the submitted equipment or design varies from that originally specified.
5. If the contractor fails to list a particular variance and his submittal is accepted but subsequently it is deemed by the city to be unsatisfactory because of an unlisted variance, the contractor must replace or modify such equipment at once and without additional cost to the City.
6. For any exceptions that are not approved by the City, the contractor shall resubmit the information in complete compliance with the specifications and drawings.

C. Record (As-Built) Drawings

1. Record drawings shall be made on separate clean bond prints of the electrical drawings issued by the City or Architect and shall be reserved for the purpose of showing work as actually installed, including accurately dimensioned locations of all conduit stub-outs and pull boxes, routing of all conduits extending from or between buildings and locations of all telecommunications equipment not installed according to drawings.
2. Drawings shall be kept up to date with neat and legible annotations made thereon daily as work proceeds, showing work as actually installed. Additional sheets may be attached to show greater detail. Drawings shall be available at all times for inspection and shall be kept on the job at a location designated by the City.
3. Contractor at his option may use an additional set of drawings for daily field annotations. This set of drawings shall be kept at the site.
4. Final record drawings shall be submitted with floor numbers, room numbers, panel directories and all other identification necessary to conform to number designations for occupancy rather than to construction numbers. All buried conduit and/or underground conduits stubs intended for future extension shall be accurately shown as to depth and exact measurement from a permanently established landmark, such as building or structural features.
5. On completion, record drawings shall be signed, dated and returned to the City for inspection and approval before acceptance of any work.
6. Provide three (3) sets of drawings to the city, provide a PDF copy and a USB copy for record keeping.

D. Final Submittal

1. Three (3) complete sets of the Final Submittal including a full set of drawings on bond paper shall be delivered to the city's Telecom Project Manager prior to acceptance tests and as a condition for final payment for the project to the contractor. It shall include all the information necessary to maintain each system, and shall consist of the following:
2. Operators Instructions (as applicable).
3. Factory-issued Service Manuals for each piece of equipment installed. The manuals shall contain complete parts lists, detailed schematics, circuit descriptions, maintenance procedures and trouble-shooting methods. In the event such manuals are not available from the factory, it shall be the responsibility of the contractor to compile and submit the required information.
4. A System Manual for each system furnished. This manual shall complement the above service manuals with all necessary additional information unique to the system that is not otherwise provided, such as a list of applicable service manuals, options selected, jumper or strapping choices, modifications, and detailed wiring information. All manuals shall be bound in a 3-ring binder with tabs identifying each system.

E. Record Drawings.

1. Two (2) clean electronic copies of all communications drawing in PDF and/or AutoCAD 2012 or the latest version or format shall be provided. Contractor to confirm with City.

1.6 TELECOMMUNICATIONS ROOM

To complete the installation, testing and cut over of the telephone and other sub-systems in a timely manner, the contractor shall give high priority to completing All of the following as soon as possible and no later than eight (8) weeks prior to the scheduled completion target date. The city's Telecom Project Manager will also require immediate notification of any changes in the target date. Failure to comply with these conditions can and will result in communications systems in-service, and occupancy, delays. That may incur costs to the contractor.

A. Communication Rooms Designations

1. Main Communications Room or Main Distribution Frame (MDF/MDF). This room houses the Telephone system and main data communications equipment. The telecommunication cables from the BEFR, close workstations, and TR's (if necessary), are terminated here. Intrusion Alarm equipment, Power Supplies Panels, CCTV, CATV distribution equipment, etc. are also housed in this room. Locations of the equipment, component, cabinet or panels in the MDF shall be coordinated with the city's Project Manager.
2. The MDF shall be located in the building in such a way that it is accessible from the Staff Area. Additionally, it shall be placed such that no data cabling, when installed and terminated, will exceed the 300-foot limitation or current EIA/TIA Standard.
3. The MDF shall be equipped with furniture to provide a work surface for technical staff. This shall be in the form of a fully supported dropdown work surface. This should be at a height that is comfortable to work at standing. A "bar-type" stool shall be provided for sitting when necessary.
4. The MDF will also be equipped with an 18" deep bookshelf about the work surface. The length may be determined in the field. If the size of the room permits, a desk and chair should be provided in place of the dropdown work surface.

B. Air Conditioning

1. The MDF shall be provided with 24-hour 7-day air conditioning. Under normal operating conditions, a separate duct zone connected to the main building system shall provide COOL AIR ONLY in the MDF. If the main system fails to operate or maintain the required ambient temperature, a standby emergency system shall be automatically activated. Both systems shall be provided and installed with separately controlled thermostats. As an option, stand-alone air conditioning separate from the building's central HVAC system may be provided. The MDF shall NOT be under the control of any building energy conservations systems. A temperature of 65 degrees Fahrenheit and a relative humidity range of 40% to 60% shall be maintained at all times. Heat dissipation for the communication equipment is approximately 25,000 BTU. Before ANY communications equipment can be activated, a live test of the air conditioning system shall be conducted in the presence of the designated staff or his/her designee. NO air conditioning units (HVAC), condensate lines, water heaters, or other types of water lines other than fire sprinklers (with the highest temperature head and pre-action type only) as required by code, may be mounted directly above any MDF unless otherwise approved in writing by the Dept of a Control Systems Engineer.

C. Electrical Requirements

1. Install "twist lock" (L5-30R or L6-30R as required) and QUAD (NEMA 5-20R) power receptacles mounted on the designated locations in the equipment racks. Install QUAD (NEMA 5-20R) electrical outlets in MDF walls. Refer to MDF power layout requirements for further details. Where the receptacle may be required to mount on Cable tray above the racks, the contractor must coordinate with electrical to provide as part of their scope.
2. Intrusion Detection/Alarm System, Fire Alarm Control (Notifier) panel and Fire Alarm Communicator (dialer) panel must be provided with dedicated hard-wired circuits.
3. Power receptacles/outlets shall be on dedicated circuits with isolated ground.

D. Fire Protection

1. Provide a smoke detector and a high temperature sensor at the MDF room. Connect the detector or sensor to the Fire Alarm panel as two different zones. A fire extinguisher of the type recommended to be use for electrical fires shall be installed on the wall adjacent to the Telecommunications Room door where it can be reached without completely entering the room. If the Telecommunications Room is to be equipped with fire protection/sprinkler heads, it shall be of the highest temperature and "Pre-Action" type.

E. Backboards

1. Install fire-retardant, ¾" inch x 8 feet plywood backboards covering all 4 walls of the MDF with the bottom mounted at 12 inches above the floor. Backboards shall be painted off-white. Backboard shall be anchored on the wall and capable of supporting installation of communications equipment/panels. Fire rated labeling Shall not be painted over. Where the backboard fire rating label is painted, It shall be the at the City's discretion to have it be removed and reinstalled and painted correctly at no cost to City.

F. Door Locks

1. Install a door lock mechanism keyed separately from all other doors or in all Telecommunications Rooms. Where access control is provided and approved by the city, provide per access control requirements.

G. Grounding

1. The grounding in MDF shall be a #2/0 AWG insulated ground cable from main building ground and terminate on a ground bus bar (Chatsworth Standard Bus Bar P/N: 10622-010).

H. Lighting

1. Lighting intensity in all Telecommunications Rooms shall be 90-100 foot-candles at 36 inches above finished floor. The bottom of lighting fixtures shall be 9 feet above the finished floor.

I. Flooring

1. Coordinate with Architect and architectural plans to provide Anti-static vinyl flooring, Armstrong Static Dissipative Tile (SDT) Excelon Resilient Tile Flooring, or approved equivalent, in all Telecommunications Rooms. Anti-static vinyl flooring must be grounded to the MTGBB (Main Telecommunications Ground Bus Bar) through a flat copper strap or sheet at least 0.022 inches thick x 2 inches wide.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. All materials and equipment shall be new, unused and manufactured within eighteen months prior to installation. All materials and equipment shall be listed by Underwriters Laboratories.
- B. All materials submitted for approval shall be no more than 3 calendar years in production. The contractor shall submit the latest equivalent part list and equipment as required.

2.2 EQUIVALENT MATERIALS AND EQUIPMENT

- A. Manufacturers' names and model numbers are used herein only as a means of establishing standards of quality and performance. Contractors must provide current equipment and devices that are no more than 3 years in production, where required for a complete functional system. Where the following are not per the latest standards or obsolete. Provide Comparable equipment of standard manufacture and established reputation, which meets the requirements outlined above, to be submitted to the city's IT Telecom Project Manager for approval. Equipment of the following manufacturers may be used if it meets or exceeds parameters of the specified equipment. Submit manufacturer listed as recommendation or Approved Equal as required for consideration and approval.

1. Intrusion Alarm - DMP
2. Door/Window Sensors – DMP
3. Glass Break Sensors – DMP
4. Sirens – DMP
5. Cable – Superior Essex, Belden, West Penn, Berk-Tek, General Cable, or approved equal.
6. Panduit or approved equal.

PART 3 - SYSTEMS

3.1 SYSTEM & AUXILIARY EQUIPMENT PRE-INSTALLATION REQUIREMENTS

- A. Electrical contractor shall install station conduits, riser conduits, cable trays and conduit hardware according to procedures Set by the Ridgecrest City's IT Standards. Contractors must work closely with the city to provide complete and functional systems per the City's requirements.

- B. The MDF shall be constructed according to procedures described under heading Part 1.6. HVAC system in the MDF. The HVAC shall be operational 24 hours, 7 days a week. The heat dissipation of the communications equipment in the MDF is about 25,000 BTU. This value is based on the average size of the animal shelter and should be lower for small animal shelters.
- C. The Communications or Low Voltage contractor shall coordinate all cable installations and/or work with the General Contractor in accordance with the Construction schedule.
- D. The installing contractor shall be responsible for removal and replacement of ceiling tiles to accommodate the telephone/data/security cables installation where ceilings are installed prior to the telecom installation.
- E. Electrical contractors shall coordinate with the communication contractor to install conduits as required for all the systems and the 120V-24VDC transformer for electronic door lock devices locations as necessary.
- F. Low Voltage contractors shall furnish and install Caddy J-Hook Cable Support System to support the voice, data and security cable runs in the ceiling space (4 hangers per 16 square feet) as required by codes. All cable installation shall be completed prior to the installation of the ceiling grid, if possible. The Low Voltage contractor shall be responsible for any damage, physical or cosmetic, to ceiling tiles and grids. The Communications or Low Voltage contractor shall be responsible for coordinating with the General/Electrical contractor regarding the cable pathway in the ceiling space as required.

3.2 BUILDING SYSTEMS

3.2.1 INTRUSION DETECTION AND ALARM

- A. System Description and Installation Requirement
- B. The intent and purpose of this system shall be to provide a security/intrusion detection entry alarm system in the building. All perimeter doors, roof hatches, or other external entry points shall be equipped with dedicated, concealed magnetic contact switches. All perimeter entry/exit point locations with keypads shall have a motion sensor located in the immediate entry/exit area. All perimeter windows shall be protected by glass break sensors. Interior protection shall be provided by combination of passive infrared/microwave detectors located in hallways, corridors, walkways as indicated on the plans.
- C. The alarm siren(s) shall be installed in the plenum above the keypad(s) or as indicated or detailed on the plans. Each alarm device shall report to the City Central Station as a separate point. Use point expander Octopoid module(s) for the point expansion of the alarm panel and a separate enclosure(s) to house the expansion device(s). Install alarm cables home run from each alarm device to the panel. Appropriately sized "end of line" resistors shall be placed at the device end only.
- D. Installation of modules, devices and wiring shall be in accordance with current system design, installation, and engineering standards. Where required, Additional power supplies, batteries, Octopodid's, Octo Relays, Battery Charger and associated cables shall be mounted in additional cabinet(s). Maximum build out per D8103 or enclosure shall be 5 modules and/or two (2) 12Volts - 7AH batteries.

- E. The intrusion alarm cables shall be installed horizontally through the ceiling area in a neat and orderly fashion and supported by approved cable hangers at appropriate intervals. The cables shall be positioned at least six (6) inches from electrical equipment, electrical wiring, telephone cabling, and intercom cabling and data wires. Exposed wiring shall only be permitted above ceiling level or ten (10) feet from floor level. The installation shall comply with the City of Ridgecrest Building Safety and Fire Codes. The contractor shall furnish, at his expense, all permits issued for scope of work. The contractor shall supply copies of all permits acquired.
- F. The system alarm communicator panel shall be provided with the latest version software and associated equipment enclosures to be installed as per approved drawings (Contractor to Submit shop drawings including devices, equipment and wiring diagrams for approval) and for approval of MDF equipment layout. Clearance in front of all alarm panels shall be a minimum of 36 inches. The alarm system shall be programmed by Ridgecrest to report to the Sheriff Central Station. If required, the installation contractor shall be responsible for obtaining an alarm permit from the local law enforcement authority.
- G. The Alarm Communicator panel shall power all peripheral alarm devices for 24 hours of standby time with 5 minutes in alarm condition conforming to NFPA 72 central station requirements in the event of power failure. load calculation, standby battery requirements and standby battery calculations. Standby power on battery back-up should be at least one (1) hour. If required, additional battery charger modules(s) and batteries shall be installed in an enclosure unless the building has generator power. In this case, the power receptacle circuit where the alarm panel is connected should be included on the standby generator power circuit. All power transformers shall be mounted in enclosures.
- H. The intrusion alarm panel shall have a dedicated hard-wired circuit (120V-20A) identified and labeled with panel and branch circuit number at the electrical panel and at the alarm panel.
 - 1. Alarm panels and equipment enclosures shall not be used as pull boxes or raceways.
 - 2. All low voltage cabling or conductors running between panels and enclosures shall be in approved raceways.
 - 3. Plenum-rated, shielded, stranded 18/4, 18/2 cables shall be used and installed for all intrusion alarm systems cabling. Cables lower than 18-gauge shall not be accepted.
 - 4. Plenum-rated, shielded, stranded (minimum of 18 gauge), PVC insulated, 18/4 cable for keypads, glass break sensors and passive infrared/microwave detectors.
 - 5. Plenum-rated, shielded, stranded (minimum of 18 gauge), PVC insulated, 18/2 cable for door contacts/switches.
- I. All intrusion alarm field devices shall be wired normally closed (energized state) and will fault on open.
- J. All intrusion alarm wiring must be appropriately identified with permanent wire markers. Copper conductors shall be used.
- K. The alarm contractor should provide all other cables and/or hardware required to ensure the system is fully functional at an optimum level.

- L. The intrusion alarm panels shall be grounded to the Telecoms Ground Bus Bar in the MDF with a #12AWG (solid) ground wire with green insulation. The ground wire shall be run inside a ½ - inch conduit.
- M. The intrusion alarm panels shall be provided with locks and four (4) sets of keys.
- N. Terminations and connections throughout the system shall employ terminal strips with rising wire clamp screws or solder terminals, all in cabinets, or enclosures. Telephone punch type blocks, and electrical wire nuts are not acceptable. The drain wire/drain shield in the shielded cable shall be properly addressed at both ends, and in most cases not used. In environments where it is used, all drain wire/drain shields shall be grounded. Shields shall be grounded in the alarm communicator panel/enclosure.
- O. The alarm contractor shall be responsible for programming and testing the alarm panel in the local mode. The alarm contractor shall furnish the Telecom Project Manager with the completed programming sheets or an alarm account data sheet document and As-Built (minimum 11"x17") drawings(s) that indicate each device/point location identified to reflect 16-character idle text in programming on not less than 12 font text on floor plan prior to the city's inspection, testing and programming of the alarm panel. The alarm contractor shall submit two (2) sets of As-built drawings to the city's IT Telecoms Project Manager.
- P. The Security zones shall be programmed in accordance to the requirements of Parks and Recreation or city requirements (contractor to verify with city Rep).
- Q. Status shall be configured in all Keypads or as designated by the city IT Project Manager.
 - 1. The alarm contractor shall be an authorized and current direct system dealer with contractor Qualifications. The contractor must provide proof of dealership with the system, as well as verification of prior experience with the Controllers and System design, Detection Systems and possess extensive knowledge of programming system features. The installer must provide proof of training via a valid training certificate prior to any work to be performed. The certificate must have been issued more than six (6) months and less than five (5) years prior to installation date. Proof of dealership must be attached to the contractor quotation.
 - 2. The alarm contractor shall consult with the city Project Manager and/or city's Telecoms Project Manager prior to system implementation.
 - 3. The alarm contractor shall provide hands-on training to city staff at a date and time to be determined by the city Project Manager in the operation of the system. A roster of attendees shall be documented.
- R. Intrusion Alarm System Materials and Equipment (provided where needed per plans) Contractor must submit the latest for approval prior to installation. Some models may not be required listed for reference where used.
 - 1. Digital keypad – DMP - or equivalent
 - 2. Alarm panel – DMP with latest version of software. - or equivalent
 - 3. Passive infrared/microwave 50'x50' wide angle motion detector - DMP or equivalent.
 - 4. Passive infrared/microwave 360-degree detector - DMP or equivalent
 - 5. Glass break sensor – DMP, Honeywell or equivalent.

6. Siren/Speaker – DMP Indoor/Outdoor or equivalent.
7. Magnetic door contact switch, flush mount – Sentrol or equivalent.
8. Magnetic door contact switch, surface mount, non-exposed wiring – Sentrol TW Series or equivalent.
9. Magnetic door contact switch, floor mount (high security) – Sentrol or equivalent
10. Transformer kit enclosure – DMP or equivalent
11. Lock and Key assembly – DMP or equivalent
12. Two (2) - (7Ah-12V) batteries
13. Transformer – DMP or equivalent
14. Keypad back boxes – DMP or equivalent
15. Aux relay – DMP or equivalent
16. OctoPopit eight zone expander – DMP or equivalent
17. OctoRelay – DMP or equivalent
18. Alarm cable – plenum (CMP) rated, PVC insulated, shielded, minimum 18- gauge 4 conductor stranded wire.
 - a. Battery Harness where needed
 - b. DD gLifeSafety Power Supply – FPO150-E1 or equivalent
 - c. EE LifeSafety Power Supply – FPO250-E1 or equivalent

3.2.2 CCTV System Description and Installation Requirement (IP Network)

A. General Requirements

1. The CCTV System shall be capable of integrating into the current City Milestone XProtect Professional Plus 2025 VMS system.
2. The specified unit shall be of manufacturer's official product line, designed for commercial and/or industrial 24/7/365 use.
3. The specified system shall be based upon standard components and proven technology using open and published protocols to meet the city's standards.

B. Sustainability

1. The specified unit shall be manufactured in accordance with ISO 14001.
2. The specified unit shall be compliant with the EU directives 2011/65/EU (RoHS) and 2012/19/EU (WEEE).

3. The specified unit shall be compliant with the EU regulation 1907/2006 (REACH).
4. The manufacturer shall have signed and supported the UN Global Compact initiative as defined by United Nations.

C. QUALITY ASSURANCE

1. The contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity and evidence that is completed at least three (3) projects of similar design and is Currently engaged in the installation and maintenance of systems herein described.
2. All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
3. The contractor or designated sub-contractor shall submit credentials of completed manufacturer certification, verified by a third-party organization, as proof of the knowledge.
4. The specified unit shall be manufactured in accordance with ISO9001.

D. WARRANTY

1. All system components and labor furnished by the contractor including wiring, software, hardware and custom parts, shall be fully warranted for parts, materials, labor and travel expenses for a minimum of three (3) year from the date of the final acceptance of the video surveillance system.
2. The manufacturer shall provide a warranty and optional extended warranty for the camera for a total period of a maximum of five years. If enacted as part of the contract, the contractor will repair or replace parts and/or labor per the warranty for the length of this warranty at no cost to the client.

E. QUALIFICATIONS

1. All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
2. The contractor or designated sub-contractor shall submit credentials of completed manufacturer certification, verified by a third-party organization, as proof of the knowledge.
3. The contractor shall provide four (4) current references from clients with systems of similar scope and complexity that have become operational in the past three (3) years. At least three (3) of the references shall utilize the same system components, in a similar configuration as the proposed system.

F. SOFTWARE UPGRADES

1. The manufacturer shall provide free upgrades to new software releases within the same major version for the lifetime of the version.

2. The software shall be backed by free support for the lifetime of the version.

G. The product shall be IP-based and comply with established network and video standards.

H. The video management system shall support integration with ONVIF Profile S conformant devices as defined by the ONVIF Organization that complies with relevant parts of IEC62676-2-3.

3.2.3 VIDEO SURVAILENCE

A. The unit types listed below describing various resolutions, form-factor and features shall be supplied by a single unit manufacturer video surveillance system.

B. The unit manufacture will be as follows:

1. Outdoor PoE switch shall be AXIS T8504-E or equivalent

3.2.4 VIDEO SURVEILLANCE UNITS

A. Per the city of Ridgecrest latest requirements, the PoE switches to be the latest Arista switches model 722XPM or above series at time of installation for CCTV system or approved equal to meet the city's standards.

1. The switch shall meet or exceed the following design specifications:

- a. Provide options for 10M to 2.5G PoE copper downlink and 25G SFP28 and 10G SFP
- b. Industry standard 802.1Q, VRFs and VXLAN/EVPN segmentation
- c. Cognitive real time Flow Trackers for CloudVision, IPFIX and sFlow
- d. Integrated MACsec encryption on all ports
- e. Cognitive, cloud grade reliability, in service maintenance and upgrades
- f. EOS programmability and cognitive management plane monitoring APIs
- g. Arista EOS cloud grade QoS, security, and reliability required for campus networks.
- h. The cognitive management plane, native in EOS, to provide real time telemetry to capture key performance metrics of infrastructure, device, application and user data for SLA monitoring and troubleshooting.
- i. The switch shall meet its output power support power over ethernet plus 10G/25G:
 - 1) Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 1
 - 2) Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 2
 - 3) Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 3
 - 4) Power over Ethernet Plus IEEE 802.3at Type 2 Class 4

- j. The switch shall support the CCS-722 power supplies.
- 2. Transmission
 - a. The switch shall allow for data to be transported over:
 - 1) HTTP (Unicast)
 - 2) HTTPS (Unicast)
 - 3) RTP (Unicast & Multicast)
 - 4) RTP over RTSP (Unicast)
 - 5) RTP over RTSP over HTTP (Unicast)
 - b. The switch shall support Quality of Service (QoS) to be able to prioritize traffic.
- 3. User Interface
 - a. Web server
 - 1) The switch shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
 - b. IP addresses
 - 1) The switch shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
 - 2) The switch shall provide support for both IPv4 and IPv6.
- 4. Protocol
 - a. The switch shall incorporate support for at least IPv4, IPv6, HTTP, HTTPS, Bonjour, SNMP v1/v2c/v3, DNS, TCP, UDP, IGMP, ICMP, ARP, SSH, RADIUS, TACACS, TELNET, Syslog, 802.1Q (VLAN)
- 5. Security
 - a. The switch shall support IEEE 802.1Q.
 - b. The switch shall provide support for restricting access to pre-defined IP addresses only, so-called IP address filtering.
 - c. The switch shall restrict access to the built-in web server by usernames and passwords.
- 6. Installation and maintenance

- a. The switch shall support the use of SNMP-based management tools according to SNMP v1, 2c & v3.
 - b. The switch shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.
- 7. Diagnostics
 - a. The switch shall be equipped with LEDs, capable of providing visible status information.
- 8. Network Hardware interfaces
 - a. PoE ports
 - 1) The switch shall be equipped with 4 10Base-T/100Base-TX/1000Base-T Fast Ethernet-ports, using standard RJ45 connectors and shall support auto negotiation of network speed and transfer mode (full and half duplex).
 - b. Uplink
 - 1) The network switch shall be equipped with one SFP port.
- 9. Power
 - a. The switch shall be equipped with a port providing connectivity for power.
- 10. Enclosure
 - a. The switch shall:
 - 1) Be manufactured with a rugged aluminum casing.
- 11. Power
 - a. 100 - 240 V AC, 50/60 Hz
- 12. Environmental
 - a. The network switch shall:
 - 1) Operate in a temperature range of -40 °C to 50 °C (-40 °F to 122 °F)
 - 2) Operate in a humidity range of 0-90% RH (non-condensing)

3.2.5 INSTALLATION

CCTV system shall be IP based, CCTV system shall include server with on board storage, VMS software, IP cameras, camera licenses, manufacturer support services, POE data switch, Cat 6 data cabling, and APC UPS. UPS to provide power to the CCTV system for a minimum of one hour in the event of building power loss. Video recording retention shall be for 365 days minimum, 24/7 continuous recording. Recording and live viewing resolution shall be a minimum of 4K resolution for exterior cameras, Quad HD resolution for fixed interior cameras, and 12MP for multi-lens/panoramic view cameras. Cameras shall be recording at a minimum of 15fps. Parks to confirm recording requirements. CCTV cameras shall be the minidome type with the appropriate mounting hardware for the camera location. CCTV system to be connected to the Parks data network for remote viewing and video exporting capabilities (Parks to confirm).

- A. The contractor's or subcontractor's main resources within the project shall carry proper professional certification issued by the manufacturer and verified by a third-party organization to confirm sufficient product and technology knowledge.
- B. The contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.
- C. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
- D. All firmware found in products shall be the latest and most up to date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA) or Network Video Recorder (NVR).
- E. All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.
- F. A proper installation shall meet NEC (National Electrical Code – US only) per the guidelines of that year's revision. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.

3.2.6 UNIFIED SECURITY PLATFORM

A. Acceptable Manufacturers

Provide CCTV by a major manufacturer (Axis IP or approved equal is preferred) or indicate to submit all for review.]

[List acceptable manufacturer/model for Servers, Workstations, Monitors, keyboards, etc. here or submit all for review].

B. General Product Description

1. Video Management System (VMS) including live viewing and archive recording, event/alarm recording and actions based upon events and alarms, full Control Center module for viewing and monitoring, Administration module for configuration and management, video clip or still image export, Quick Control Center module to view exported video clip on computer without full software installation, web client for monitoring live, playback, alarms and export files.
2. VMS shall support viewing and archiving unlimited number of cameras.
3. Software shall support upgrades from the previous major version.

4. Software should accommodate server/workstation or client/server application, depending on the number of cameras connected on centralized or distributed network architecture.
5. The software should support remote monitoring through the Internet, including transcoding image formats and frame-rate conversion to accommodate limited bandwidth network/internet connections.

C. Detailed Product Description

1. Purpose

- a. The software shall accommodate the monitoring of video images on one-to-many computer workstations and shall accommodate recording (archiving) of any or all images at user adjustable frame rates and resolutions.
- b. The software shall support events and alarms.
- c. The software shall facilitate integration with other 3rd party systems including alarm/access control systems, building automation systems, perimeter systems, etc.
- d. The software shall intrinsically accommodate two-way voice communication between the monitoring location and camera locations. Voice communication from the remote encoder shall be archived with video.
- e. The software shall support integration to intelligent video analysis devices.
- f. The software shall facilitate collection, storage and export of material relating to incidents, for external analysis.
- g. The software shall facilitate comprehensive situational awareness by integrating alarms and video in logical groupings related through system hierarchical maps (including both building plans and satellite views of campuses).
- h. The software shall permit "Video Guard Tours" by allowing users to "tour" a facility (or facilities) through sequences of several Layouts with cameras shown cyclically, each for a predefined amount of time, allowing the user to "walk" the facility using the video system.

2. Environment

a. Hardware

1) General Network

- 2) Ethernet Network: The software shall operate within a normal Ethernet IP network environment using Level 2 or Level 3 digital switches, routers, hardware firewalls, etc. for all communications between all digital cameras, encoders, monitor decoders, and the VMS software, including client and server applications.
- 3) All IP network equipment shall be based on the latest technology offered by a major brand name manufacturer (e.g. HP ProCurve, or similar quality)
- 4) The IP network shall support subnetting and Virtual Private Network (VPN) configurations
- 5) The IP network should support multicasting between all ports and shall allow for multicast streams to be routed between networks, subnets and VPNs
- 6) Protocols
- 7) The network shall be based on TCP/IP, UDP/IP, and RTP/IP network protocols
- 8) The network shall support multimedia streaming UDP, Unicast UDP, Unicast TCP, and HTTP
- 9) The network shall support SNMP and DHCP protocols
- 10) Quality of Service (QOS)

b. Operating System

- 1) The software shall operate in an open environment using Microsoft Windows Operating Systems.
- 2) Refer to manufacturer's release notes for supported operating system versions.

c. Databases

- 1) The VMS shall support Microsoft SQL server.

d. Software

- 1) Operating Framework

The software shall be based on Microsoft.NET® framework for both server and client applications.

- 2) Anti-Malware Software

The software shall allow the installation of anti-virus and network security software on the server and client machines.

- 3) Software Architecture

- a) The software shall adhere to multi-tier architecture with different layers for clients, server and database.
- b) The Client Software shall include the following applications:
 - i. Control Center for monitoring and viewing
 - ii. Admin Center for administration
 - iii. Operator screen recording and redisplay
 - iv. Quick Control Center – Self-contained version of Control Center which doesn't require installation and is used primarily as a stand-alone player
 - v. Web client primarily for viewing live and playback recorded video.
- c) Resiliency
 - i. The VMS software system shall be designed and implemented with Resilience as a key architectural principle. The system configuration shall offer optional failover and redundant components for critical systems functions such as the System Directory and the Archiving facilities so that the configuration can be brought to a 'no single point of failure' status.
- d) Backward compatibility
 - i. The system shall allow future versions to be backward compatible with all software updates within a major version.

3. System Attributes

a. Local/Regional/Global Architecture

- 1) The software shall be capable of servicing enterprise systems of any size, either located in a single campus or dispersed over many geographical locations.
- 2) The software shall support systems of all sizes from a single VMS to a global enterprise system, which is supported by multiple VMSs that are monitored globally.
- 3) The client application software shall support the notion of a Global Client. This allows the user to connect to multiple systems from a single application view and to operate them together (e.g. view cameras from different systems on the same screen, or receive and manage alarms from multiple different systems concurrently).
- 4) The administrator application shall support Central User Management for global enterprise systems, comprised of multiple directories, through integration with a single global service of Microsoft Active Directory.

- 5) The software shall support generation of global reports from multiple directories, using the Reporting Tool in the administrator application.

b. Scalability and Modularity

- 1) The VMS software shall comprise modular software services to facilitate scalability and resilience. The following functionality shall be supported:

- a) Directory
- b) Event Distribution Server (EDB)
- c) Archiver
- d) Gateway
- e) Transcoder
- f) Web Server
- g) Application Server
- h) Case management service
- i) Global Admin Server

(The functionality of these modules is described in more detail in Section 3 System Attributes above)

- 2) The VMS server software modules shall be based on the Microsoft .Net platform.

- a) The VMS system shall support the installation of its services on multiple PCs to support a truly distributed architecture and flexibility in allocation of hardware resources:
- b) Services may be installed together or separately
- c) The MS-SQL based databases can be installed on the same machine with the service to which they belong or on a different server

- 3) The VMS software shall support the configuration and deployment of the services above in the following additional roles:

- a) Failover Directory
- b) Failover EDB
- c) Failover Archiver
- d) Redundant Archiver

- 4) The VMS services shall be installed on a server computer or a workstation that complies with the manufacturer's current system specifications. Refer to manufacturer for most recent requirements.
- 5) Multimedia storage:
 - a) The software shall be capable of storing multiple video and audio sources on multiple Archiver servers.
 - b) The VMS shall offer RAID-5 and non-RAID solutions.
 - c) The multimedia storage solution shall be based primarily on internal hard drives and shall support Direct Attached Storage (DAS) systems if internal storage is not enough. The system shall also support Network Attached Storage (NAS) systems and Storage Area Network (SAN) systems.

c. Server software attributes

- 1) Directory Service
 - a) The Directory shall maintain a catalogued database of settings for all the entities in the system (cameras, users, alarms, rules, etc.) using an MS SQL server
 - b) The Directory shall perform the following roles:
 - i. Manage and authorize login and logout requests of clients and services
 - ii. Provide system configuration services
 - iii. Provide system configuration status and events
 - iv. Validate and perform configuration changes
 - v. Provide Alarm and Incident Management services
 - vi. Communicate with the Active Directory when this option is enabled in the VMS software
 - c) The Directory service shall support 10,000 cameras and 150 concurrent connections on a single directory provided physical machine with the following hardware specifications:
 - i. 2x AMD Epyc 9355 or better
 - ii. Minimum of 128GB DDR5 RAM
 - iii. Minimum of 128GB NVME
 - iv. 2 x 25Gbps network card
 - v. Minimum 12 drive bays for video retention

- d) The VMS architecture shall not rely on the Directory as a single point of failure with respect to video and audio monitoring. Logged-in users shall not be interrupted in viewing live and archived video, even in the event of Directory server failure or disconnection.
 - e) The VMS software shall support multiple Failover Directory service modules per system for improved system resiliency
 - f) Each Failover Directory shall regularly synchronize its database with the primary Directory database
 - g) The Failover Directory shall become active and act as a primary directory in the event of losing connectivity with the Primary Directory
 - h) The Failover Directory shall revert back to passive mode upon resuming connectivity with the Primary Directory
 - i) Failover functionality shall include a priority numbering mechanism to determine priority of each failover system
- 2) Event Distribution Service (EDB)
- a) The EDB service shall perform rule-based distribution of events and action
 - b) The EDB service shall redirect specific events and actions only to registered services and client applications rather than broadcasting them, in order to minimize network traffic
 - c) EDB service shall have the capability of recording events into an MS SQL database audit trail
 - d) The VMS software shall support multiple Failover EDB service modules per system for improved system resiliency
- 3) Archiver Service
- a) The VMS software shall not limit the number of Archiver servers in the system. This allows the installation of multiple instances of the Archiver service on different computer servers, which enables distributed architecture in diverse network topologies.
 - b) The Archiver shall manage and operate edge devices, such as IP cameras, video encoders, video decoders, audio devices, PTZ cameras, CCTV keyboards, and any other types of edge devices that the VMS controls

- c) The Archiver shall provide discovery services of edge devices, which simplifies the addition of new edge devices to the VMS
- d) The Archiver shall perform configuration and monitoring of the edge devices
- e) The Archiver shall support recording of video, audio, and related metadata
- f) The Archiver shall be capable of executing any recording task, including schedule, manual, alarm, motion- or event-based recording
- g) The Archiver shall support independent recording settings for each video or audio stream
- h) The Archiver software shall be capable of recording unlimited concurrent video streams from IP cameras and video encoders
- i) The Archiver's software recording technology shall prevent file fragmentation while writing to the multimedia storage
- j) The Archiver shall be capable of recording either stream of a dual-stream camera, according to user and system settings
- k) The Archiver shall support digital signature for recorded data in real-time
- l) The digital signature shall be based on SHA1 based hash function and 1024-bit RSA encryption key
- m) The Archiver shall support playback of recorded video, audio and related metadata
- n) The Archiver shall use only the native data generated by the encoding device and shall not transcode, re-encode, or otherwise destroy the media before saving to the associated hard drives for storage
- o) The Archiver shall support motion detection
- p) The Archiver shall provide edge device command and control services, including:
 - i. Commanding PTZ domes
 - ii. Operating CCTV keyboards
 - iii. Activating relay switches and output pins
 - iv. Serial communications via edge device serial ports
 - v. Notifications and status changes from edge devices, including input pins, video, and audio inputs, etc.

- q) The Archiver shall manage and transmit camera sequences
 - r) The Archiver shall support Proxy functionality, redirect video and audio to client applications or audio and video decoders as required, in all unicast and multicast topologies
 - s) The Archiver shall provide metadata services including:
 - i. Tagging and Bookmarks to describe recorded footage with text
 - ii. Motion information on recorded video
 - iii. Recording time stamps and Recording triggers
 - t) The Archiver shall provide query services for search of multimedia recordings and metadata
 - u) The Archiver shall manage and display alarms-related video in Control Center
- 4) Failover Archiver capability
- a) The VMS software shall provide the option of configuring every Archiver as a Failover Archiver (FOA). Each Archiver can serve as a primary Archiver and as a Failover Archiver or provide both functions concurrently.
 - b) The FOA shall take over units from a primary Archiver service in the event of the primary Archiver failure. The FOA shall assume all responsibilities of the primary Archiver regarding the Failover devices, including management, recording, playback, sequences, etc.
 - c) The FOA shall take over units only from primary Archivers in the same Failover group, as defined by the user
 - d) The FOA shall perform prioritized Failover based on the following conditions:
 - i. The unit's (edge device's) Failover priority, as defined by the administrator
 - ii. The Archiver's Failover priority, as defined by the administrator
 - iii. The Failover Archiver's available capacity
 - e) The VMS shall support any number of Primary and Failover Archiver servers. The VMS software shall support configuring an Archiver service as a Redundant Archiver, to provide users with one or more additional copies of the recorded footage, for data security purposes.

- f) It shall be possible to configure redundant recording on a Primary or Failover Archiver
 - g) It shall be possible to select any edge device (unit) from any Primary Archiver to be recorded on any Redundant Archiver in the system, as long as there is multicast connectivity between the edge device and the Redundant Archiver
 - h) The Redundant Archiver shall support the same or a different retention period than the Primary Archiver for each scene it records
 - i) In a Unicast environment an archiver failover shall result in no more than 2 minutes recording gap.
 - j) In a multicast configuration the system shall continue monitoring live video, un-interrupted, during the process of an Archiver failover. In the event that an Archiver is unable to respond, and requires failover to another Archiver, the users will not lose live video monitoring from of cameras that are currently being viewed.
- 5) Gateway Service
- a) The VMS software shall support a Gateway Server that shall allow users to connect and operate the VMS from remote locations, over the Internet, over firewalls, VPNs, and proxies
 - b) The Gateway Server shall mediate between incoming client requests to the VMS servers, thus allowing remote connectivity even when the VMS servers are not exposed to incoming traffic. The Gateway Server shall have only one TCP port exposed to external connections.
- 6) Transcoder Service
- a) The Transcoder Server shall allow clients to view good quality video streams from remote locations, over the Internet or limited bandwidth connections, over firewalls, VPNs, and proxies
 - b) The Transcoder Server shall transcode any video stream to MJPEG/MPEG4/H.264 stream in order to overcome the video compression issues related to limited bandwidth connections
 - c) The Transcoder Server shall support all incoming videos including live, archive, video sequences, and video on alarm
 - d) The Transcoder Server shall provide video services via only TCP port, thus masking the video servers, encoder and cameras from direct connections coming from clients on external networks

- e) The Transcoder Server shall provide remote users full functionality in a transparent way. The remote user will use the system normally, despite the fact that video streaming goes through the Transcoder.

7) Case management service

The VMS shall support a secure incident and/or evidence container that maintains Chain of Custody, allowing clips of recorded material, snapshots, information about alarms and other events, together with related externally-sourced material (documents, etc), to be securely packaged, stored and accessible for viewing and/or exporting, for later presentation as evidence.

d. Security

1) Password Security

The system shall allow defining user password policy, including minimum length, minimum number of letter and numbers.

2) Active Directory

The system shall be capable of integrating to Active Directory and sync users and users groups with AD.

3) Web Client Security

The system shall allow setting TLS certificate to be used for the web client application

4) Edge Device Security

Edge device security refers to securing the control channel between the archiver and edge devices, using Transport Layer Security (TLS) protocol.

- a) The system shall allow setup of policy to use secured connection with edge devices when connecting new units
- b) The system shall define whether to block edge devices with unsecured connection
- c) The system shall define whether to block edge devices with untrusted certificates

4. Functions

a. Video Display and Recording Functions

1) General

- a) The VMS shall support live viewing (monitoring), concurrent recording, viewing of previously and concurrently recorded video and management of an unlimited number of video sources.
 - b) The VMS software shall have the ability to receive video from IP cameras or any other video source connected to video encoders, as well as from Android-based and IOS handheld devices capable of video transmission.
 - c) The software shall support PAL and NTSC signals.
- 2) Encoding and Decoding
- a) The software shall support MPEG-4, MJPEG, H.264 and H.265 video formats.
 - b) The software shall sustain full operation using any resolution supported by approved edge devices, including but not limited to CIF, 2CIF, 4CIF, VGA and a range of HD and Megapixel resolutions including 720p, 1080p, 3MP, 5MP, 10MP and 4K.
 - c) The software shall support display and recording of frame rates from one frame per second (fps) to 30 fps.
 - d) The software shall support edge devices from multiple manufacturers including Axis, DVTel Legacy, IQeye, Mobotix, Pelco, Panasonic, Sony, Verint, and ONVIF-conformant devices.
 - e) The software shall support both IP cameras, encoders and Android-based and IOS handheld devices capable of video transmission.
 - f) The system shall be flexible supporting different configuration selections per video source, as supported by the edge devices, including, but not limited to:
 - i. Video format
 - ii. Bit rate
 - iii. Compression and quality
 - iv. Resolution
 - v. Frame rate
 - g) Dual-Streaming: The software shall support edge devices capable of transmitting multiple streams. The software shall support independent settings per stream including:
 - i. Independent resolution
 - ii. Independent frame rate

- iii. User may use one stream for live monitoring and the second stream for recording, or use just one of the streams for both live monitoring and recording
- iv. The software shall allow the administrator to split a dual-stream camera (from certain types of edge devices) into two separate, independent scenes, thus:
 - Allowing the configuration of each scene with different video quality schedules, for example one scene with high quality and the other scene with low quality
 - Providing the option to view live any of the scenes or both concurrently
 - Providing the option to record any of the scenes or both concurrently with different retention settings

3) Adaptive Streaming

- a) The VMS shall support a method of rationalizing bandwidth usage.
- b) The Adaptive Streaming component shall choose the most suitable stream to display on the client monitor according to the size of the current viewing tile. The component shall maximize the number of pixels that can be displayed in the tile according to the tile size and the maximum displayable resolution of the monitor.
- c) Adaptive Streaming shall improve the following functionality:
- d) Reduce bandwidth consumption
- e) Increase number of viewable video streams
- f) Reduce system resource load on client machine and Transcoder server
- g) The Adaptive Streaming mechanism shall react to the following user actions:
 - i. Dragging the video to a different sized tile or changing the layout
 - ii. Maximizing the tile size
 - iii. Using digital zoom
- h) The system shall use all available streams from the camera, based on its capabilities.

- i) In the case where a user is viewing MJPEG video via the Web or Mobile client, the Adaptive Streaming functionality shall be handled by the Transcoder service. The Transcoder itself shall request the most appropriate stream from the cameras in order to meet the requested resolution.
- 4) Recording
- a) Recording shall be available in any format, resolution, and quality supported by the system.
 - b) The recording of video and audio shall be performed by the Archiver service.
 - c) The Archiver shall support a total recording capacity of up to 500 cameras at 1Mbps each, all recording simultaneously at 30fps NTSC/25fps PAL and 4CIF video resolution on a single server.
 - d) The Archiver multimedia storage system shall be based on advanced recording methods that prevent disk fragmentation to maintain a constant writing performance over time.
 - e) The system shall deter unauthorized deletion of media from outside sources, have the ability to provide physical annunciation as required, and warn administration when such deletion is attempted in the form, including, but not limited to:
 - i. Text message
 - ii. Email message
 - iii. Event/Alarm Pop Up
 - f) The software shall facilitate Distributed, Redundant, and/or Failover recording as optional features.
 - g) The software shall support multiple recording triggers: manual, schedule, motion-based, alarm-based, and event-based. The software shall save the recording reasons as part of the video clip's metadata.
 - h) The software shall support Pre- and Post-Recording for alarm and for motion-based recording.
 - i) The software shall allow for easy control of recording retention period (how long clips remain archived before being overwritten).
 - i. The software shall support the configuration of different retention period rules for each camera

- ii. The software shall support the configuration of different retention period rules for different recording triggers (for example, alarm clips shall be retained for one month while other clips shall be retained for one week)
 - j) The software allow configuration of recording schedules which can be set individually per camera (audio recording schedule shall be derived from the camera).
 - k) The software shall support recording of either the live stream or the recorded stream when using edge devices that support dual streams.
- 5) Smooth Reverse Playback
- a) The VMS shall support smooth reverse playback, with the ability to display all video frames and not only the key frames.
 - b) Online video playback shall be performed in TCP/IP transport method by default.
 - c) The software shall allow configuration of the transport method for playback to be either TCP or UDP.
- 6) 360° Cameras
- a) The VMS shall support 360° panomorph-enabled edge devices.
 - b) The VMS shall support edge-side dewarped cameras.
 - c) The VMS shall be able to present each view independently and control its video settings
 - d) The VMS shall support client-side dewarping allowing the user to zoom in and view all aspects of panoramic area.
- 7) Handheld Device-Based Video
- a) The VMS shall support receiving real-time video streams from Android-based and iOS handheld devices.
 - b) The VMS shall handle the handheld-device based video similar to handling IP camera video, and provide similar functionality including, but not limited to, the ability to record it, bookmark it, display live video and playback from archive, as well as export the video.
 - c) The VMS shall support receiving the handheld-device based video over WiFi, 3G, 4G and LTE connections.

- d) The VMS shall support receiving the handheld-device based video in MJPEG or H.264 compressions, in various resolutions and frame rates.
 - e) The VMS shall support receiving a GIS location of the handheld-device and to be able to display its location over a GIS map.
 - f) The VMS shall allow the handheld device application user to freely connect and disconnect from the system using his user credentials, freely start and stop streaming video to the VMS, and use the handheld device to tag video clips that were recorded by the VMS.
 - g) The VMS shall allow many handheld devices to connect concurrently to the system.
 - h) The VMS shall allow multiple users to connect using the same physical handheld device, while creating a separate scene (logical camera entity) for each user on each device.
 - i) The VMS shall allow operators to easily search for recorded video from handheld-devices, according to any combination of the following parameters: username, device name, device id, date-time, and bookmark text tagging.
- 8) Video Export
- a) The software shall support the ability to export video and audio clips for investigative, prosecutorial, management, and training purposes.
 - b) The software shall support exporting the native format of video or audio recordings to tamper-proof files protected with SHA1-based digital signature and with 1024-bit RSA encryption, in order to comply with court of law evidentiary requirements.
 - c) The software shall support the ability to play exported, native format clips on a standard computer using a stand-alone player that shall verify the authenticity of the clips and indicate the verification results. The player shall run on any workstation and comply with the VMS standalone player requirements, with no need to install any software.
 - d) The VMS software shall also provide file export functionality for export of single frames of video (snapshot) in JPEG, PNG or BMP file formats. Exported JPEG and BMP files shall comply with standard image viewing software tools based on Windows OS.

- e) The software shall support export of video clips in MP4 and AVI file format, audio in WAV file format, and interleaved audio and video in AVI file format. Exported AVI or WAV files shall comply with standard audio and video playing software tools based on Windows OS.
 - f) Export shall be available from the Control Center and the Web Client applications.
 - g) The VMS software shall provide a Control Center function for advanced export management, supporting multiple concurrent exports from multiple cameras, and including the option to burn the exported clips on a DVD with the stand-alone player and an "autorun" file.
 - h) Export shall be supported within a module that builds collections of case material, allowing export of the case content to an offline storage location.
- 9) Mass Export
- a) The Mass Export feature shall allow users to export a large amount of data in the most efficient manner when backing up files from the Archiver storage directly to a different hard drive. The target hard drive shall be a local drive, an external drive, direct attached storage, Network Attached Storage (NAS), or Storage Area Network (SAN).
 - b) Mass Export jobs shall be executed on demand.
 - c) Mass Export jobs shall be processed by the Archiver Service.
 - d) Mass Export shall support copying the data directly from the Archiver to an external storage device, such as a USB hard drive, DAS, NAS, or SAN device
 - e) Mass Export shall arrange the exported footage in folders according to the recording source (camera or audio input) and name the exported clips with timestamps of the recording start times and end times
 - f) It shall be possible to open mass exported folders or files with the stand-alone player application and playback the footage offline
 - g) Users shall be able to configure each Mass Export job to be performed in one of two modes:
 - i. Normal Mode: The archiver shall perform the export while continuing to perform all other tasks, including recording and playback
 - ii. Emergency Mode: The archiver shall stop recording for the duration of the Mass Export

- h) The Mass Export data should be digitally signed the same way as regular export.
- 10) Web Client Video streaming
 - a) The web client shall stream live and recording video in MJPEG and H.264 format.
 - b) The web client shall use native html and shall not require Active X, or any other plug-in such as Adobe Flash Player, for displaying video.
- 11) Web Publishing
 - a) The VMS shall allow the administrator to easily publish live video to external systems, public web sites, web applications, or any 3rd party system that can receive video streams from standard streaming servers such as Microsoft Media Gateway or VLC.
 - b) The administrator shall be able to publish any set of cameras from the VMS by using the Transcoder server and by installing a common video streaming solution, such as VLC or Windows Media Encoder, which provides access to the video via URLs.
 - c) The Transcoder shall be able to individually or simultaneously serve (a) VMS clients with low bandwidth by using MJPEG streaming, and (b) non-VMS clients by using a standard streaming solution.
- 12) Live Viewing with TCP Streaming
 - a) The VMS shall support Live viewing with Unicast TCP on cameras that support this mode. The Unicast TCP allows the system to resend blocks that were lost or interrupted on the network, resulting in better-quality and smoother video viewing of live content.
- b. Other Monitoring Functions
 - 1) Events

Event Definition: An Event signifies a change of condition in the system.

 - a) The VMS software shall support intelligent, rule-based event communications. The EDB service shall distribute events only to subscribed services and client applications.
 - b) The VMS software shall listen for events from edge devices and distribute them in the system as needed. As a minimum, the following types of events shall be supported:

- i. Dry contact/Input pin events
 - ii. Motion detection events
 - iii. Video and audio signal lost/recovered events
 - iv. Unit status events
- c) The software shall be able to distinguish each possible event generated by the edge device, including but not limited to:
 - i. Each Area of Interest Motion on/off
 - ii. Each dry alarm contact state normal/abnormal
 - iii. Each analytic configured event normal/abnormal
- d) The software shall be able to take an action upon the occurrence of the event, according to the defined configuration of the action.
- e) The software shall produce software events and distribute them in the system as needed. As a minimum, the following types of events shall be supported:
 - i. Login/Logout events
 - ii. Server status events
 - iii. Server Activity events (Recording, Clip Locking, Discovery, Motion Detection)
 - iv. Client Activity events (PTZ, camera software switching, export, configuration)
 - v. Alarm situations
 - vi. Bookmark and Incident events
 - vii. Storage status events
 - viii. Server and edge device availability events
 - ix. Video Analytic events (such as intrusion, trip wire detection, object removed, loitering, etc.)
 - x. Radiometric events

2) Actions

Action Definition: An action is a function that the system can be configured to perform automatically in response to an event.

- a) The software shall support the configuration of automatic actions.
- b) The software shall provide means for the user to link specific actions to specific events, such that occurrences of the event will trigger the automatic execution of the action.
- c) The software shall support the following actions as a minimum:
 - i. Create an Incident
 - ii. Trigger an alarm
 - iii. Switch video, audio, camera sequence, layout, or a map onto a user client workstation
 - iv. Change Relay/Out-pin state

- v. Go to PTZ preset
- vi. Run PTZ pattern
- vii. Change recording settings
- viii. Start or stop recording
- ix. Send an email
- x. Execute external actions as defined in the system by SDK or other integration tools
- xi. Clear camera analytics

- d) The software shall support time triggered actions, where an action can be fired either as a single time occurrence or periodically; daily, weekly or monthly. As an example, the user can create a daily timer to change output pin that controls lights by end of workday.

3) Alarms

Alarm Definition: An alarm is a critical condition requiring personnel attention in response to an action by an edge device, by the system, or by a human operator.

- a) The VMS software shall provide alarm management capabilities.
- b) The software shall support the creation and configuration of an unlimited number of alarm types.
- c) The alarm management shall be able to set any monitor to automatically display cameras in response to alarm inputs.
- d) Alarm video may be displayed on dedicated monitors or may temporarily replace video that is otherwise being viewed until the alarm condition is accepted (acknowledged) or cleared (reset).
- e) Alarms shall be triggered manually by users or automatically as a response to an event according to the administrator's definitions or video analytics.
- f) Alarms may be configured to be automatically cleared after a certain duration.
- g) Alarm instances can be configured to be deleted from the database after a certain time interval.
- h) Alarms shall be configured to display video content (including live and archived footage) and audio content (when linked to video) to the recipient users.
 - i. The alarm management shall automatically clear alarmed video and other alarm content once the alarm is cleared and shall restore previous content.

- ii. The software shall provide methods to display multiple alarms (each with multiple videos) on any number of monitors.
 - i) The user shall be able to snooze, forward alarms to other users, and clear alarms.
 - j) Alarms shall be configured to trigger recording of video and audio with pre-alarm and post-alarm periods, if defined.
 - k) Alarm recording shall be marked with automatic bookmarks.
 - l) Recorded alarm clips shall be searchable by searching for alarm history, recording reason, or bookmarked text.
 - m) The VMS software alarm management shall maintain a history of alarms in an MS-SQL database.
 - n) The VMS software shall support searching the alarm history database by different search criteria, such as priority, user who cleared, etc.
- 4) Advanced Alarm Management

The VMS shall support Advanced Alarm Management including:

- a) Color coding alarms
- b) Alarm life-cycle: Alarm status instances shall include Triggered, Accepted, Snoozed, Forwarded and Cleared
- c) The VMS shall highlight the cameras which are part of the alarm when the alarm is triggered
- d) The VMS shall support the simultaneous display of multiple cameras associated with an alarm. Cameras shall be spread on available tiles armed for an alarm.
- e) The VMS shall allow alarms to be displayed on maps with color-coding based on alarm status. The software shall allow multiple maps with alarm zones to be created.
- f) Alarm feature shall support the following display modes:
 - i. Block mode: All scenes associated with an alarm type will be shown, in sequence, in one available tile.

- ii. Salvo mode: All scenes associated with an alarm shall be displayed in available tiles. If there are more scenes than available tiles, the remaining scenes shall be displayed before displaying the next alarm. Multiple alarms shall be displayed in cyclic mode on available tiles according to priority. Alarm Procedures shall be displayable with their associated alarms.
- iii. Flat mode: The scenes associated with an alarm are displayed simultaneously on the available 'Armed for Alarms' tiles. If there are not sufficient 'Armed for Alarms' tiles for the scenes of a particular alarm, only as many scenes as possible will be displayed. When one alarm is cleared, the scenes from the next alarm will be displayed by priority.

5) Motion Detection

- a) The VMS software shall support motion detection in the following modes:
 - i. Edge device (hardware)-based motion detection: Where the detection is performed by the edge device on full view or zones (Regions of Interest)
 - ii. Server-based: Where the detection is performed by the server for streams sent to a server from an edge device
- b) The software shall support the configuration of motion detection profiles, allowing the definition of sensitivity and threshold for Motion-on and Motion-off events.
- c) The software shall record and display motion indication values, allowing display of the motion level as histograms on the timeline of the recorded video.
- d) The software shall support motion smart search, allowing the user to define a Region of Interest to query the system for all the motion incidents that have occurred in that region during a certain time period.

6) Video Analytics

- a) The VMS software shall support three major methods of Video Analytics:
 - i. Full Edge-based (IOImage): The Video Analytics extraction shall be done and processed entirely at an edge device, such as an analytics-enabled video camera or encoder.
 - ii. Proxy Server-based: The Video Analytics extraction shall be done on a proxy server and processed on a central server.

- b) The software shall provide access to Video Analytics edge devices and/or proxy server(s) and shall be integrated for alarm management. Video Analytics shall be an available optional item.
 - i. The software shall not limit the number of analytic algorithms that can be applied per camera
 - ii. The software shall provide architecture that increases the number of algorithm options per camera and reduce the number of servers required to perform these analytics
- c) Analytics supported by the above and used with VMS typically include:
 - i. Video Motion Detection (VMD)
 - ii. Intrusion Detection, which include multiple trip-wire detection rules and multiple video detection zones,
 - iii. Unattended object, and stopped vehicle detection
 - iv. Video Analytics for people and vehicle counting
 - v. Video Analytics for crowd detection (crowd is defined by percentage of area covered)
 - vi. Video Analytics Object Removal detection
 - vii. Video Analytics PTZ Camera Control – PTZ camera control for automatic object/person tracking
 - viii. Video Analytics over PTZ camera presets
- d) The software shall support analytics over SD resolution as well as HD resolution.
- e) The software shall provide an ability to search large amounts of data quickly for relevant images (for example, Smart Search).
- f) Analytic encoder binding – the VMS shall support binding of analytic-enabled encoders such as IOI TRK-101 or TRK-101-P with suitable cameras such as Quasar or Ariel line cameras to enable encoder functionality that provides Video Analytics on the camera scene, or allows PTZ tracking of moving objects.
- g) The system shall support PTZ tracking for supported cameras when connected to an intelligent encoder such as a TRK-101-P PTZ Tracker.
- h) The system shall support Arm/Disarm of analytic cameras/encoders either manually or by schedule

5. Client software

- a. The VMS shall provide client applications for the following needs:
 - 1) Control Center – Viewing and monitoring application

- 2) Admin Center – System Administration and Configuration application
 - 3) Quick Control Center – Self-contained version of Control Center which doesn't require installation and is used primarily as a stand-alone player
 - 4) Web client used for viewing live, playback, alarms and export recorded video
 - 5) Operator Monitoring – An agent software that shall enable monitoring and recording the PC screen in the VMS
- b. The VMS client application shall communicate with the VMS server-side and handle the user requests without interfering with the background tasks of any of the VMS services, or impacting its ongoing operation
 - c. The VMS client applications that connect and communicate with the VMS server-side shall require the user to authenticate via the Login dialog box by providing username and password
 - d. The VMS client application shall provide multi-language support
 - e. The VMS client applications shall utilize GUI skinning technologies

1) Admin Center Client

All administrative functions shall be accessible through an Administration Client,

Administrative functions shall include:

- a) Setup and Configuration
 - b) User Management
 - c) Edge Device Configuration
 - d) General Configuration Tasks
 - e) General System Management Tasks
 - f) Audit Trail and Reporting
 - g) Metadata
 - h) Preparation of Case Material
- 2) Setup and Configuration:
 - a) Initial Configuration Wizard: The software shall provide setup wizards in order to simplify the deployment process. It shall walk the user through basic steps, such as time-zone, network settings, etc.

- b) Status Dashboard: The AC shall have a dashboard displaying a live and interactive summary of the VMS status. It shall include:
 - i. Camera status (online, recording)
 - ii. Storage status
 - iii. Database status summary
 - iv. Recorded stream quality
 - v. License information
 - vi. Logged in user information (name, application, IP/Hostname)
 - vii. Logged in user information shall include the ability for an authorized user to logout other users, from the AC dashboard.
- c) Administrator User Interface: The AC shall offer the administrator a task-oriented user interface for ease of use. The AC shall provide means for the user to quickly navigate to perform the most common tasks of system administration.
- d) Licensing: The AC shall provide a licensing interface to help the user install and review the system licenses and the license usage statistics.
 - i. Licensing must be associated with the system globally
 - ii. License for User connections must not be locked to a specific machine
 - iii. Integrations, add-ons, and options must be applied on a per-system basis and not be tied to a specific machine, which would require multiple licenses per-system

3) User Management

The AC shall provide a means for User Management, including:

- a) Management of users and user groups
- b) Management of both camera access rights and privileges
- c) Rights and Privileges may be assigned to individual users or to groups of users (individual users sharing common rights and privileges, thus a "Group")
- d) Management of passwords, including password policies
- e) Management of privileges and camera access right settings for groups and individual users:
 - i. The AC shall provide a simple user interface to create User Groups and assigning privileges to them

- f) Active Directory®: The AC shall support user management using optional integration with Microsoft Active Directory.
 - i. It shall be possible to import groups and users from Active Directory
 - ii. The VMS software shall communicate with Active Directory to verify and authenticate users
 - iii. The software shall support unified login with the user PC login using the Windows credentials
 - g) It shall be possible for a user to force logout a user (if authorized to do so).
- 4) Edge Device Configuration
- a) Utility Discovery Tool
 - b) The system shall include a Utility Discovery Tool to identify and set up the VMS supplier's proprietary edge devices
 - c) The system shall provide a discovery interface to initiate a broadcast discovery for edge devices that are connected to the local area network. Once discovered, the user shall be able to assign edge devices to an Archiver.
 - d) Replacing Devices: The AC shall support replacing a device when the device is malfunctioning. In such cases, the software shall store the camera settings and allow access to its recorded data, even after replacement with a new device.
 - e) Compound Scenes: The AC shall support the notion of Scenes to separate between logical configurations of cameras and the physical configuration of the unit. The AC shall support creation and management of simple scenes, such as cameras and microphones, as well as compound scenes, such as a camera with microphone, or a stitched scene containing video from multiple cameras.
 - f) Profiles: The AC shall allow the user to create and manage configuration Profiles, in order to reduce the configuration work by assigning one profile to multiple entities
 - g) Batch Operations: The AC shall support Batch Operations, thus allowing the administrator to perform certain configuration tasks (remove or move) concurrently on multiple entities

- h) Copy Configuration: The AC shall support a Copy Configuration feature to ease configuration by copying and applying configuration settings from one camera to other cameras

5) Edge Device Security

The system shall support secured connection between selected or all cameras and archivers, using Transport Layer Security (TLS) for control information (as a minimum):

- a) The system shall indicate which cameras are securely connected.
- b) The system shall allow changing the security mode for groups of cameras/edge devices, and allow switching between secured and unsecured mode.
- c) The system shall support generation of self-signed-certificate for groups of cameras, supported with ONVIF API.
- d) The system shall include the capability to bulk-change camera passwords (on camera side) (i.e. from the system, force changing passwords for all cameras, or all cameras of a particular supplier/model range)

6) General Configuration Tasks

The AC shall provide a means for the following additional configuration tasks:

- a) Mail server settings
- b) Storage setup (size allocation in the partition level)
- c) Recording lifespan
- d) Schedules and coverage
- e) Alarms
- f) Event-triggered actions
- g) Software services

7) Audit Trail

- a) The VMS software shall support the recording of all Events, Actions, and Alarms into an Audit Trail database
- b) The VMS shall automatically audit all events in the system
- c) The Audit Trail Database shall be based on MS SQL

8) Reporting

The VMS shall provide a reporting utility to allow authorized users to generate reports.

- a) Reports shall be filtered by time, date, types, and free text
- b) Reports shall be viewable on the AC screen as well as exported and printed as common file formats, such as PDF and RTF, Word® or Excel®
- c) As a minimum, the following reports shall be supported:
 - i. User Logon Report
 - ii. Alarm Report
 - iii. Equipment Failure Report
 - iv. Server Monitoring Report
 - v. User Activity Report
 - vi. External Events Report

9) Administering Failover Resources

- a) The Admin Center application shall support the configuration and deployment of the services in the following additional roles:
 - i. Failover Directory
 - ii. Failover EDB
 - iii. Failover Archiver
 - iv. Redundant Archiver
- b) The software shall support multiple Failover directory servers for uninterrupted user logins and other directory functions
- c) The distributed and resilient architecture shall support uninterrupted viewing of live and archived video for logged-in users, even in the event of directory server failure or disconnection, and even if a Failover directory is not configured in the system
- d) The software shall support multiple Failover EDB servers for uninterrupted event and action distribution in case the primary (default) EDB is not available
- e) The software shall support multiple Failover Archiver (FOA) servers to ensure that archiving tasks can continue in the event of a primary Archiver failing to provide its services
- f) The software shall support FOA groups to allow the administrator to set specific relationships between primary and Failover Archivers

- g) Each Archiver can be defined both as a primary and as a Failover Archiver, allowing it to use its extra resources to backup other Archivers
- h) Each Failover Archiver shall have a priority
- i) Each Unit shall have a Failover priority
- j) The software shall support automatic recovery from all the Failover scenarios (Directory, EDB and Archiver) and fallback to the primary server when possible

b. Control Center Client

- 1. All functions required by operators for monitoring and utilizing the system's surveillance functions and responding to real-time situations shall be provided by a fully-featured client application
- 2. Each instance of the CC shall support the option to connect up to four monitors
- 3. The CC shall provide the user with an interface to control the display. The User shall be able to define how many monitors CC will be opened and which one will be used as primary.
- 4. It shall be possible to operate the CC application using the PC mouse, the PC keyboard, a CCTV keyboard, a gaming joystick, or any combination thereof.
- 5. The CC Client shall provide the operator with a task-oriented user interface for ease of use and to assist with efficient management of different tasks.
- 6. The CC shall support Full Screen mode for video viewing, allowing hiding or minimizing all other GUI components in order to maximize the video display 'real-estate'
- 7. The CC GUI shall be flexible and customizable. The user shall have different ways to organize the GUI on all the monitors available on that CC instance and create application layouts to match different needs.
- 8. The user shall support the option to maintain, or not maintain, video aspect ratio per tile or for the entire CC, allowing the user to stretch video to fit the entire tile
- 9. The CC Client shall be able to connect to up to 45 sites with a maximum of 10,000 cameras in total.
- 10. Each CC Client instance shall have the power to decode and display 32 concurrent 4CIF H.264 video streams, each at 30fps, with a bit rate of 1Mbps each when using a workstation that complies with the relevant recommendations of the VMS specifications

c. Control Center Viewing Options

The CC Client shall provide the following viewing options:

1) Live/Archived simultaneous viewing

- a) The CC shall support live monitoring and playback of archived video and audio simultaneously, side-by-side, on any of the tiles on its screens
- b) The CC shall support live or archive video monitoring from any edge device supported by the VMS, regardless of the video compression method, the configured video profile, or the communication method.

2) Navigation Tree Pane

The Navigation Tree pane shall include the following capabilities:

- a) Representation for cameras, camera sequences, tile layouts, and maps
- b) Display a hierarchy of sites and system resources to which the user has access rights
- c) Present a hierarchical logical view, displaying the system resources (cameras, tile layouts, etc.). Cameras and other system resources may appear under sites if defined.
- d) Display all logical entity types, including but not limited to cameras, camera sequences, audio devices, users, Control Centers and their monitors, input pins, output pins, PTZ cameras, stitched scenes, layouts, maps, and external entities defined by third party plug-ins or SDK integrations.
- e) Allow the user to filter the view by entity type
- f) Allow the user to search and highlight or filter the tree by text

3) Viewing Pane (one per screen)

The Viewing Pane is a GUI component that contains one or more tiles for the display of any content supported by the CC application

a) Multiple Tile Layouts

It shall be possible to configure the default layout that the CC will display upon launching

- i. Each Tile Layout shall enable viewing of up to 32 video tiles simultaneously on a single SVGA resolution screen.
- ii. Each Tile Layout shall support the display of different tile patterns, including but not limited to:

- A single tile
- 2x2 (Quad)
- 3x3
- 4x4
- 5x5
- Other tile pattern combinations including patterns that are optimized for 16:9 aspect ratio monitors

b) The following indications and controls shall be available on the video tiles:

- i. The scene name and logical ID
- ii. The content type, (e.g. live, archive, alarm, sequence, etc.)
- iii. The Tile ID
- iv. Buttons to control the different functions according to the tile content

c) Picture in Picture (PIP) for Dual Sensor Cameras

- i. When viewing a dual sensor camera (thermal and visible sensor) the CC shall display the Visible and Thermal images in a single tile using a Picture-in-Picture layout, where one scene is displayed on the main tile area and the other scene is displayed on a smaller window in the corner of the main tile.
- ii. The CC shall allow toggling the images and switch between the visible/thermal scenes
- iii. The CC shall allow resizing and minimizing the small PIP window
- iv. The CC shall allow dragging the PIP scene to another tile to be displayed in full tile size

4) Search and Query Pane

The Query Pane shall provide for the search of recorded data including the following types of data:

- a) Video and audio recordings, alarms, incidents and bookmarks,
- b) using the following criteria:
- c) Text search
- d) Site and/or scene selection
- e) Date and time range
- f) Recording reason
- g) Thumbnail Search

- h) Thumbnail search shall support zoom functionality. Zoom on playback in thumbnail search shall zoom in to each thumbnail as it does in playback
 - i) Thumbnail search shall allow the ability to define a time interval by which to separate thumbnail images
 - j) User (when applicable)
 - k) Recording "Lock" state
- 5) Motion Query Pane
- The Motion Query Pane shall provide for the search of motion in video recordings by any of the following means:
- a) Smart Search – Based on a region of interest defined by the user
 - b) Motion Indication – Based on motion level recorded during a specified time
 - c) Motion Bookmarks – Based on bookmarks that were created automatically upon detected motion
- 6) Alarm Pane and Alarm Management
- The CC shall offer the user advanced alarm management capabilities
- a) Alarm Pane

The Alarm Pane shall provide for display and management of alarms

 - i. The Alarm Pane shall display all the alarms to the user in a grid-type list
 - ii. The user shall have the ability to view, sort, and filter the alarm list in the alarm pane and clear acknowledged alarms from the list
 - iii. The CC user shall receive all the alarms that are addressed to that user or to a group of which the user is a member
 - b) Alarm Notification

The CC shall notify the user of an alarm in the following ways:

 - i. Provide an red flashing alarm indicator that shows the number of active alarms on the screen
 - ii. Add the alarm to the Alarm Pane
 - iii. Pop-up a notification window in the corner of the screen

- iv. Optionally pop-up the alarm video in a tile and mark the tile with a red flashing border

c) Alarm Display

The alarm associated video streams shall be displayed in the CC in the following ways:

- i. The CC shall have the ability to simultaneously display multiple cameras associated with an alarm on available tiles
- ii. The user shall have the ability to designate a tile for automatic alarm display upon receiving the alarm, by arming the tile for alarms
- iii. The user shall have the ability to manually select a tile to display an active alarm by using the mouse drag-and-drop or double-click from the Alarm Pane

d) Alarm Management

The user shall have a means to manage alarms:

- i. The user shall have the ability to manually trigger alarms
- ii. The user shall have the ability to view, sort and filter the alarm list in the Alarm Pane
- iii. The user shall have a way to 'Snooze' alarms
- iv. The user shall have a way to forward alarms to other users
- v. The user shall have a way to acknowledge alarms and add an acknowledgement text description
- vi. The user shall have a way to display an Alarm Procedure (URL or Map Content)
- vii. The CC shall display alarm-related video according to alarm priority. In case a higher priority alarm is triggered, its associated video should override lower priority associated alarm videos.

7) Event Pane

- i. The Event Pane shall provide for display and management of events
- ii. The Event Pane shall display events to the user in a grid-type list
- iii. The user shall have the ability to view, sort, filter, and clear events in the Event Pane
- iv. The user shall have the ability to edit data that is being displayed in some events, such as the text description of bookmarks and incidents

8) Timeline Pane

- a) The Timeline Pane shall provide the user with an interactive timeline GUI for the active playback in focus
 - b) The Timeline Pane shall support the display of the playback timeline in different time resolutions (from seconds to months) that can easily be selected by the user using the mouse 'click-and-drag'
 - c) The Timeline Pane shall provide the user with a means to control the playback with features such as 'jump-to-time', speed, and direction
 - d) The Timeline shall display metadata related to the playback, including date and time information, playback speed and direction, motion indication, bookmarks, and recording reasons
 - e) The Timeline Pane shall allow the user to mark a timeframe selection for the purpose of either locking, exporting, or loop playback of the recording
 - f) The Timeline Pane shall allow the user to view and add bookmarks to existing recordings
 - g) The Timeline Pane shall allow the user to expose all of the different playback tracks in the timeline with color coding. The available tracks include: All recordings, manual, schedule, event, alarm, edge recording and protected
- 9) Export Status Pane
- For displaying export jobs and their status
- 10) Offline Playback Pane (OPP)
- a) The OPP shall allow the user to open and playback exported footage
 - b) The OPP shall allow the user to open specific exported clips or open folder which contains multiple clips
 - c) The OPP shall display the list of open clips as a simple list or arrange the clips by scene name
 - d) The OPP shall allow the user to select which clips or scenes to playback from the list of opened clips
 - e) The OPP shall support transparent continuous playback of clips from the same scene, assuming the clips represent a continuous timeframe
 - f) The OPP shall allow the user to validate the authenticity of exported clips

- g) The OPP shall allow the user to perform synchronized playback of exported clips from multiple video and audio sources
- 11) Case Management Module
- a) Case management module attributes:
 - i. The CC shall provide the user with a case management mode allowing the user to view and create cases for investigation and evidentiary purposes.
 - ii. This module shall allow the user to collect related pieces of data and metadata from the system and other sources, and organize them under a single file to create a case.
 - Video and Audio Clips
 - Still Snapshots
 - Alarms, Incidents and Bookmarks
 - Any other files
 - URLs
 - Maps
 - iii. This module shall allow the users to add text descriptions and time stamps to the case data
 - iv. This module shall allow the user to create, save, modify, and delete cases
 - v. This module shall allow the user to search for saved cases using various search criteria
 - vi. This module shall allow the user to export a case onto a portable device or media in order to display the case away from the system
- 12) Video export attributes
- a) The CC shall support export of recorded video to video clips
 - b) Export rights shall be assigned by individual User or at the User Group level
 - c) Export shall be performed from the timeline or from the Query Results Pane
 - d) The user shall have the ability to set the export properties, including file name, export path, codec type, including a copy of the standalone player, etc.
 - e) The user shall have the ability to export a sub-clip from an already exported clip by selecting a time segment on the timeline of the original clip
 - f) The CC shall provide the user with status information on export jobs, including progress and error messages in a special Export Status Pane

- 13) Global Client capability
- a) The CC shall support the Global Client capability, allowing the user to connect to multiple VMS systems concurrently, and operate them
 - b) Perform live and archived playback of any camera, sequence or audio source from multiple systems concurrently
 - c) Receive and manage alarms and events from multiple systems concurrently
 - d) Operate resources like Global (multi-system) maps, control PTZ domes, and control output pins from multiple systems concurrently
 - e) The user shall have the ability to select the subset of systems to connect to in the initial login, as well as choose to disconnect from a system and connect to a system after the initial login.
- 14) Live/Archived video stitching capability
- a) The CC shall support the display and operation of live and archived stitched video scenes, allowing for multiple cameras to be presented in a single tile as a panorama
 - b) The system shall allow viewing multiple live and archived stitched videos in any tile selection
 - c) The system shall support manipulation of the display of the stitched scene and use various zoom and preset capabilities of the PTZ control
 - d) Stitched Scene Handling - It shall be possible to record stitch scenes, search for stitched scenes recording, playback, and export stitched scene footage.
- 15) Supervisor Mode
- The Control Center shall provide an agent that shall enable monitoring and recording of operator client screens in the VMS
- 16) Guard Tour
- The CC shall support 'Guard Tour' mode where the Viewing Pane switches the display of selected Layouts in a round robin way, every few seconds, according to the user-defined Dwell Time parameter
- 17) On-Screen Display technology

- a) The CC shall use On-Screen Display (OSD) technology to provide specific indications and controls on the video tiles and other types of tiles
- b) The user shall have the ability to configure which OSD elements should be displayed and to set the level of transparency for the OSD controls and their background
- c) The following indications and controls shall be available on the video tiles:
 - i. The scene name and logical ID
 - ii. The content type, (e.g. live, archive, alarm, sequence, etc.)
 - iii. The Tile ID
 - iv. Buttons to control the different functions according to the tile content
- d. Web client

The web client shall provide an interface for the operator to view live video, as well as, playback and export recorded video. The web client shall provide the following viewing options:

- 1) Live Camera Layout – A GUI component that contains one or more tiles for the display of live camera scenes.
 - a) The Live Camera Layout shall support the display of up to 9 cameras in supported Chrome and Opera Browsers. It shall support up to 6 cameras in IE 11 and up.
 - b) The Live Camera Layout shall support the display of dynamic tile layout patterns which adjust accordingly as video scenes are added.
 - c) The Live Camera Layout shall allow users to rearrange the location of the tiles by drag and drop functionality
- 2) Camera Catalog – Includes representation for cameras and displays preview of scene being viewed
 - a) The Camera Catalog shall display online and offline cameras.
 - b) The Camera Catalog shall display snapshot previews of camera scene for all online cameras
 - c) The Camera Catalog shall allow the user to single-click a camera scene to select it for viewing in the Live Camera Layout
 - d) Camera/Site filter – Shall allow for searching and filter based on camera name and system/site names

- 3) Web client export - Shall allow for the export of recorded videos in AVI, MP4 and DVT format
 - a) The web client shall support the ability to export still images (snapshots) and video clips while maintaining the source video quality
 - b) The web client shall support exporting the native format of video recordings to tamper-proof files, protected with SHA1 based digital signature 1024-bit RSA encryption, to comply with court of law evidentiary requirements
 - c) The web client shall support export of video clip in DVT, MP4 or AVI file format. Exported AVI files shall comply with standard audio and video playing software tools based on Windows OS. Exported DVT
 - d) Notification Center
 - i. The Notification Center shall display export status and completed exported videos and snapshot downloads. The number of export jobs shall be displayed above the notification center.
 - ii. The notification Center shall allow for user to download completed exported videos and snapshots.
- 4) Alarm Management – the web client shall support incoming alarm functionality, providing the following functionality:
 - a) The user shall receive a popup alert when new alarm is triggered
 - b) The web client shall display list of alarms with thumbnail of the camera associated with the alarm
 - c) The user shall be able to perform basic operations with each alarm:
 - i. View the live or recorded cameras associated with the alarm
 - ii. Accept or delete and alarm
 - iii. View alarm information
- 5) Secured HTTPS Connection - the web client shall support secured (Transport Layer Security) TLS protocol, and allow the user to load TLS certificate for enabling HTTPS connection.
- 6) Picture in Picture (PIP) for Dual Sensor Cameras

When viewing a dual sensor camera (thermal and visible sensor) the web client shall display the Visible and Thermal images in a single tile using a Picture-in-Picture layout, where one scene is displayed on the main tile area and the other scene is displayed on a smaller window in the corner of the main tile.

- a) The web client shall allow toggling the images and switch between the visible/thermal scenes
 - b) The web client shall allow minimizing the small PIP window
- 7) Save site filters, live view layouts - the web client shall save session information specific to users so that a user can log in and pick up where they left off. The following items shall be persisted upon re-login by the same user, to the same system with the same browser: Sites Filter, Selected Cameras in Live, Viewed alarms and Export format.
- e. Mobile Device Support

The VMS shall support viewing live and recorded video through mobile devices with iOS or Android operating systems. The mobile apps shall be able to carry out the following functions:

 - 1) Store multiple site profiles – select which site to login to
 - 2) View live: digital zoom, PTZ control, maximize tile
 - 3) Search playback
 - 4) See status of camera
 - 5) See recording status
 - 6) Trigger an alarm on the VMS system that can be identified as originating for the mobile user, and which can include the mobile user's GPS location.
- f. Client Portal (Client Application Deployment)
 - 1) The VMS shall provide a web interface to enable deployment of the client software installation packages and a stand-alone player.
 - 2) Users may access the client portal from any location in their organization's network or through the Internet.
 - 3) Access shall be via any standard browser by typing in the URL address of the client portal and then downloading the desired software package.
 - 4) Once downloaded, the user can install the software on their client workstation or use the stand-alone player.
- g. Cloud-based Health Monitoring
 - 1) The VMS shall support a cloud-based system monitoring module.

- 2) The cloud shall be accessible from anywhere with Internet access via a web browser.
- 3) The cloud shall support real-time health status for:
- 4) Physical servers that comprise the security surveillance installation
- 5) Edge devices
- 6) Recording status
- 7) Database size
- 8) The cloud shall support proactive alerts when system thresholds are crossed (based on user definitions).
- 9) The cloud shall support system's database backup upload to the cloud.
- 10) The cloud shall be secured and access shall be granted only to authorized users.

6. System Integration Functions and Tools

Objective: The VMS manufacturer shall offer a Software Developer's Kit in order to facilitate functional interfaces to a variety of different types of software and systems and to perform extended custom functions that are not initially a part of the VMS software.

The VMS software shall offer integration tools, including Software Development Kit and plug-In technology, and provide the most popular environment for 3rd party systems (such as Access Control, Fire Alarm, Public Address, Aviation, Marine, Gaming Table, Point-of-Sale, etc.), developers and products (such as IP cameras, encoders, etc.) for rapid development and quick integration.

a. Software Development Kit (SDK)

- 1) The SDK shall provide Microsoft .NET libraries arranged as VMS Application Programming Interfaces (APIs) to achieve the following capabilities:
 - a) Monitor live and archived video and/or audio from the software in SDK applications
 - b) Configure the VMS software from SDK applications
 - c) Control and operate the VMS software resources
 - d) Create customized solutions on top of the VMS for specific needs
- 2) The SDK application shall be able to operate from any workstation that can communicate with the VMS software.
- 3) The SDK shall have comprehensive documentation with examples.

4) Infrastructure:

- a) .Net extended SDK
- b) Application plug-in technology – Shall provide the developers the infrastructure to be able to change the look and feel of the client applications for both the configuration and monitoring application. This shall include but not be limited to:
 - i. Adding buttons to the monitoring application based on customer needs
 - ii. Adding panes
 - iii. Displaying different content in video tiles, such as WinForms or a web application
 - iv. Adding new types of entities to the system, such as any sensor, reader, motion sensor, etc.
 - v. Changing GUI of existing entities in the configuration system (for example, color and icons)

5) Server plug-in technology

The SDK shall provide the developers with the infrastructure to be able to change the behavior of the server-side services and applications. This includes but shall not be limited to:

- a) When adding entities, assigning them parameters according to a pre-defined formula
- b) Adding additional types of validation
- c) Adding new types of privileges
- d) Direct Show Filter (DSF)
- e) Metadata – Save external information by utilizing the VMS database and synchronizing it with played video

6) Interfaces facilitated to other systems

The SDK shall facilitate interfacing to other systems to include (at a minimum):

- a) Designated Access Control systems
- b) Perimeter Detection systems
- c) Gunshot Detection systems
- d) IP interface
- e) Input/Output boxes
- f) Asset Management systems
- g) Alarm panels

- h) Video walls
- i) Video Analytics systems
- j) Situational Awareness software
- k) Audio systems
- 7) Interface types
 - a) Basic serial Interface
 - b) IP interface using XML
 - c) Metadata interface
 - d) SDK and APIs
- 8) Available SDK technologies
 - a) Microsoft Windows™
 - b) Microsoft SQL Server™
 - c) .Net and C++ support
 - d) ActiveX®
 - e) COM Objects
 - f) XML®
 - g) Plug-ins
 - h) Microsoft WMI
 - i) Microsoft Message Queue®
- 9) SDK Functions
 - a) The SDK shall facilitate access to and interfacing with all VMS features and functions
 - b) Every action that can be performed manually shall be available via the SDK. This includes, but is not limited to, adding entities, updating entities, removing entities, displaying entities in the monitoring system, and triggering alarms automatically.

- c) The SDK shall allow interfacing available features and functions from other related software and hardware products in order to extend the functionality of the VMS system, the other system or both, or to create entirely new functional systems out of a combination of any number of related systems.
- d) Examples of sample SDK functions shall include:
 - i. Facility Alarm Verification: Display video from the VMS on an Access Control system in response to unauthorized use of access credentials
 - ii. Vehicle Access Assistance: The VMS system shall automatically display video of a vehicle and car license plate in response to an intercom call from the parking gate
- e) The VMS software shall have an open architecture and support hosting software plug-in modules that were not developed with the original core software. Plug-in modules are software add-on components that can be added to the core software and become an integral part of the system.
- f) The VMS software shall support plug-ins to allow adding GUI components to the Control Center application as well as the Admin Center applications
- g) Application plug-ins shall have the ability to communicate with the application modules and the rest of the VMS as if they are an integral part of the system
- h) The VMS shall provide infrastructure for server-side plug-ins in order to allow separate development of new software capabilities that extend the original VMS software capabilities. Such plug-ins may allow the following options:
 - i. Development of additional edge device integrations
 - ii. Development of new entity types (extending the core VMS model)

3.2.7 CCTV IP Cameras

- A. Contractor shall be responsible to provide proper required PoE power and connectors for each camera listed below per manufacturers listed Data Sheet requirements, No Exceptions will be taken as each camera will have its own power consumption requirements and connector type.

- B. All Camera cables shall be General Cable GenSPEED 6000 Enhanced Category 6 plenum rated 23 AWG, 4-pair, Blue/Black jacket cables (contractor must obtain approval for color prior to installation). No substitutions will be allowed without prior written approval from the city IT Project Manager. All cables shall be installed from the camera jack directly to the appropriate Cat 6 patch panels in the MDF. All cable pairs or modular jacks shall be wired to ANSI/TIA/EIA568-B using T568-A wiring scheme at both ends. All cables shall be tested to minimum Cat 6 standards. Camera types listed below describing various resolutions, form-factor and features shall be supplied by a single camera manufacturer video surveillance system.

3.2.8 Cameras

- A. Provide high resolution digital video cameras by Axis or equivalent by a major manufacturer.
1. 12-megapixel quad-stream H.264/MJPEG, True (Shutter) WDR, IP66-rated day/night digital video camera with fixed 1.05mm, F2.4, 1.29mm hemispheric lens, within an IK10 vandal-resistant housing for wall mounting, ceiling mounting, or pendant mounting.
 2. The digital video camera shall support H.265/H.264/MJPEG compression on four (4) simultaneous video streams, up to 12-megapixels through a digital network.
 3. Resolution and bandwidth shall be scalable.
 4. The camera shall incorporate at minimum a fully digital 1/1.7", 4000 x 3000 (12MP) Progressive Scan BSI CMOS imaging system with IR illumination and electronic day/night ICR for infrared sensitivity.
 5. The camera shall utilize scene adaptive algorithms to provide a high image quality with low bandwidth and storage requirements (Smart Picture Quality to automatically adapt to wider range of changing conditions using advanced picture settings optimizations).
 6. The camera shall provide bi-directional audio via audio I/O.
 7. The camera shall accommodate one (1) alarm input and provide one (1) relay output.
 8. The camera shall provide a micro-SDXC card slot with support for up to 128GB (Class 10) devices.
 9. The camera may be powered by 12VDC or IEEE 802.3af PoE (Class 0 to Class 3).
 10. The camera shall be IEEE-compliant utilizing the multicast networking protocol such that a single camera may be transmitted to multiple viewers/archivers on the network simultaneously, further reducing bandwidth and providing greater flexibility in network monitoring/recording configurations.
 11. Resolution shall be scalable between D1 (720 x 576/480) to 12MP (4000 x 3000) on CM-6212 for selected digital streams which may be set to unicast or multicast.
 12. Bandwidth shall be scalable between 64Kbps and 20,480Kbps.

13. The audio capabilities shall support either half-duplex or full-duplex audio on two-way connections.
14. The camera shall support G.711, G.726, and AAC audio compression.
15. The camera shall accommodate one (1) digital alarm input and provide one (1) digital alarm relay output.
16. The camera shall provide a web Interface for viewing, configuration, and control.
17. Motion Detection:
 - a. The camera shall provide intelligent multi-zone video motion detection with the following configurable parameters:
 - 1) Sampling pixel interval (1-10)
 - 2) Detection level (1-100)
 - 3) Sensitivity level (1-100)
 - 4) Time interval(sec) (0-7200)
18. Storage and Bandwidth Efficiency:
 - a. Motion Compensation and Processing:
 - 1) The camera shall employ industry-standard motion compensation methods as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce the storage and bandwidth consumption associated with scene motion.
 - 2) Compliant motion compensation shall employ a block-matching algorithm covering an area of at least 256 macro-blocks surrounding each block to be processed.
 - 3) The motion compensation process shall output industry-standard H.264 compliant motion vectors as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce storage and bandwidth consumption associated with scene motion.
 - 4) The compliant motion vectors shall be compatible with and verifiable using Windows Media Player equipped with FFDSHOW or equivalent utility to visualize the motion vectors contained within the resulting H.264 video stream.
 - b. Compression Efficiency:
 - 1) The camera shall provide an effective rate control algorithm which maintains set frame rates of full 30fps (NTSC) or 25fps (PAL) at 12MP using no more than 45 (+/-10%) pixels per bit of storage with full screen (100%) motion including panning/tilting velocities of at minimum 25% of the camera field of view per second.

- 2) The images shall remain free of objectionable compression artifacts when operating as defined in paragraph "H.2.a" under recommended lighting conditions.
- 3) Pixels per bit (ppb) efficiency shall be defined as $ppb = (ppf) * (fps) / (bps)$ where:
 - a) ppb = pixels per bit
 - b) ppf = pixels per frame (= horizontal resolution x vertical resolution)
 - c) fps = frames per second
 - d) bps = bits per second. This is a bandwidth measurement which equals the Kb/s generated by the camera x1000

19. Camera:

- a. Image Sensor:
 - 1) CM-6212: 1/1.7" 12MP Progressive Scan CMOS
 - 2) Day/Night with IR sensitivity on all models
- b. Sensor Resolution:
 - 1) 12 megapixels (4000 x 3000)
- c. Scanning Mode: Progressive
- d. Sensitivity:
 - 1) Color (Day) Mode: 0.1 Lux @ F2.4
 - 2) B/W (Night) Mode: 0.1 Lux @ F2.4 with IR illuminator measured with DSS off at 30 IRE
- e. Applicable Lens Type:
 - 1) Fixed F2.4, 1.29mm lens
 - 2) Viewing angle: 180°
- f. IR Illuminator: High-power/high-efficiency SMD devices with wide-angle illumination.
 - 1) Effective IR range: 5m/16 ft. at 360°
 - 2) IR Compensation: Automatically adjusts the scene brightness to compensate for nearby bright objects. On/Off.
 - 3) IR LED illuminator: Auto/Off

- 4) Day/Night Threshold: 9 settings
- g. White Balance: Auto/ATW/One Push/Manual (On/Off)
- h. Shutter Speed: 1.0 to 1/10,000 sec. (Auto)
- i. Digital Slow Shutter: 1~30 fps (NTSC)/1~25 fps (PAL)
- j. Noise Reduction: 2DNR,3DNR, ColorNR On/Off (3 levels)
- k. Exposure Modes: Auto/Manual
- l. Day/Night Mode: Auto/On/Off/Smart. Smart mode eliminates erroneous switching back to day mode when used with high levels of IR lighting.
- m. True (Shutter) Wide Dynamic Range: On/Off (3 levels)
- n. Tamper Detection (On/Off)
- o. Privacy Zone: On/Off (5 zones)
- p. Video Motion Detection: Up to 4 independent zones
- q. Digital Zoom: 10x
- 20. Video:
 - a. Compression: H.264 Baseline/Main/High Profiles (MPEG-4 Part 10) and MJPEG compression; quad-streaming
 - b. Performance:
 - 1) 12MP (4000 x 3000) @ 20 FPS
 - 2) Quad-stream: 12MP @ 15 FPS + HD 720p @ 12/15 FPS + HD 720p @ 12/15 FPS + D1 @ 12/15 FPS
 - c. Resolution Range: Up to 5 user selectable resolutions from D1 to 12MP (CM-6212).
 - d. Bandwidth:
 - 1) Configurable between 64Kbps to 20,480Kbps
 - 2) Rate Control: CBR/VBR
 - e. Video Motion Detection (VMD):
 - 1) Intelligent multi-zone VMD
 - 2) Up to four independent zones
- 21. Audio:
 - a. Bidirectional Audio:

- 1) Line-In for using line-level audio inputs
- 2) Line-Out to feed any single-ended line-level audio input, such as an amplified bullhorn, amplified speakers, or public address system

22. Alarms:

- a. Input: One (1) 5V, 10K Ω dry contact
- b. Output: One (1) relay contact, 300VDC/300VAC @ 130mA maximum

23. Network:

- a. Ethernet: 10/100/1000Base-T auto-sensing, half/full-duplex (RJ45)
- b. Protocols: IPv4, IPv6, TCP/IP, UDP unicast/multicast, RTP, RTSP, HTTP, HTTPS, ICMP, FTP, SMTP, DHCP, PPPoE, UPnP, IGMP, SNMP, QoS, ONVIF Profile S, IEEE 802.1X
- c. Digital Streams: The camera shall provide four digital streams plus bi-directional audio on one Ethernet connection
- d. Operating Systems: Windows 7, 8, and 8.1 (64-bit)
- e. Web Browsers: Internet Explorer 9 and above (32-bit)

24. Management:

- a. Configuration: Remote (via web interface or supported Video Management Software)
- b. Firmware Updates: Flash memory for upgrade of camera firmware over the network

25. Power:

- a. Input Voltage:
 - 1) 12VDC \pm 10%
 - 2) PoE (IEEE 802.3af (Class 0 to Class 3))
- b. Power Consumption:
 - 1) 12VDC: 8W
 - 2) PoE: 10W with heater and IR operating

26. Connections:

- a. Network: RJ45
- b. Power:

- 1) 12VDC (Through 2-pin terminal block connector)
 - 2) PoE: Through the RJ45 connector
 - c. Audio In/Out:
 - 1) Line-In/Line-Out: 1.5mm audio jack
 - d. Alarm In/Alarm Out: Through terminal block connector
 - e. microSDXC card drive: For recording up to 128GB, Class 10 (card not included)
- 27. Physical and Mechanical:
 - a. Physical:
 - 1) Dimensions: \varnothing 163 x 104mm (6.43 x 4.1 in.)
 - 2) Unit Weight: 2.1 lbs. (0.95kg)
 - 3) Enclosure: IP66 with IK10 vandal-resistant
 - b. Mechanical:
 - 1) Bubble Rating: K10 Vandal Resistant Polycarbonate
 - 2) Bubble F-Stop Clear Bubble: F0.0, Optional Smoke Bubble: F1.0
 - 3) Pan/Rotate/Tilt: 355° pan, \pm 100° rotate, 80° tilt
- 28. Environmental:
 - a. Operating Temperature: 14°F to 122°F (-10°C to 50°C) with heater, -13°F to 122°F (-20°C to 50°C) for cold start with PoE
 - b. Storage Temperature: -4°F to 158°F (-20°C to 70°C)
 - c. Humidity: Up to 90% (non-condensing)
 - d. Ratings: IP66
 - e. Internal Heater: Automatic
- 29. Regulatory:
 - a. USA: FCC 47 CFR Part 15, Subpart B, Class A; UL (UL 60950-1)
 - b. Worldwide: CE (EN 55032 Class A; EN50130-4; IEC 60950-1, EN 61000-6-4)
 - c. RoHS
- 30. Optional Accessories, where required for camera mounting:

- a. Indoor Wall Mount Kit with Wall Bracket:
- b. Indoor Pendant Kit: (Supports 1.5" female threaded wall brackets as well as 3/4" EMT Conduit Pendant)
- c. Outdoor Pendant Mount Kit with Wall Bracket: (Adds Short Wall Bracket to CM-CAPX-IND-P kit)
- d. Outdoor Pendant Kit: (Includes 1-1/2" male pipe threaded mount and 3/4" female EMT conduit compatibility)
- e. Recessed Kit
- f. Smoked Bubble
- g. Mini-Dome Conduit Backbox
- h. electrical box mounting adapter
- i. Pole Mount. Includes CX-ARMX-1 mounting bracket,

B. Provide 4 megapixel, Quad HD, shutter WDR, 30 / 25 frames per second high-resolution digital video mini-dome camera or approved equivalent by a major manufacturer.

- 1. Quad HD Definition 2K/4 megapixel (2560 x 1440) triple-stream H.264 / H.265, shutter WDR, IP67/NEMA 4-rated day/night mini-dome digital video camera with integrated 2.8mm to 8.5mm (CM-3304-11-I) / 9mm to 22mm (CM-3304-21-I) motorized auto-focusing, vari-focal P-iris lens, within an IK10 vandal-resistant bubble and housing for surface mounting (standard), recessed mounting, or pendant mounting (options).
- 2. The digital video camera shall support H.265 / H.264 compression on three (3) simultaneous video streams (Ultra HD 2160p, Full HD 1080p, HD 720p and D1) through a digital network.
- 3. Resolution and bandwidth shall be scalable.
- 4. The camera shall incorporate a fully digital Ultra HD (8.3 megapixel) backside illumination CMOS imaging system with IR illumination and day/night IR cut filter for infrared sensitivity.
- 5. The camera shall provide enhanced low light performance using binning mode in Full HD 1080p resolution, increasing the light sensitivity of the sensor during low light conditions
- 6. The camera shall utilize scene adaptive algorithms to provide a high image quality with low bandwidth and storage requirements (Smart Picture Quality to automatically adapt to wider range of changing conditions using advanced picture settings optimizations).
- 7. The camera shall provide bi-directional audio via audio I/O.
- 8. The camera shall accommodate alarm inputs and provide a relay output.

9. The camera shall provide a microSDXC card slot with support for up to 128GB (Class 10) devices.
10. The camera may be powered by AC/DC or 802.3af Class 0 Power over Ethernet (PoE).
11. The camera shall fit on a standard 4S electrical box.
12. The camera shall be IEEE-compliant utilizing the multicast networking protocol such that a single camera may be transmitted to multiple viewers/archivers on the network simultaneously, further reducing bandwidth and providing greater flexibility in network monitoring/recording configurations.
13. The digital video camera shall provide the user with H.265 and H.264 video compression on up to four digital streams simultaneously.
14. Resolution shall be scalable between CIF to 1440P Quad HD (2560 x 1440) on selected digital streams which may be set to unicast or multicast.
15. The camera shall be capable of producing 30 frames per second (NTSC) and/or 25 frames per second (PAL) 1440P Quad HD (2560 x 1440) video stream.
16. The camera shall be capable of producing 60 frames per second (NTSC) and/or 50 frames per second (PAL) Full HD / 1080P (1920 x 1080) video stream.
17. Bandwidth shall be scalable between 64Kbps and 20,480Kbps.
18. The audio capabilities shall support either half-duplex or full-duplex audio on two-way connections.
19. The camera shall accommodate alarm inputs and provide a relay output.
20. The camera shall provide a web Interface for viewing, configuration and control.
21. Motion Detection:
 - a. The camera shall provide intelligent multi-zone video motion detection with the following configurable parameters:
 - 1) Sampling pixel interval (1-10)
 - 2) Detection level (1-100)
 - 3) Sensitivity level (1-100)
 - 4) Time interval(sec) (0-7200)
22. Storage and Bandwidth Efficiency:
 - a. Motion Compensation and Processing:
 - 1) The camera shall employ industry-standard motion compensation methods as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce the storage and bandwidth consumption associated with scene motion.

- 2) Compliant motion compensation shall employ a block-matching algorithm covering an area of at least 256 macro-blocks surrounding each block to be processed.
- 3) The motion compensation process shall output industry-standard H.265 and H.264 compliant motion vectors as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce storage and bandwidth consumption associated with scene motion.
- 4) The compliant motion vectors shall be compatible with and verifiable using Windows Media Player equipped with FFDSHOW or equivalent utility to visualize the motion vectors contained within the resulting H.265 / H.264 video stream.

b. Compression Efficiency:

- 1) The camera shall provide an effective rate control algorithm which maintains set frame rates of full 30fps (NTSC) or 25fps (PAL) in 4K Ultra HD using no more than 45 (+/-10%) pixels per bit of storage with full screen (100%) motion including panning/tilting velocities of at minimum 25% of the camera field of view per second.
- 2) The images shall remain free of objectionable compression artifacts when operating as defined in paragraph "H.2.a" under recommended lighting conditions.
- 3) Pixels per bit (ppb) efficiency shall be defined as $ppb = (ppf) * (fps) / (bps)$ where:
 - a) ppb = pixels per bit
 - b) ppf = pixels per frame (= horizontal resolution x vertical resolution)
 - c) fps = frames per second
 - d) bps = bits per second. This is a bandwidth measurement which equals the Kb/s generated by the camera x1000.

C. Provide 8 megapixel, 4K Ultra HD, shutter WDR, 30 / 25 frames per second high-resolution digital video bullet camera or approved equivalent by a major manufacturer. Housing to be Minidome as required.

1. Ultra High Definition 4K/8 megapixel (3840 x 2160) triple-stream H.264 / H.265, shutter WDR, IP67/NEMA 4-rated day/night bullet digital video camera with integrated 3.4mm to 9mm motorized auto-focusing, vari-focal P-iris lens, within an IK7 vandal-resistant housing for wall and pole mounting options.
2. The digital video camera shall support H.265 / H.264 compression on three (3) simultaneous video streams (Ultra HD 2160p, Full HD 1080p, HD 720p and D1) through a digital network.
3. Resolution and bandwidth shall be scalable.

4. The camera shall incorporate a fully digital Ultra HD (8.3 megapixel) backside illumination CMOS imaging system with IR illumination and day/night IR cut filter for infrared sensitivity.
5. The camera shall provide enhanced low light performance using binning mode in Full HD 1080p resolution, increasing the light sensitivity of the sensor during low light conditions
6. The camera shall utilize scene adaptive algorithms to provide a high image quality with low bandwidth and storage requirements (Smart Picture Quality to automatically adapt to wider range of changing conditions using advanced picture settings optimizations).
7. The camera shall provide bi-directional audio via audio I/O.
8. The camera shall accommodate alarm inputs and provide a relay output.
9. The camera shall provide a microSDXC card slot with support for up to 128GB (Class 10) devices.
10. The camera may be powered by AC/DC or 802.3af Class 0 Power over Ethernet (PoE).
11. The camera shall fit on a standard 4S electrical box.
12. The camera shall be IEEE-compliant utilizing the multicast networking protocol such that a single camera may be transmitted to multiple viewers/archivers on the network simultaneously, further reducing bandwidth and providing greater flexibility in network monitoring/recording configurations.
13. The digital video camera shall provide the user with H.265 and H.264 video compression on up to four digital streams simultaneously.
14. Resolution shall be scalable between CIF to 4K Ultra HD (3840 x 2160) on selected digital streams which may be set to unicast or multicast.
15. The camera shall be capable of producing 30 frames per second (NTSC) and/or 25 frames per second (PAL) 4K Ultra HD (3840 x 2160) video stream
16. The camera shall be capable of producing 60 frames per second (NTSC) and/or 50 frames per second (PAL) Full HD / 1080P (1920 x 1080) video stream
17. Bandwidth shall be scalable between 64Kbps and 20,480Kbps.
18. The audio capabilities shall support either half-duplex or full-duplex audio on two-way connections.
19. The camera shall accommodate alarm inputs and provide a relay output.
20. The camera shall provide a web Interface for viewing, configuration and control.
21. Motion Detection:
 - a. The camera shall provide intelligent multi-zone video motion detection with the following configurable parameters:

- 1) Sampling pixel interval (1-10)
- 2) Detection level (1-100)
- 3) Sensitivity level (1-100)
- 4) Time interval(sec) (0-7200)

22. Storage and Bandwidth Efficiency:

a. Motion Compensation and Processing:

- 1) The camera shall employ industry-standard motion compensation methods as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce the storage and bandwidth consumption associated with scene motion.
- 2) Compliant motion compensation shall employ a block-matching algorithm covering an area of at least 256 macro-blocks surrounding each block to be processed.
- 3) The motion compensation process shall output industry-standard H.265 and H.264 compliant motion vectors as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce storage and bandwidth consumption associated with scene motion.
- 4) The compliant motion vectors shall be compatible with and verifiable using Windows Media Player equipped with FFDSHOW or equivalent utility to visualize the motion vectors contained within the resulting H.265 / H.264 video stream.

b. Compression Efficiency:

- 1) The camera shall provide an effective rate control algorithm which maintains set frame rates of full 30fps (NTSC) or 25fps (PAL) in 4K Ultra HD using no more than 45 (+/-10%) pixels per bit of storage with full screen (100%) motion including panning/tilting velocities of at minimum 25% of the camera field of view per second.
- 2) The images shall remain free of objectionable compression artifacts when operating as defined in paragraph "H.2.a" under recommended lighting conditions.
- 3) Pixels per bit (ppb) efficiency shall be defined as $ppb = (ppf) * (fps) / (bps)$ where:
 - a) ppb = pixels per bit
 - b) ppf = pixels per frame (= horizontal resolution x vertical resolution)
 - c) fps = frames per second

- d) bps = bits per second. This is a bandwidth measurement which equals the Kb/s generated by the camera x1000

23. Camera: voice

- a. Image Sensor:
 - 1) 1/2.5" Progressive Scan BSI (Backside Illuminated) CMOS
 - 2) Day/Night with IR sensitivity on all models
- b. Sensor Resolution: 3840 x 2160
- c. Scanning Mode: Progressive
- d. Sensitivity:
 - 1) Color (Day) Mode: 0.07 Lux measured at 30 IRE
 - 2) B/W (Night) Mode: 0.01 Lux measured at 30 IRE
- e. Lens Type
 - 1) UHD quality, auto-focusing, motorized vari-focal 3.4~9mm F1.5 P-Iris lens
 - 2) Horizontal viewing angle: 42-104 degrees
- f. Digital Slow Shutter Speed (DSS): 1/1.75(6.25) to 1/60(50) NTSC(PAL)
- g. IR Illuminator: Twelve high-power/high-efficiency SMD devices with wide-angle illumination.
 - 1) Effective IR range: 30m/98 ft.
 - 2) IR Compensation: Automatically adjusts the scene brightness to compensate for nearby bright objects.
- h. White Balance: Auto/indoor/outdoor/manual (On/Off)
- i. Automatic Electronic Shutter (AES): 1/1.75 to 1/10,000 sec. (Auto)
- j. Digital 3D Noise Reduction: On/Off (0-100)
- k. Iris Control: P-Iris
- l. Day/Night Mode: SmartIR/Auto/On/Off. SmartIR eliminates erroneous switching back to day mode when used with high levels of IR lighting.
- m. Shutter Wide Dynamic Range: On/Off and additional Digital Wide Dynamic Range
- n. Tamper Detection (On/Off, 3 levels)
- o. Privacy Zone: On/Off (8 zones)

- p. Video Motion Detection: Up to 4 independent zones
- q. Mechanical IR Cut Filter: Yes
- r. IR Peak Emission Wavelength 850nm
- s. Signal to Noise Ratio (SNR): +-50 dB

24. Video:

- a. Compression: Enhanced H.265 Main Profile + Enhanced H.264/H.265 Main/High/Baseline Profile: (MPEG-4 Part 10) + MJPEG, triple-streaming
- b. Performance:
 - 1) Single stream 30/25 FPS @ 4K Ultra HD (3840 x 2160) (NTSC/PAL) or
 - 2) Triple-stream: 4K @ 15/12 FPS + HD1080P @ 15/12 FPS + D1 @ 15/12 FPS (PAL/NTSC) simultaneously or
 - 3) Triple-stream: HD 1080P @ 60/50 FPS + 720P @ 30/25 FPS + D1 @ 30/25 FPS (PAL/NTSC) simultaneously
- c. Resolution Range: Scalable from D1 to 4K UHD
- d. Bandwidth:
 - 1) Configurable between 64Kbps to 20,480Kbps
 - 2) Rate Control: CBR/CVBR/VBR/MJPEG
- e. Video Motion Detection (VMD):
 - 1) Intelligent multi-zone VMD
 - 2) Up to four independent zones

25. Audio:

- a. Bidirectional Audio:
 - 1) Line-level In for using line-level audio inputs
 - 2) Line-level Out to feed any single-ended line-level audio input, such as an amplified bullhorn, amplified speakers, or public address system
- b. Compression: G.711

26. Alarms:

- a. Input: One (1) dry contact
- b. Output: One (1) relay contact

- 27. Network:
 - a. Ethernet: 10/100 IEEE 802.3, auto sensing 1 x RJ45
 - b. Protocols: TCP, UDP, ICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTSP, RTCP, PPPoE, NTP, UPnP, SMTP, SNMP, IGMP, 802.1X, QoS, IPv4, IPv6, SSL, LDAP
 - c. Digital Streams: The camera shall provide up to three digital streams plus bi-directional audio on one Ethernet connection
 - d. Web Browsers: Internet Explorer 10+, Firefox 50+, Chrome 55+
- 28. Management:
 - a. Configuration: Remote (via web interface or supported Video Management Software)
 - b. Firmware Updates: Flash memory for upgrade of camera firmware over the network
- 29. Power:
 - a. Input Voltage:
802.3af Power over Ethernet (PoE) Class 0
 - b. Power Consumption: 8 Watts indoor or 13 Watts outdoors with heater and IR on
- 30. Connections:
 - a. Network: RJ45
 - b. Power:
PoE: Through the RJ45 connector
 - c. Audio In/Out:
 - 1) Line In/Line Out: 1.5mm audio jacks
 - d. Alarm In/Alarm Out: Through terminal block connector
 - e. microSDXC card drive: For recording up to 128GB, Class 10 (card not included)
- 31. Physical and Mechanical:
 - a. Physical:
 - 1) Dimensions: 215 x 86 x 80 mm (8.48 x 3.39 x 3.15 in.)
 - 2) Unit Weight: 1.3 lbs. (0.59kg), 4 lbs. with packaging

- 3) Volume Weight: 3 lbs., (1.35kg)
 - 4) Enclosure: IP67/NEMA 4 with IK7 vandal-resistant rating
- b. Mechanical:
 - 1) View Port Rating: IK7 Vandal Resistant Polycarbonate
 - 2) View Port F-Stop:
 - a) Clear: F0.0
 - 3) Pan/Rotate/Tilt: 360 degrees Pan/360 degrees rotate/80 degrees tilt
- 32. Environmental:
 - a. Operating Temperature:
 - 1) Unified Indoor/Outdoor Model: -40°F to 122°F (-40°C to 50°C)
 - b. Storage Temperature: -40°F to 140°F (-40°C to 60°C)
 - c. Humidity: Up to 90% (non-condensing)
 - d. Ratings: IP67 and NEMA 4
 - e. Internal Heater: Automatic
- 33. Regulatory:
 - a. USA: FCC 47 CFR Part 15, Subpart B, Class A; UL (UL60950)
 - b. Worldwide: CE (EN55022-1998 Class A; EN50130-4; EN60950),
RoHS, RCM
- 34. Warranty: Four-years
- 35. Ordering Information: Model numbering legend for cameras or use information from other approved alternate manufacturer.
 - a. Type: CB = Fixed bullet video camera
 - b. Series: 33 = Ariel Series 3
 - c. MP Resolution: 08 = 8.3MP 4K Ultra HD
 - d. Lens Type:
 - 1 = D/N 3.4~9mm UHD quality, motorized, auto-focusing with P-Iris lens
 - e. Housing and IR illuminator options:

- 1) 1 = Indoor/Outdoor IP67 IK7 vandal-resistant housing with heater/IR day/night
- 2) – I = IR illuminator option

36. Other Options:

- a. Surface mount: CB-4S-31 4S Mounting Adapter
- b. Wall Junction Box: CB-WLBX
- c. Pole Mount: CB-PLBX

D. Provide indoor/outdoor 4x2K Convertible 180°/360° panoramic mini-dome H.265/H.264/MJPEG IP camera designed for operation in spaces that require video coverage of a wide area of interest, and able to be deployed interchangeably by the installation technician for both 360 and 180 mode mounting orientations, or approved equivalent by a major manufacturer.

1. Up to 4K (4 x 1080p image sensors), triple-stream H.265/H.264/MJPEG, True (Shutter) WDR support, IP67-rated, day/night mini-dome digital video camera with fixed F2.0, 3.6mm lens, within an IK10 vandal-resistant housing for overhead mounting or side orientation mounting, designed so that the same unit can be deployed with 360 or 180 mode orientations.
2. The camera shall be equipped with sensors and lenses that are field configurable, supporting both 360 and 180 modes
3. The camera shall automatically sense when it is being used in 360 or 180 mode deployment.
4. The camera shall provide a Mechanical Tilt capability in both 360 and 180 mode orientations
5. Mounting accessories shall be compatible with other dome cameras provided by the same vendor
6. In 360 mounting mode, the camera should provide up to three simultaneous single streams (with resolutions and frame rates selected by the user from the available options) containing four images, one in each direction.
7. In 180 mounting mode, the camera shall provide up to three simultaneous single streams (with resolutions and frame rates selected by the user from the available options) containing a blended stitching of the linear scene. User adjustment of the digital stitching shall be supported. In order to support the wide viewing angles required for 180 mode mounting, an aspect ratio of 24:9 shall be supported.
8. The three (3) simultaneous video streams (up to 4K) shall be delivered through a digital network.
9. Resolution and bandwidth shall be scalable.
10. The camera shall incorporate a fully digital 4 x 1080p Full HD CMOS imaging system with IR illumination and day/night IR cut filter for infrared sensitivity.

11. The imaging system shall incorporate Back Side Illumination to enhance pixel sensitivity to a level of at least 1/2.8" BSI.
12. WDR – the camera shall support multi-exposure, shutter based Wide Dynamic Range capability
13. The camera IR illumination shall be separately controllable for X and Y axis, so that the illumination can be optimized for the requirements of either 360 or 180 mode mounting.
14. IR illumination shall have a range of 25 m.
15. The camera shall utilize scene adaptive algorithms to provide a high image quality with low bandwidth and storage requirements (Smart Picture Quality to automatically adapt to wider range of changing conditions using advanced picture settings optimizations).
16. The camera shall provide bi-directional audio via audio I/O.
17. The camera shall accommodate alarm inputs and provide a relay output.
18. The camera shall provide a microSDXC card slot with support for up to 128GB (Class 10) devices.
19. The camera may be powered by 802.3at PoE+ or 24VAC
20. The camera shall be IEEE-compliant utilizing the multicast networking protocol such that a single camera may be transmitted to multiple viewers/archivers on the network simultaneously, further reducing bandwidth and providing greater flexibility in network monitoring/recording configurations.
21. The digital video camera shall provide the user with H.265 and H.264 video compression on up to three digital streams simultaneously.
22. Resolution shall be scalable dependent on operation mode, from D1 to 4K/3840x1440 which may be set to unicast or multicast.
23. The camera shall be capable of producing 30 frames per second (NTSC) and/or 25 frames per second (PAL) 4K Ultra HD (3840 x 2160) video stream
24. The camera shall be capable of producing (NTSC) or (PAL) Full HD / 1080P (1920 x 1080) video stream at 30 frames per second.
25. Bandwidth shall be scalable between 64Kbps and 20,000Kbps.
26. The camera shall support the functionalities required to implement mechanisms for automatic dynamic video streaming adaptation with supported VMSs. The camera shall showcase valid integrations, introducing such mechanism with one or more VMS products.
27. The audio capabilities shall support either half-duplex or full-duplex audio on two-way connections.
28. The camera shall accommodate alarm-input and alarm-output.

29. The camera shall provide a password protected web Interface for viewing, configuration and control. The web interface shall support the following web browsers: Internet Explorer, Chrome and Firefox.
30. Motion Detection:
 - a. The camera shall provide intelligent multi-zone video motion detection with the following configurable parameters:
 - 1) Sampling pixel interval (1-10)
 - 2) Detection level (1-100)
 - 3) Sensitivity level (1-100)
 - 4) Time interval(sec) (0-7200)
31. Storage and Bandwidth Efficiency:
 - a. Motion Compensation and Processing:
 - 1) The camera shall employ industry-standard motion compensation methods as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce the storage and bandwidth consumption associated with scene motion.
 - 2) Compliant motion compensation shall employ a block-matching algorithm covering an area of at least 256 macro-blocks surrounding each block to be processed.
 - 3) The motion compensation process shall output industry-standard H.265 and H.264 compliant motion vectors as described and recommended by the Motion Pictures Experts Group (MPEG) to control and reduce storage and bandwidth consumption associated with scene motion.
 - 4) The compliant motion vectors shall be compatible with and verifiable using Windows Media Player equipped with FFDSHOW or equivalent utility to visualize the motion vectors contained within the resulting H.265 / H.264 video stream.
 - b. Compression Efficiency:
 - 1) The camera shall provide an effective rate control algorithm which maintains set frame rates of full 30fps (NTSC) or 25fps (PAL) in 4K Ultra HD using no more than 45 (+/-10%) pixels per bit of storage with full screen (100%) motion including panning/tilting velocities of at minimum 25% of the camera field of view per second.
 - 2) Pixels per bit (ppb) efficiency shall be defined as $ppb = (ppf) * (fps) / (bps)$ where:
 - a) $ppb = \text{pixels per bit}$

- b) ppf = pixels per frame (= horizontal resolution x vertical resolution)
- c) fps = frames per second
- d) bps = bits per second. This is a bandwidth measurement which equals the Kb/s generated by the camera x1000

32. The camera shall meet or exceed the following specifications:

Camera:

- a. Image Sensor:
 - 1) 4x 1/2.8" BSI CMOS
 - 2) Day/Night with IR sensitivity
- b. Sensor Resolution: 4 x 2.1 megapixels (1920 x 1080)
- c. Scanning Mode: Progressive
- d. Sensitivity:
 - 1) Color (Day) Mode: 0.02 lux @ 30 IRE
 - 2) B/W (Night) Mode: 0.1 lux without IR, 0 lux with IR @ 30 IRE
- e. Lens Type:
 - 1) F2.0, 3.6mm, fixed-focus lens
 - 2) H FoV 92°
- f. IR Illuminator: High-power/high-efficiency SMD devices with wide-angle illumination arranged to cover both installation modes.
 - 1) Effective IR range: Up to 25m (82 feet)
 - 2) Illumination Angle: 60 degrees
 - 3) IR Compensation: Automatically adjusts the scene brightness to compensate for nearby bright objects.
- g. White Balance: Auto/ATW/Manual
- h. Automatic Electronic Shutter (AES): 1.0 to 1/10,000 sec. (Auto)
- i. Digital Slow Shutter: 1~30 fps (NTSC)/1/1.5~25 fps (PAL)
- j. Noise Reduction: ,3DNR
- k. Digital Wide Dynamic Range: Low/Medium/High/Off
- l. Day/Night Mode: Auto/Color/B&Wa

- m. Tamper Detection (On/Off)
- n. Privacy Zone: On/Off (8 zones)
- o. Video Motion Detection: Up to 4 independent zones
- p. Mechanical IR Cut Filter: Yes
- q. IR Peak Emission Wavelength 850nm
- r. Signal to Noise Ratio (SNR): +-50 dB

33. Video:

- a. Compression: Enhanced H.265 Main Profile + Enhanced H.264/H.265 Main/High/Baseline Profile: (MPEG-4 Part 10) + MJPEG, triple-streaming
- b. Performance:
 - 360 Mode:
 - 1) Single stream 4K Ultra HD (3840 x 2160) (NTSC/PAL) @ 30/25 FPS or
 - 2) Dual Stream 4K @ 15/12 FPS + HD1080P @ 15/12 (PAL/NTSC) simultaneously or 4K Ultra HD (3840 x 2160) @ 25FPS + D1 @ 25 FPS or Full HD 1080p + HD 720p @ 25/30 FPS
 - 3) Triple-stream: 4K @ 15/12 FPS + HD1080P @ 15/12 FPS + D1 @ 15/12 FPS (PAL/NTSC) simultaneously 180 Mode:
 - 4) Single stream 3840 x 1440 (NTSC/PAL) @ 30/25 FPS
 - 5) Dual Stream 3840 x 1440 + 1920 x 720 @ 25/30 FPS
 - 6) Triple-stream: 3840 x 1440 + 1920 x 720 @ 15/12 FPS + D1 @ 20 FPS (PAL/NTSC) simultaneously
- c. Resolution Range: Scalable from D1 to 4K UHD
- d. Bandwidth:
 - 1) Configurable between 64Kbps to 20,000Kbps
 - 2) Rate Control: CBR/CVBR/VBR/MJPEG
- e. Video Motion Detection (VMD):
 - 1) Intelligent multi-zone VMD
 - 2) Up to four independent zones

34. Audio:
- a. Bidirectional Audio:
 - 1) Line-level In for using line-level audio inputs or Mic-in
 - 2) Line-level Out to feed any single-ended line-level audio input, such as an amplified bullhorn, amplified speakers, or public address system
 - b. Compression: G.711 (uLAW/aLAW)/G.726/AAC/PCM
35. Outlet
- Alarms:
- a. Input: One (1) dry contact
 - b. Output: One (1) relay contact, 400VDC/250VAC @ 120mA maximum
36. Network:
- a. Ethernet: 10/100 IEEE 802.3, auto sensing 1 x RJ45
 - b. Protocols: TCP, UDP, ICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTSP, RTCP, PPPoE, NTP, UPnP, SMTP, SNMP, IGMP, 802.1X, QoS, IPv4, IPv6, SSL, LDAP
 - c. Digital Streams: The camera shall provide up to three digital streams plus bi-directional audio on one Ethernet connection
 - d. Web Browsers: Internet Explorer 10+, Firefox 50+, Chrome 55+
37. Security
- The camera shall support internal and end-to-end security features that limit access and make it more difficult for unauthorized control signals to be carried out. The following shall be supported at a minimum:
- a. Direct camera support for:
 - 1) Password protection,
 - 2) IP address filtering,
 - 3) HTTPS encryption,
 - 4) IEEE 802.1X network access control,
 - 5) Digest authentication.
 - b. End-to-end support (when connected to a VMS system that supports security features, for User-configurable security policies that enable enforcement of the following:

- 1) Compulsory changing of the manufacturer's default unit passwords
- 2) Secured connections (TLS) for control messages, using unit self-certificates or downloaded third-party certificates

38. Management:

- a. Configuration: Remote (via web interface or supported Video Management Software)
- b. The and initial capabilities.
 - 1) Discover camera by connection to the camera network
 - 2) Display existing DHCP address (if there is a DHCP server), default IP address, MAC address.
 - 3) Display installed Firmware version,
 - 4) Reset camera to supplier defaults.
 - 5) Upgrade the firmware
 - 6) Assign a user-defined IP address
 - 7) Display camera uptime.
- c. Firmware Updates: Flash memory for upgrade of camera firmware over the network

39. Power:

- a. Input Voltage:
 - 1) 24VAC (+20%)
 - 2) IEEE 802.3at (PoE+)
- b. Power Consumption: 24.9W with IR and heater operating

40. Connections:

- a. Network: RJ45
- b. Power:
 - 1) 24VAC (through terminal block connector)
 - 2) PoE+: through the RJ45 connector
- c. Audio In/Out:
 - 1) Line In/Line Out: through terminal block connector

- d. Alarm In/Alarm Out: through terminal block connector
 - e. microSDXC card drive: For recording up to 128GB, Class 10 (card not included)
 - f. RS-485: PelcoD and PelcoP protocols
 - g. Analog Video: BNC (1V p-p), 75Ω
41. Physical and Mechanical:
- a. Physical:
 - 1) Dimensions: Ø 190 x 130 mm (7.5 x 5.1in.)
 - 2) Unit Weight: 3.44 lbs. (1.56kg)
 - 3) Enclosure: IP67 with IK10 vandal-resistant
 - b. Mechanical:
 - 1) IK10 Vandal Resistant Polycarbonate
42. Environmental:
- a. Operating Temperature: -40°F to 122°F (-40°C to 50°C)
 - b. Storage Temperature: -40°F to 140°F (-40°C to 60°C)
 - c. Humidity: Up to 90% (non-condensing)
 - d. Ratings: IP67
 - e. Internal Heater: Automatic
43. Regulatory:
- a. Safety: AS/NZS CISPR22 (Class B); EN50130-4; EN61000-3-2/3; EN61000-4-2/3/4/5/6/8/11; EN61000-6-3 (Class B); UL 60950-1
 - b. Electromagnetic Interference (EMC): ANSI C63.4: 2009 (FCC 47 CFR Part 15 Subpart B, Class B; CISPR Pub. 22); EN55022:1998 Class A; EN55032:2012; EN60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + A2:2013; EMC Directive 2004/108/EC; IEC 60950-1:2005 (Second Edition) + Am 1:2009 + Am 2:2013; ICES-003: Issue 5
 - c. Environmental: RoHS 2011_65_EU, excluding Pb in 2LI (lead on second level interconnect); WEEE Directive 2012/19/EU; REACH

3.2.9 CABLING SYSTEM Station Cables (DATA)

1. The Communications Contractor shall be responsible for obtaining a low voltage installation permit from the appropriate authority prior to start of installation.

2. The Communications Contractor shall be responsible for consulting with the building inspector to determine whether there are special local requirements for strapping the cables in the attic area.
3. The Communications Contractor shall be responsible for coordinating with the building's General Contractor to determine the cable routings, schedules for cable placement and ceiling inspection.
4. The Communications Contractor shall provide installation of the cable hangers and sleeves that will support the horizontal cables in the attic area per all applicable local building code(s).
5. The Communications Contractor shall furnish and install voice/data locations, voice only locations, and data only locations as required.
6. The Communications Contractor shall furnish and install whips, wall plate adapters and floor plate adapters.
7. All data outlets shall be furnished and installed complete with two (2) data jacks (Cat 6, RJ45) terminated with two (2) Cat6 plenum rated cables unless otherwise noted.

A. System Requirements

1. All data cables shall be General Cable GenSPEED 6000 Enhanced Category 6 plenum rated 23 AWG, 4-pair, blue jacket cables. No substitutions will be allowed without prior written approval from the Telecom Project Manager. All cables shall be installed from the station jack directly to the appropriate Cat 6 patch panels in the MDF. All cable pairs or modular jacks shall be wired to ANSI/TIA/EIA568-B using T568-A wiring scheme at both ends. All cables shall be tested to minimum Cat 6 standards.
2. The jack housings and faceplates shall have two (2) positions for jacks. Blank covers shall be installed in vacant jack positions. Jack housings and faceplates shall be compatible with the Panduit Mini-Com Jacks. The type and color is to be determined by the installed location. Some will be flush or non-flush. Modular furniture faceplates shall be color coordinated with the color of the furniture base plate. The Communications Contractor shall furnish and install the proper jack housings and faceplates. The Communications Contractor shall determine the type of faceplate prior to the scheduled installation and must be approved by the city's IT Telecom Project Manager prior to use.
3. Floor boxes or monuments shall be flush-mounted and fully adjustable with trade size conduit feeds (3/4", 1" and 1 1/4"). Depending on the number of floor box gang (required for power receptacles and data/voice jacks) required on the floor box, Legrand/Wiremold RFB2, RFB4 and RFB6 Series floor boxes shall be used. Specific type and model shall be specified depending on ground (i.e. tile, carpet or wood) type. FPCTCBZ (Bronze) or FPCTCBS (Brass) flanged cover shall be used depending on the choice of DPW Project Manager on a particular project. All conduit feeds shall be in accordance with the Conduit Sizes for Low Voltage Wires and Cables (to be provided by Telecom Project Manager).
4. Floor monument mounting plates shall be Panduit CF-1064EI.

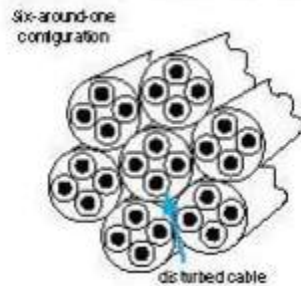
5. The Communications Contractor shall furnish and install patch panels and wire managers or organizers.
 - a. Patch panels shall be provided for the STAFF areas. The patch panels shall be Panduit Mini-Com 48 port all metal modular, part number CP48BLY. The horizontal wire organizers shall be Panduit WMPH2E and WMPSE as required. Furnish one (1) horizontal wire organizer per patch panel plus one (1) additional wire organizer at the top of each row of patch panels. Be sure to include the Panduit Mini-Com Jacks on the patch panel. Vertical wire managers shall also be furnished and installed as required using Panduit WMPVHC45E as specified in the Equipment Rack Elevation layout.
6. The RJ45 data jacks shall be wired according to TIA/EIA 568-B using the T568-A wiring scheme.
7. All jacks (Cat 6, RJ45) shall be Panduit Mini-Com Jacks part number CJ6X88TGBU (blue). No substitutions will be approved.
8. All data jacks and patch panels shall be labeled according to Ridgecrest standards. Labels are to be typed or printed with a labeling device and permanently affixed. No hand-written lettering is acceptable. The labels shall be printed on white tape with black lettering for jacks. Patch panels shall be labeled both front and back. The patch panel labels shall be black tape with white lettering, four (4) labels per strip. See the Project Manager if further clarification is needed.
9. All jacks shall be modular Panduit, Panduit Mini-Com Jacks. All jacks (Cat 6, RJ45) shall be Panduit Mini-Com Jacks part number CJ688TGOB (Blue). Substitutions must be city approved. The STAFF areas shall use blue jacks.
 - a. All voice/data outlets shall be furnished and installed complete with two (2) data jacks (Cat 6, RJ45) terminated with two (2) Cat6 plenum rated cables unless otherwise noted.

Example: DXYYYYZZZ (Data jack) - D1001MDF, D1002MDF...

VXYYYYZZZ (Voice jack) - V1001MDF, V1002MDF...
10. D stands for data, V stands for Voice, X stands for floor level, YYY is jack number starting from 001, and ZZZ is the serving patch panel or MDF/TR room. Alpha (A&B) lettering of data jacks in not allowed. Data designation "D" and MDF shall not be required for the Patch Panel labeling.

Example: XYYY - 1001, 1002...
11. The MDF end of the voice cables (if applicable) shall be terminated on the 66 blocks mounted in the designated location in the MDF/TR backboard. 66 block label starts from 1001, 1002, and so on.
12. All wire and cable runs in the ceiling area shall be supported with ceiling hangers, supplied and installed by the selected Communications Contractor. Cables must be supported at a space interval that is allowable by code. At no point shall cable(s) rest on acoustic ceiling grids, panels or lighting support wires, electrical conduit or HVAC pipes or ducts.

13. Cable shall be installed in continuous lengths (no splices allowed) from origin to MDF, using the shortest route possible, and shall be tight bundled in groups of no more than six-around-one, and combined bundles of six-around-one of not greater than three bundles or a total of 21 cables.



Section DC D8 BSD – LOW VOLTAGE CRITERIA

14. The data cables shall be bundled with a Velcro type of tie, such as Panduit HLS, HLM, HLC or equivalent. Do not use plastic ties on data cables.
15. Furnish and install flexible tubing (Seal Tite) to conceal wire runs into modular furniture or where needed to secure multiple exposed cables.
16. It shall be the responsibility of the Communications Contractor to determine and furnish the quantity of voice/data wire needed.
17. The Communications Contractor shall furnish and install three (3) Category 6 cables with three (3) RJ45 jacks; two (2) adjacent to the Fire Alarm Monitor Panel and one (1) adjacent to the Intrusion Alarm System. The other end of the alarm cable should terminate on a 66 blocks (not on the relay rack patch panel) near the Telco blocks at the MDF. This will be used to provide Telco dial tone to the alarm systems. The mb lines to be used will be ordered by Project Manager. The Communications Contractor will cross-connect the alarm mb lines from the Telco block to the 66-block. The alarm contractor will terminate the lines into the alarm systems.

B. Workstation Outlets

1. Each outlet location installed in the wall, on the modular furniture system, or on the floor, shall be equipped with two (2) data jacks (CAT6, RJ45) terminated with two (2) CAT6 plenum-rated cables (UON). Provide and install jacks with a color to be determined by DPW Project Manager.
2. Each outlet location shall be provided with two (2) Cat 6 cables unless otherwise noted on the plan.
3. All jacks shall be Category 6, 8 position, 8 wire with termination cap color, wired to the ANSI/TIA/EIA 568-B using the T568-A wiring scheme. The jack faceplates shall have two (2) positions for RJ45 jacks. All jacks shall be manufactured by Panduit (CJ688TGBU). No brand substitutions will be accepted by the City.
4. Panduit (CFPE2) shall mount jacks on a two- (2) module, Electrical Ivory, faceplate for the wall.

5. Where outlet location is specified for a wall-mounted telephone, provide and install a voice cable terminated on a RJ45 jack with a single module faceplate by Panduit (Phone Plate with module – KWP3Y).
6. Provide and install appropriate faceplate, extender as determined by modular furniture brand. The jack faceplates shall have two (2) positions for RJ45 jacks. The Communications Contractor shall determine bracket type and color prior to scheduled installation.
7. If faceplates are mounted to double gang boxes, the Communications Contractor shall provide and install, as required, In-Wall box adapters as manufactured by Panduit.
8. The Communications Contractor shall be responsible to install cover plates or blank modules of the appropriate color on any unused single or double gang boxes. Modules by Panduit (CMB).
9. The Communications Contractor shall provide cross-connect jumpers for telephone lines as required from the MPOE to MDF, between MDF's and IDF's and for faxes, modems, elevator phones, fire alarm and security systems, etc. as required.
10. Any deviation/substitution must be verified and approved in writing by the DPW Project Manager prior to use.

C. Wireless Network Access Point Data Cables

1. Category 6 data cables will be used to provide connectivity between the Wireless Access Points (WAPs) and the data network switch in the MDF or Telecommunications Closets. Two (2) run of data cables terminated with RJ45 jacks shall be provided per AP location. The jacks shall be mounted on a biscuit with dual port mount or a junction box with a faceplate for dual jacks.
2. The Contractor shall run and position the data cables in the ceiling space and terminate the data cable on an RJ45 jack (orange color) mounted on the faceplate of a single gang box outlet installed below the ceiling). The Contractor shall patch the WAPs as required with "orange" patch cords (at device end) and "Yellow" patch cords on the patch panel.
3. The locations of the Aruba WAPs and Category 6 cable runs will be determined following an RF survey or as per layout drawings provided by the Telecom Project Manager.

4. The WAPs shall be installed per the manufacturer's installation guidelines, below ceiling and horizontally mounted with logo facing downward. Vertical installation of the WAPs will not be allowed. Any deviation will require prior approval of the DPW Project Manager. Oberon Model 1029 wall-mount bracket shall be used for wall-mounted WAP installations. The jacks shall be mounted on a dual port faceplate. When aesthetics is strictly required by the architect, Terrawave Model TWC-AC-BKT-L mounting bracket shall be used for above T-bar ceiling installations. For below suspended ceiling/T-bar ceiling installations, use Ceiling Grid Clip, Recessed (AIR-AP-T-Rail-R), if the ceiling tiles land below the ceiling grid. Use Ceiling Grip Clip, Flush (AIR-AP-T-RAIL-F) if the T-bar ceiling tiles are flush with the ceiling grid. For hard ceiling installations with data outlet boxes mounted on the ceiling, Universal Mounting Bracket (AIR-AP-BRACKET-2) shall be used.

D. Patch Cables

1. The Communications Contractor shall furnish patch cords per length, color and quantity as required by DBT's design and confirmed by Telecom Project Manager.
2. Patch cords shall be Panduit Category 6, 23 AWG stranded, 4-pair assemblies with RJ45 plugs on both ends, straight through (no pair reversals), and "slender strain" relief and "clear" boot type, Category 6, UTPSP, patch cords. The Communications Contractor shall be responsible for the installation and dressing of all patch cables in the MDF, TR and Workstations based on the Patch Schedule provided the Telecom Project Manager.

E. CABLE TESTING

1. All testing shall be per the Ridgecrest City STD-902 Testing Standard. An orientation with the Telecom Project Manager shall take place on site prior to the test. It shall be scheduled at least one week in advance. Telecom Project Manager shall certify prior to testing the following:
2. Test meters have been calibrated to TIA/EIA Standard within the last 12 months. With a Certificate of Compliance, meter serial number and dated.
3. Test meter shall be fully charged.
4. Test configuration set to the City Standards.
5. Manufacturer's warranty certification (if applicable) requirements shall be reviewed to ensure that all warranty requirements are met.
6. The Communications Contractor shall furnish one (1) printed copy and one copy on CD-ROM, with the complete set of test results. Copies of PC based software to view drawings and results shall also be provided to the DPW Project Manager.

F. Communications Contractor Requirements

1. Communications Contractor shall provide sufficient skilled labor to complete testing within the agreed upon test period.

2. Communications Contractor shall have a minimum of 3 years experience installing and testing structured cabling systems. All installers assigned by the Contractor to the installation shall have factory certification that they are qualified to install and test the provided products.
3. Communications Contractor is responsible for supplying all of the required test equipment used to conduct acceptance tests.
4. Communications Contractor is responsible for submitting acceptance documentation as defined in section 3.7.5 below.

G. Test Process

1. The City reserves the right to be present during any or all of testing.
2. Testing shall be of the Permanent Link. However, the Communications Contractor shall warrant performance (see Part 3) based on Channel performance and provide patch cords that meet channel performance.
3. All cabling not tested strictly in accordance with these procedures shall be re-tested at no additional cost to the City.
4. 100% of the installed voice and data cabling must be tested. All tests must pass acceptance criteria defined in 3.7.5.d.
5. Test equipment shall be fully charged prior to each days testing.

H. Standards Compliance & Test Requirements

1. Cabling must meet the indicated performance specifications:
_____ TIA 568B Category 6
_____ TIA 568A Category
2. All test equipment used must meet the performance specifications defined in section 3.7.6 below.

I. Documentation

1. Test reports must be submitted in hardcopy and electronic format. Hand-written test reports are not acceptable. Hardcopy reports are to be submitted in labeled 3 ring binders with an attached affidavit verifying passing execution of all tests. For large installations electronic reports with hardcopy summaries are preferred. Hardcopy summary reports shall contain the following information on each row of the report: circuit ID, test specification used, length, date of test, and pass/fail result.

2. Electronic reports are to be submitted by Electronic Copy. If proprietary software is required to view test results, the software shall be provided to DPW Project Manager. If the results are delivered in a standard format like Excel, Access, CSV files, etc. then software to read these files need not be provided. Electronic reports must be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.
3. Test reports shall include the following information for each cabling element tested:
 - a. Wiremap results that indicate the cabling has no shorts, opens, misfires, split, reversed, or crossed pairs, and end to end connectivity is achieved.
 - b. For Category 6 cabling: Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst-case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
 - c. Length (in meters), propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
 - d. Cable manufacturer, cable model number/type, and NVP
 - e. Tester manufacturer, model, serial number, hardware version, and software version
 - f. Circuit ID number and project name
 - g. Autotest specification used
 - h. Overall pass/fail indication
 - i. Date of test
 - j. Test reports shall be submitted within 7 business days of completion of testing.

J. Testing and Acceptance

1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions.
2. All copper pairs of each installed cable shall be tested and verified prior to system acceptance.

3. Any defect in the cabling system performance or installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
4. All cables shall be tested in accordance with this document, the ANSI/TIA Standards, the Panduit warranty guidelines, and industry best practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

K. Copper Channel Testing

1. All twisted-pair copper cable links shall be tested for compliance to the requirements in ANSI/TIA for the appropriate Category of cabling installed using a test unit meeting a minimum IEC IIIe level of accuracy.
2. All testers used must have been factory calibrated by the manufacturer within one year of use or according to factory calibration recommendations, whichever is more stringent.
3. Contractor shall set references according to manufacturer's recommendation prior to each day's testing and reset references anytime the tester unit shuts down due to inactivity.
4. Resetting references shall also be done whenever test results become sporadic or the tester demonstrates a consistent deterioration of test measurement performance.
5. Testing of any links that include field-terminated plugs shall follow the procedure outlined in Panduit document #PN614, available from the Panduit representative, or downloadable from www.panduit.com.

L. Testing Equipment

1. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years' experience in producing field test equipment. Manufacturers must be ISO 9001 certified.
2. All test tools of a given type shall be from the same manufacturer and have compatible electronic results output.
3. Test adapter cables must be approved by the manufacturer of the test equipment. Adapters from other sources are not acceptable.
4. Baseline accuracy of the test equipment must exceed TIA Level III, as indicated by independent laboratory testing.
5. Test equipment must be capable of certifying Category 6 links.
6. Test equipment must be capable of storing full frequency sweep data for all tests and drawing color graphical reports for all swept measurements.
7. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.

8. Test equipment must be capable of running individual NEXT, return loss, etc. measurements in addition to autotests. Individual tests increase productivity when diagnosing faults.
9. Test equipment must include a library of cable types, sorted by major manufacturer.
10. Test equipment must store Category 6 autotests in internal memory.
11. Test equipment must be able to internally group autotests and cables in project folders for good records management.
12. Test equipment must include DSP technology for support of advanced measurements.
13. Test equipment must make swept frequency measurements in compliance with TIA standards.
14. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.

3.2.10 VOICE COMMUNICATIONS SYSTEM

VoIP System

A. System Description and Installation Requirements

1. The City has directed that all new Voice Systems be part of a centrally administered, distributed processing system. City to install a WAN router at the site and as required. The city will insure connectivity is implemented to the Hosted VoIP systems.
2. The Contractor (if included in the scope of work) shall, at a minimum, test all newly installed equipment using the City of Ridgecrest LAN and IPT System Functionality and Cut-Over Test Plan (to be provided by the city IT Project Manager) as applicable or as directed by the Project Manager. The City reserves the right to require additional tests not listed on said Test Plan. The Contractor shall coordinate with Ridgecrest Project Manager as to which tests are applicable. The Project Manager shall be present and shall participate in all tests. Further, the Contractor shall certify to the IT Project Manager and Communication Services Analyst that the system is fully operational and functional.
3. The city's IT Project manager or personnel shall be responsible for password logon access to the Hosted system servers. No access shall be given to the Contractor.
4. The Contractor (if included in the scope of work) shall be responsible to perform the following tasks to ensure a successful and consistent installation:
 - a. Develop configuration documentation with input from the city.

- b. Develop an implementation-specific Network diagram with input from the City's design team.
 - c. Receive and inventory all equipment delivered at the site on the approved form provided by Project Manager where required. Record all pertinent information including but not limited to the model name/number, serial numbers, OS and/or IOS versions.
 - 5. Verify the operation of the programmed and installed Communications per the Project Implementation Plan.
 - 6. Document and deliver system completion certificates for the equipment installed.
 - 7. Develop project implementation test plans with input from the city.
 - 8. The Contractor shall utilize an IP address scheme furnished by the city. Separate VLANs shall be provided for data devices; VoIP telephone instruments, The Contractor shall permanently affix a machine printed label with the assigned IP address to each equipment component to which one has been assigned.
 - 9. The Contractor shall furnish, install, set-up and configure all equipment for use with the city's Operations Manager.
- A. No more than one (1) week after the telephone system is fully operational, the IT Project Manager, IT Supervisor or his/her designee and appropriate Staff will test all newly installed equipment. The city IT shall at a minimum test all newly installed equipment and configuration using the city of Ridgecrest LAN and IPT System Functionality and Cut-Over Test Plan, installation and configuration will be signed off by the Project Manager, VoIP Engineer, city IT Project Manager and the Communications Contractor. A Certificate of Acceptance will be signed by the IT Project Manager, Telephone Repair Shop designee, and City Staff, where available. The warranty of the telephone system infrastructure and cabling will start on the signature date.
 - B. The Communications Contractor shall cross-connect all PSTN facilities as required and determined by CITY Project Manager and DPR Staff. These may include but are not limited to PRIs, analog trunks, faxes, and modem lines. Physical locations for faxes and modems to be determined during installation.
- 3.2.11 WiFi Wireless Network
- A. Indoor access points shall be Aruba model 600 series (or approved equal) ceiling-mounted or wall-mounted. Exact location to be reviewed and verified with the city's Telecom Project Manager and as per provided access points layout.
 - B. Outdoor access points shall be Aruba (or approved equal). Exact location to be reviewed and verified with the city's Telecom Project Manager and as per provided access points layout.
 - C. Below are the three (3) standard Wifi networks which may be provided (contractor must coordinate with the city's IT project Manager or approval):
 - 1. An open, unauthenticated wireless network that provides access to the Internet only for the general public (access is subject to the standard city URL filtering policy).
 - 2. A secure wireless network that requires an RSA SecureID token or adaptive authentication in order to gain access to city resources.

3. A secure wireless network for mobile devices that requires each device to be registered prior to accessing the network. Access is to the Internet as well as a limited number of Intranet sites is provided.
- D. External access points shall be Aruba per project requirements as this is the city's Standard manufacturer used.

3.2.12 DISTRIBUTION CABLING (where applicable)

A. Voice Cabling

1. The Communications Contractor shall provide, install and terminate an appropriately sized, CMR or CMP rated CAT3 cable (as determined by the city Telecom Project Manager), to provide connectivity between the MPOE and MDF.
2. Backbone cables shall be installed separately from the station cables. Where both cables are installed in a cable tray or wire way, backbone cables shall be installed first and bundled separately from the station cables.

3.2.13 Cable Pulling and Termination

A. General

1. Contractor is responsible for installing systems according to all applicable codes and the standards cited in this document.
2. Contractor shall use grommets to protect the cable when passing through metal studs or any openings that can possibly cause damage to the cable.
3. Do not deform the jacket of the cable. The jacket shall be continuous, free from pinholes, splits, blisters, burn holes or other imperfections.
4. Install proper cable supports, spaced less than four (4) feet apart, and within manufacturer's requirements for fill ratio and load ratings.
5. Leave a pull string to the end of each conduit run. Replace pull string if it was used for a cable pull.
6. Note service loops may not touch the ceiling assembly and if so must be remedied at the Contractor expense.
7. Label every cable within 12 in. of the ends with self-laminating wire wrap cable appropriate to that cable size. Use a unique number for each cable segment as required by the project documentation and the labeling section of this document.
8. Dress the cables neatly with hook and loop cable ties in telecommunications rooms. Plastic ties are approved in pathways where cable bundles will not be reentered.
9. The contractor is responsible for using plenum-rated cable ties in plenum spaces.

B. Copper

1. All Greenfield (new) projects shall use Cat 6 cable.

2. Within all new (Greenfield) installations within Ridgecrest City, contractors shall use copper pinout T568B.
3. All four pair Category 6 cable runs shall be kept to a maximum of 295 feet / 90 meters for each run.
4. Use low to moderate force when pulling cable. Maximum tensile load may not exceed 25' lbs. maximum pulling force per 4 pair cable.
5. Patch cords in horizontal links (equipment side and work area side) shall total no more than 10 meters.
6. No pathway, including conduits, shall have greater than a 35% fill per TIA and BICSI fill charts. The contractor is responsible for bringing to the attention of the Ridgecrest City project manager any insufficiently sized conduit or cable pathways in project documentation.
7. Keep Category 6 cables as far away from potential sources of EMI (electrical cables, transformers, light fixtures, etc.) as required in cited TIA Standards.
8. All copper horizontal cabling shall have slack service loops no less than 12" at the work area (equipment outlet) and not less than 3 feet in the telecommunications room.
9. Slack at the work area may be stored in the ceiling and in the telecommunications room may be wall mounted or contained in pathways or racking systems if done in a neat, workmanlike fashion.
10. Maintain the twists of the pairs all the way to the point of termination, or no more than 0.5" (one half inch) untwisted.
11. All UTP patching shall be accomplished using Category 6 rated modular patch panels as indicated elsewhere in this document.

C. Fiber (where required per project See plans)

1. When installing fiber cable, Contractor shall maintain a minimum bend radius, both under pulling load and installed, per requirements outlined within TIA standards, or manufacturer's recommendations, whichever is the most stringent.
2. Fiber terminations shall be done according to recommendations of TIA, manufacturer's requirements, and accepted industry best practices.
3. All unjacketed fiber shall be contained within appropriate fiber enclosures. Exposed tight-buffered strands or loose-tube strands will not be tolerated and shall be remedied at Contractor's expense.

3.2.14 EQUIPMENT RACKS / MOUNTINGS

- A. The contractor shall provide and install equipment racks that are earthquake rated for Zone 4. All rack installations shall be in accordance with the Ridgecrest City Standard 902. This standard will require the use of a 3-inch spacer bar (B-Line P/N STD108DET4) or the Chatsworth Cable Tray Elevation Kit (P/N: CPI 10506-702) to attach the rack to the cable tray.

1. The contractor shall provide and install standard 4 posts relay racks, 19"W x 29"D x 7"H (Chatsworth P/N 50120-703, 45 RMU), black color, shall be used to mount the Network equipment, UPS and batteries. A 4 post rack, 22"W x 25"D x 74"H, black color, shall be used to house the audio video equipment where required.
 2. All equipment racks shall be augmented with horizontal and vertical wire management hardware, both front and back as required, to properly dress cables and patch cords. The horizontal wire organizers shall be Panduit WMPH2E and WMPSE. Furnish one (1) horizontal wire organizer per patch panel plus one (1) additional wire organizer at the top of each row of patch panels. Be sure to include the Panduit Mini-Com Jacks on the patch panel. Vertical wire managers shall also be furnished and installed using Panduit WMPVHC45E as required. Refer to the Equipment Rack Layout provided by the City Project Manager for further details.
 3. The number of equipment racks shall be determined by the contractor and approved by City Telecom Project Manager. The number of racks required shall be dependent on the size of the facility or the number of data ports and computer stations.
 4. All data cables shall be terminated on separate patch panels in the MDF. The cables shall be terminated and labeled sequentially on the patch panels. The Equipment Rack Layout will be provided by the contractor and shall obtain approval of DPW Project Manager. Voice cables are normally terminated on the 66 blocks mounted on the designated backboard space as shown in the MDF layout. Confirm with CITY Project Manager regarding voice cable termination in the MDF/TR.
- B. Structural cable tray, relay racks, cabinets, systems, attachments and earthquake bracing shall comply with Zone 4 earthquake, NEMA, NEC and TIA/EIA-569 standards. Floor mounting hardware shall be a 3/8" bolt, lock washer, flat washer, with anchor in the floor, quantity as required.
- C. Mount equipment racks to the floor slab so that no electrical connection is made between the racks and building steel.
- D. Provide a minimum of 36 inches of clearance in the front and the back of equipment racks. Where rear clearance cannot be maintained, equipment racks that have pull out rack interiors shall be used.
- E. Cable trays shall be Chatsworth Products, INC. (CPI) P/N 11252-713, black color.
1. All structural ironwork shall be UL-certified, providing the best bonding for static and grounding. Painted structural ironwork is not allowed.
 2. Cable tray shall be of the tubular type construction. The tray shall be installed with the rungs on the topside of the tray. All attachments to drywall shall be on 3/4" plywood.
 3. Cable tray shall be mounted at 7'3" above the finish floor. This will require the installation of a 3" (Black) spacer manufactured by B-Line Systems, INC., P/N STD108DET4 or the Chatsworth Cable Tray Elevation Kit (P/N: CPI 10506-702). The B-Line part number is not cataloged and requires special order. The 7'3" allows for the cable tray to be positioned over the 7' doorway.
 4. Structural cable tray, relay racks, cabinets, systems, attachments and earthquake bracing shall comply with Zone 4 earthquake, NEMA, NEC and TIA/EIA-569 standards. Floor mounting hardware shall be a 3/8" bolt, lock washer, flat washer, with anchor in the floor, quantity as required.

5. All exposed cut and sharp edges shall be deburred and filed to a safe finish. Cable tray runway ends shall be capped with a black rubber cap.
6. Relay racks shall be high strength aluminum construction with universal 5/8"-5/8"-1/2" tapped mounting hole #12-24 thread pattern on both front and rear. Designed and seismic built to the EIA-310C Standard.
7. All cable tray and racks shall be individually grounded to the Telecoms Ground Bus Bar using the standard ground lug and #6 AWG stranded ground copper wire with "Green" jacket or insulation. Daisy chaining the ground wire between racks is not allowed.
8. The Communications Contractor shall install, position, reposition, or remove racks and equipment as required without disruption of ongoing services. The Communications Contractor shall furnish extension cables, power taps, or temporary racks if needed.

F. AC power and grounding

1. Use isolated ground 120V AC power circuits for all audio and video equipment. AC power circuits shall comply with National Fire Protection Association 70-2005 (NEC), paragraphs 250.96(8), 250.146(0) 250.96(8) and 408.40.
2. Power and grounding shall comply with IEEE Std 1100-1999, Recommended Practice for Powering and Grounding Electronic Equipment.
3. Equipment racks and their AV power shall be installed per National Fire Protection Association NEC 2005 Handbook paragraph 250.96(8) and Exhibits 250.41 and 250.42.
4. The Communications Contractor shall install, position, re-position, or remove racks and equipment as required with-out disruption of ongoing services.

G. Selection of electronic equipment:

1. No discontinued or end-of-life equipment will be acceptable.
2. No used equipment will be acceptable.

H. Methods:

1. Conduit
 - a. Maximum 40 percent fill rate.
 - b. Fill each conduit with only cables carrying like signal levels and types.
 - c. Limit each conduit run to no more than two ninety-degree bends. Between pull-boxes there shall be no more than an accumulated bend of one hundred and eighty degrees
 - d. Install pull-boxes where and as required.
 - e. All conduits containing like cable or signal types shall route to collector junction boxes, which will connect to equipment racks with single large conduits, one for each signal type.

I. Wiring and cabling

1. Label each wire or cable to match labeling on approved shop drawing wiring diagram.
2. Physically separate cables of different signal types and levels to minimize interference and magnetic induction.
3. Do not install any telecom cables adjacent to power cables.
4. Where cables of differing signal type must cross each other, the cables shall cross perpendicularly.
5. Install edge protection material where cables cross metallic edges.
6. Seal cabling or conduit passing through acoustically rated partitions, ceilings and floors.

PART 4 - EXECUTION

4.1 INSTALLATION

- A. The contractor's or subcontractor's main resources within the project shall carry proper professional certification issued by the manufacturer and verified by a third-party organization to confirm sufficient product and technology knowledge.
- B. The contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.
- C. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
- D. All firmware found in products shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA) or Network Video Recorder (NVR).
- E. All firmware found in products shall be the latest and most up-to-date version as specified by the manufacturer, or by the product component provider.
- F. All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.
- G. A proper installation shall meet NEC (National Electrical Code – US only) per the guidelines of that year's revision. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.
- H. All equipment shall be installed in accordance with the published practices of the equipment manufacturer, applicable FCC regulations, generally accepted industry standards, cited codes and standards, and these specifications.
- I. Temporary Installation
 1. The contractor shall temporarily install all electronic equipment for the final tests of the equipment and the systems, and then shall remove and store all equipment which is not built-in until occupancy by City personnel. The contractor shall then return and make complete and final installation and check-out.
- J. Equipment Not Installed

1. Equipment not meant for installation and all spares shall be delivered on site, to CITY Telecom Project Manager and secured.

K. Wiring

1. Terminations and connections throughout all systems shall employ one of the following methods:
 - a. Solder terminals, telephone-type punch terminal strips or machine wire-wrapped terminals in all cabinets.
 - b. Crimp connectors at outlet boxes and screw type or plug and socket connections at all equipment. Note that crimp-type connections are approved only for stranded wire.
2. 66-Type blocks shall only be used for voice distribution cables. They are not permitted for any other installation.

L. Labels

1. All controls, function switches, etc. shall be clearly labeled on all equipment panels. This labeling shall be permanently etched or engraved. Neat nameplates engraved on two-layer plastic and affixed with epoxy glue may be used.

M. Flexible Wire

1. Stranded wire and flexible cable shall be used for all connections to equipment not permanently attached to walls, floors or racks.

N. Conduits

1. Thin wall conduit shall be used for conduits 2" in diameter or less. For conduits over 2" in diameter, rigid steel galvanized shall be used. However, if it is necessary to use flex duct or plastic PVC, prior approval must be obtained in writing from DPW Project Manager and the next larger size flex duct or PVC shall be used. The flex shall be anchored at all bends and runs between bends must be straight and non-zigzagging through studding, joints, etc. If PVC conduit is to be used, use steel galvanized conduit for all bends over 15 degrees.
2. All communications conduit shall be one (1) inch inside diameter unless otherwise noted on the drawings.
3. A ¼" inch nylon pull line shall be installed in each conduit. For conduits over two (2) inch in diameter, provide three-eighth (3/8) inch nylon pull line.
4. All conduits shall be clearly and permanently identified at all terminals or cabinet as to its terminating end.
5. Individual communications conduit runs shall not have more than the equivalent of two (2) 90-degree bends, the DPW Project Manager and CITY Telecom Project manager shall be contacted to determine the size, type and location of a pull box that must be installed. Pull boxes shall not be used for transitions in conduit runs.
6. The radius of any conduit bend shall not be less than ten (10) times the inside diameter of the conduit.

7. Open ends of conduit shall be plugged during construction to prevent the entrance of moisture or foreign material. If moisture or foreign material is found at the time telephone and data cables are being installed, it shall be the responsibility of the contractor to thoroughly clean the conduit before the cable installation proceeds.
8. All conduits shall be securely fastened in place and shall be free from burrs, defects or obstructions that could interfere with the installation of cables.
9. All conduits, unless otherwise noted on drawings, shall terminate on designated communications backboards either three (3) inches above the floor or six (6) inches below the ceiling.
10. All conduits shall be reamed and secured by locknut where applicable. All conduits shall have bushings on both ends.
11. All conduit not terminating in terminals, cabinets or outlet boxes shall be capped.
12. Conduit and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign objects or other defects.
13. Empty conduit/sleeves, unless noted otherwise, shall be run to and between respective communications rooms and/or closets.
14. All underground communications conduit shall be PVC and shall have a minimum earth cover of eighteen (18) inches, except where subject to vehicular traffic (including road right-of-way) the PVC conduit shall be concrete encased with a minimum of thirty (30) inches of earth cover. Telephone conduit may be buried in the same trench as power (480 Volts or less) if separated by a minimum of three (3) inches of concrete or twelve (12) inches of dirt.
15. The number of outlets included in each home run shall be specifically limited, as shown on the plans, and shall not be exceeded.
16. The CITY Telecom Project Manager is responsible for duct assignments and shall be contacted before the installation of cables in the conduits.
17. Any deviation/substitution must be verified and approved in writing by the CITY Telecom Project Manager prior to use.

O. Outlets

1. All communications outlets shall be installed at the same height above the finished floor, unless otherwise noted on the drawings, as the electrical outlets, and shall be:
2. For single conduit entrance, 4 11/16 inches x 2 1/8 inches x 2 1/8 inches.
3. For two (2) or more conduit entrances, 4 11/16 inches x 4 11/16 inches x 2 1/8 inches.
4. Plaster rings are required. Tiger Box rings may not be used.
5. All core-drilled holes in counter tops shall be three (3) inches in diameter. A removable/reusable grommet and cover shall be installed.

4.2 FUNCTIONALITY TEST AND INSPECTION

The following functionality test and inspection deliverables are required where applicable to this project.

- A. The City's IT Project manager shall, at a minimum, test all newly installed equipment and configuration using the City of Ridgecrest LAN and IPT System Functionality and Cut-Over Test Plan developed (as stated on Section 2.02 paragraph 17 above) prior to the test date. The Communications Contractor shall work with appropriate City staff to incorporate any required tests that are not already included in the attached sample. The City reserves the right to require additional tests not listed on the Test Plan. The Communications Contractor and Telecom Project Manager shall be present and participate in all tests. Further, the Communications Contractor shall certify that the system is fully operational and fully functional.
- B. The City shall test all the newly installed equipment and verify that the system is fully operational and fully functional.
- C. The City shall accept the various systems installed and authorize payment to the Communications Contractor only after the City has received all deliverables specified and the Communications Contractor has fulfilled all obligations. This shall require, among other things, that the Communications Contractor:
 - 1. Has provided all materials and services included in the Original (or Adjusted, if applicable) Bid Schedule of Materials & Services and all change orders.
 - 2. Has provided to the CITY Telecom Project Manager a final "As Built" Schedule of Materials & Services. This schedule is the net result of compilation of the Original (or Adjusted, if applicable) Bid Schedule of Materials and Services and all change orders and reflects the actual materials and services delivered to the City.
 - 3. Has tested all systems and provided test results to the CITY Telecom Project Manager indicating operability in accordance with the specifications.
 - 4. Has completely provided to the CITY Telecom Project Manager the documentation as required above.
 - 5. Has cleared all deficiencies (Punch List items).
 - 6. Has turned over to the city any spare parts as specified.
 - 7. Has restored to original condition any damaged City premises, premise facilities, or equipment caused by Contractor personnel
 - 8. Has cleared all material and debris from the work site and generally restored the work site to an orderly condition.
 - 9. Has removed all abandoned or non-working equipment, wiring and mountings from the TRs, ducts, and conduits.
 - 10. Has contacted and made arrangements for the DPW Project Manager to determine the disposition of existing equipment.
 - 11. Has dressed all cables, patch cables, and power cords after user migration.
 - 12. Has fire stopped required conduits and pathways.

13. Has completed all required training sessions.
 - a. Written procedures for the tests not included above shall be prepared by the contractor and submitted for review and approval by the CITY Telecom Project Manager at least 30 days prior to the test. The contractor shall supply personnel and, wherever required, auxiliary equipment for the test, without cost to the City.
 - b. The City reserves the right to conduct, using contractor equipment and labor, a random re-test of up to five (5) percent of the cable plant to confirm documented results. Random re-testing, if performed, shall be at the expense of the contractor, using standard labor rates. Any failing cabling shall be re-tested and restored to a passing condition. In the event more than two (2) percent of the cable plant fails during re-test, the entire cable plant shall be re-tested and restored to a passing condition at no additional cost to the City.

4.3 TRAINING

- A. The CITY Phone Trainer shall provide phone and Unity Connection Voice mail familiarization and usage classes training on the VoIP telephone system. All other products in PART 2, the Communications contractor shall furnish the services of a competent trainer or instructor for classroom and hands-on instruction in the operation and maintenance of the equipment supplied. The training shall be sufficient to qualify City technicians to maintain the equipment and systems.
- B. All training plans and materials shall be submitted by the contractor for review and approval by city's staff at least 30 days prior to acceptance tests.
- C. Classroom space for training will be provided by the City. All training classes shall be conducted on a mutually agreeable schedule prior to system acceptance.
- D. Operator training curriculum, if required, shall be comprehensive enough to enable City personnel receiving initial training to independently conduct training classes and instruct other operators. The contractor shall conduct training and furnish training materials for up to 20 students, as determined by City.
- E. Maintenance training. The Communications Contractor, if required, shall include in his maintenance training plan the recommended duration of maintenance training necessary to thoroughly cover the subject matter. This plan is subject to revision based upon City review.
- F. The contractor shall furnish training materials to each student, which they shall keep. The training material shall include the Systems Manual, less appendices. Maintenance training shall be conducted twice to provide training for up to 10 students in each session.
- G. The contractor shall provide one formal, technical training seat for each product installed.
- H. Training shall be conducted on-site as follows:
 1. End-User's Training. The CITY Trainer shall provide IP telephone and Unity Connection voice mail familiarization and usage classes for all newly assigned end-users at thirty (30) people or less per class. User guides reflecting implanted features and access shall be provided for all end-users as follows:
 2. Review how to use an IP phone b. Review main IP Phone features (hold, transfer, conference, etc.)

3. Review how users can access the CM User Options page and use the various features (Speed dials, address book, etc.)
4. When feasible during the installation or configuration of any equipment that may be required, the Contractor will contact the City's Maintenance Supervisor and invite him/her to send a technician to accompany the Contractor's technician. This will permit the City's maintenance staff to become familiar with the equipment being installed and configured. This "over the shoulder" training should be conducted as may be deemed feasible to do so.
5. Training shall also include overall system configuration, software programming, equipment and cabling interconnects and locations, purpose and function of each piece of equipment, troubleshooting and repair of each piece of equipment and troubleshooting and repair of the systems as a whole. The Contractor shall furnish training and obtain manufacturer's certification for City technicians to install, maintain, troubleshoot and repair the systems and equipment. The Contractor shall also provide training manuals detailing the training session concepts. Estimated number of technician training participants is ≤10.

END OF SECTION

**SECTION 28 31 00
FIRE DETECTION AND ALARM**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Design, furnish, install, test, certify, and place into service a complete addressable fire alarm system. The system shall be complete with all hardware and software specifically tailored for this installation.
- B. Provide a fire alarm system consisting of, but not limited to the following components:
 - 1. Fire alarm control panel (FACP)
 - 2. Conduit and wiring necessary to connect the FACP to alarm initiating devices, notification appliances and auxiliary equipment
 - 3. Addressable manual fire alarm stations
 - 4. Addressable analog area smoke detectors
 - 5. Addressable analog heat detectors
 - 6. Connections to sprinkler waterflow alarm switches
 - 7. Connections to sprinkler supervisory switches and tamper switches
 - 8. Audible and visual combination notification appliances
 - 9. Air handling systems shutdown relays
 - 10. Elevator recall/shunt relays (if the building has an elevator)
 - 11. Battery standby
 - 12. Conduit and GFE cable to building's main telecommunications room
- C. Provide a fire alarm system that conforms to the requirements of the latest editions of (1) NFPA 72 National Fire Alarm and Signaling Code, (2) NFPA 70 National Electrical Code, (3) ASME A17.1 Safety Code for Elevators and Escalators, and

(4) NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems.

1.2 SYSTEM FUNCTIONAL DESCRIPTION

- A. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors
- B. The fire alarm system shall be manufactured by an ISO 9001:2008 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

- C. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof). It's acceptable for peripheral devices to be manufactured outside of the U.S. by a division of the U.S. based parent company.
- D. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.
- E. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final checkout and to ensure the systems integrity.
- F. The system shall identify any off normal condition and log each condition into the system database as an event.
 - 1. The system shall automatically display on the control panel the first event of the highest priority by type. The priorities and types shall include alarm, supervisory, and trouble.
 - 2. The system shall have a queue operation, and shall not require event acknowledgment by the system operator. The system shall have a labeled color-coded indicator for each type of event.
 - 3. The user shall be able to review each event by selecting scrolling keys.
 - 4. New alarm, supervisory, or trouble events shall sound a silence-able audible signal at the control panel.
- G. Operation of any alarm-initiating device shall automatically:
 - 1. Update the control/display as described above.
 - 2. Audibly and visibly annunciate the alarm condition at the FACP.
 - 3. Activate all NAC appliances in accordance with the respective evacuation plan and matching functional matrix. The fire alarm evacuation tone shall be the three-pulse temporal pattern.
 - 4. Operate the alarm relay and initiate the transmission of an alarm signal to the LANL central station over a digital alarm communicator system.
- H. Activation of a supervisory initiating device shall:
 - 1. Update the control/display as described above.
 - 2. Audibly and visibly annunciate the supervisory condition at the FACP.
 - 3. Operate the supervisory relay and initiate the transmission of a supervisory signal to the LANL Central Station over a digital alarm communicator system.
- I. The entire fire alarm system wiring shall be electrically supervised to automatically detect and report trouble conditions to the FACP. Any opens, grounds, or disarrangement of system wiring and shorts across alarm horn/strobe wiring shall automatically:
 - 1. Update the control/display as described above.

2. Operate the trouble relay contacts to initiate the transmission of a trouble signal to the LANL central station over a digital alarm communicator system.
3. Visually and audibly annunciate a general trouble condition, on the FACP. The visual indication shall remain on until the trouble condition is repaired.

- J. The FACP shall have an optional LED Annunciator/Switch Card component installed and programmed for pre-defined disable groups particular to this installation. Disable groups shall consist of the following to facilitate routine inspection, testing, and maintenance (ITM):

All control relays that initiate/control closure of the specified combination fire/smoke dampers listed in Sections 1.2.B.6 and 1.2.B.7.

All notification appliances.

- K. Complete maintenance and repair service for the fire detection system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty.
- L. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, required tests, and list pricing for any replacement products included on the bill of materials, along with the list pricing for products not on the bill of materials; if test and inspection rates are different than full service rates the bid/proposal shall include pricing for all levels for a minimum period of five (5) years Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.
- M. Include, also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accept-ed. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

1.3 SYSTEM DESIGN

- A. System Design: Provide the services of a qualified factory trained fire alarm designer for the FACP to be installed on this project. The designer shall assure the completeness and correctness of the fire alarm system design by performing the following:
1. Prepare drawings of FACP indicating location of components, interconnection of components and connections to alarm initiating, indicating, and auxiliary circuits.
 2. Prepare a system input/output matrix to verify that the proper sequences occur for each initiating point or zone.
 3. Prepare drawings of fire alarm layout, conduit and wiring plans. Show location of all fire alarm appliances, conduit layout, quantity, and type of wires in each conduit, and interface with other systems for functions such as central station signaling, fan shutdown, damper operation, and elevator recall.
 4. Prepare terminal-to-terminal field wiring diagrams for alarm initiating, indicating and auxiliary circuits; detail the interfaces with other systems; indicate labeling of each fire alarm system conductor.

5. Calculate conductor sizes for each alarm initiating, indicating, and auxiliary circuit; limit voltage drops so that they do not exceed the FACP manufacturer's limitations, for the most remote device on each circuit.
6. Prepare battery load calculations for the FACP and any remote power supply panels and select proper battery size. Battery shall be sized to include an additional 50% safety margin above calculated system demand.
7. Calculate alarm signal in all spaces to comply with ADAAG requirements: minimum 15 dBA above ambient at all locations, but not over 120 dBA at any location.
8. Select alarm initiating, alarm indicating, and auxiliary devices compatible with FACP.

1.4 ACTION SUBMITTALS

A. Provide the following per project submittal procedures.

B. Certifications

1. Within 30 days after Notice to Proceed (submittal; see Appendix), certifications of the qualifications of the fire alarm installing firm as described in the quality assurance paragraph of this Section.
2. Within 30 days after Notice to Proceed (~60% submittal; see Appendix), certifications of the qualifications of the fire alarm system technician as described in the quality assurance paragraph of this Section.
3. Certification from the fire alarm control manufacturer that proposed alarm- initiating devices, alarm appliances, and auxiliary devices are compatible with the FACP and other auxiliary equipment.

C. Delegated Design Submittals

1. Calculations: Submit the following with Design Drawings

- a. System battery capacity calculations to demonstrate that the battery is sized to support the system operating in a "normal" (non-alarm) condition for not less than 24 hours plus a general alarm condition (all alarm notification appliances used for evacuation being activated) for not less than 10 minutes following the completion of the 24-hour period. Battery shall be sized to include an additional 20% safety margin above calculated system demand.
- b. Voltage drop calculations to demonstrate that the signal voltage at the most remote notification appliances on each circuit will not be less than the FACP or the notification appliance manufacturer's recommendations.

2. Design/Installation Drawings

- a. Prepare floor plan drawings using a minimum scale of 1/8" = 1'-0" for plans and 1/4" = 1'-0" for details.
- b. Hand-lettering shall be a minimum of 3/16" and other lettering a minimum of 1/8" to permit reproduction.

- c. Show location of FACP, all fire alarm appliances, conduit layout, quantity and type of wires in each conduit, and interface with other systems for functions such as central station signaling, fan shutdown, damper operation, and elevator recall.
 - d. Show layout of the FACP indicating location of components, interconnection of components, and connections to alarm initiating, indicating, and auxiliary circuits.
 - e. Provide terminal-to-terminal wiring diagrams for alarm circuits, supervisory circuits, remote power supply panels, and interfaces with other systems such as HVAC and elevators.
 - f. Submit with calculations at least 30 days prior to scheduled start of fire alarm system installation (~60%, 90%, 100% submittals; see Appendix). Installation shall not proceed without 100% Submittal design approval by the LANL Fire Protection Group.
- 3. Catalog Data: For all equipment furnished under this Section. See Appendix for submittal schedule.
 - 4. Installation Instructions: See Appendix for submittal schedule.
 - 5. Materials and Parts List: See Appendix for submittal schedule.
 - 6. FACP Program
 - a. Provide FACP input/output matrix and a copy of the proposed FACP program at least two weeks prior to the anticipated pre-test date of the fire alarm system.
 - b. Provide final FACP input/output matrix and the final FACP program before requesting final tie-in/acceptance testing.
 - 7. O&M Manual
 - a. Submit operating and instruction manuals with the 100% submittal of calculation and drawings
 - b. Submit five complete sets of project-specific operating and maintenance instruction manuals upon successful completion of testing. Provide complete, step-by-step testing instructions giving recommended and required testing frequency of all equipment, methods for testing each piece of equipment, and a complete trouble shooting manual explaining how to test the primary internal parts of each piece of equipment. Maintenance instructions shall be complete, easy to read, understandable, and shall provide the following information:
 - 1) Provide instructions for replacing any components of the system, including internal parts.
 - 2) Provide a list of recommended spare parts.
 - 3) Provide instructions for periodic cleaning and adjustment of equipment with a schedule of these functions.

- 4) Provide a complete list of all equipment and components with information as to the address and telephone number of both the manufacturer and local supplier of each item.

- c. Provide operating instructions prominently displayed on a separate sheet located next to the FACP in accordance with UL Standard 864.

D. Test Reports

1. Submit report of the pre-final tests indicating system status and corrective actions required before requesting the final acceptance tests.
2. Submit test plan for the final acceptance tests of unique/special fire detection and alarm equipment such as UV/IR fire detectors, high- sensitivity smoke detection (HSSD) systems, air-aspirating/sampling detectors, linear fire detectors, and others having special manufacturer's requirements and recommendations for acceptance testing, before requesting the final acceptance tests.
3. Upon successful completion of final acceptance tests, submit final "Record of Completion" and "Inspection and Testing Form" as required by NFPA 72.

E. Project Record Documents

1. Provide updated drawings reflecting as-built conditions showing the work completed under this Section. Include notes on special systems or devices, new and existing, locations of equipment, actual conduit installation, wiring color-coding, wire tag notations, interconnections between all equipment, and internal wiring of the equipment. Include conduit size, conductor size, and number of conductors per conduit.
2. Provide the updated drawings on electronic media in ".pdf" and AutoCAD "*.dwg" formats.
3. Provide "Record of Completion" and associated documentation for the completed system according to NFPA 72.

- F. Warranties: Warrant all equipment and wiring free from inherent mechanical and electrical defects for one year (365 days) from the date of final acceptance, in writing.

1.5 QUALITY ASSURANCE

A. Qualifications of the installing firm:

1. Be licensed by any state in the United States to engage in the design, fabrication, and installation of fire alarm systems.
2. Have satisfactorily installed at least twenty fire alarm systems of equivalent nature and scope to the system described in this Section.
3. Provide the services of a qualified fire alarm system technician to design the fire alarm system and to test the completed system.
4. Be a factory-certified representative of the manufacturer of the FACP that will be used on this project.

B. Qualifications of the fire alarm system technician:

1. Be factory trained in the theory, operation, installation, and troubleshooting of the FACP that will be used for this project.
2. Have satisfactorily designed at least twenty fire alarm systems of equivalent nature and scope to the system described in this Section.
3. Have satisfactorily field-tested at least twenty fire alarm systems of equivalent nature and scope to the system described in this Section.
4. Be NICET (National Institute for Certification in Engineering Technologies) Fire Alarm Certified, or certified by an equivalent organization acceptable to the LANL Fire Authority Having Jurisdiction.

1.6 PRODUCT HANDLING

- A. Materials and Equipment: Protect from damage during shipping, storage, and installation.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide materials and equipment that are new and unused, free of defects, specifically designed for the use intended, conform to the requirements of the NEC and NFPA 72, and are NRTL listed for the intended use.
- B. Provide products suitable for operation at an elevation of 7,500 ft.

2.2 FIRE ALARM CONTROL PANEL

- A. Main FACP shall be a NOTIFIER Model NFS-320 and shall contain a microprocessor based Central Processing Unit (CPU) and power supply in an economical space saving single board design. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.
- B. The FACP shall incorporate all control electronics, relays, and necessary modules and components in a flush or semi-flush mounted cabinet (dependent on FACP mounting location). The operating controls and zone/supervisory indicators shall be located behind locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified. The assembly shall contain a base panel, system power supply and battery charger with additional modules to meet the requirements of these specifications.
- C. System circuits shall be configured as follows: Addressable analog loops Class B/Style 4; Initiating Device Circuits (if used) Class B/Style B; Notification Appliance Circuits Class B/Style Y.
- D. The system shall store all basic system functionality and job specific data in non-volatile memory. The system shall survive a complete power failure intact.
- E. The system shall allow down loading of a job specific custom program created by system application software. It shall support programming of any input point to any output point.

- F. The system shall support distributed processor intelligent detectors with the following features: integral multiple differential sensors, environmental compensation, pre-alarm, dirty detector identification, automatic day/night sensitivity adjustment, dual normal/alarm LEDs, relay bases, and isolator bases.
- G. The system shall use full digital communications to supervise all addressable loop devices for placement, correct location, and operation. It shall allow swapping of "same type" devices without the need of addressing and impose the "location" parameters on replacement device. It shall initiate and maintain a trouble if a device is added to a loop and clear the trouble when the new device is defined in the system.
- H. The system shall have a nationally recognized testing laboratory (NRTL) listed detector sensitivity test feature, which will be a function of the smoke detectors and performed automatically.
- I. All panel modules shall be supervised for placement and initiate a trouble signal if damaged or removed.
- J. The system shall have a CPU monitoring circuit to initiate a trouble signal should the CPU fail.
- K. The system evacuation signal rate shall be suitable to support audio-visual combination-type electronic three pulse temporal pattern sounder and strobe combination units.
- L. The system program shall meet the requirements of this project, current codes and standards, and satisfy the LANL Fire Authority Having Jurisdiction.
- M. Passwords shall protect any changes to system operations.
- N. The power supply shall be a high efficiency switch mode type with line monitoring to automatically switch to batteries for power failure or brown out conditions. The automatic battery charger shall have low battery discharge protection. The power supply shall provide internal power and 24 Vdc for notification appliance circuits. All outputs shall be power limited. The battery shall be sized to support the system for 24 hours of supervisory and trouble signal current plus general alarm for 10 minutes.
- O. The FACP shall have a high-contrast, alphanumeric display to show system status, alarm information, and supervisory information. The FACP shall have LED indicators for the following common control functions: AC power, alarm, supervisory, monitor, trouble, disable, ground fault, CPU fail, and test. There shall be control keys and visual indicators for; reset, alarm silence, trouble silence, and drill.
- P. Battery boxes, if required, shall be UL Listed for the purpose.
- Q. The FACP shall have a digital alarm communicator transmitter (DACT) module to transmit detailed alarm, supervisory and trouble signals to a digital alarm communicator receiver (DACR) at a Central Monitoring Station.
 - 1. The DACT shall support dual telephone lines, "contact ID" communications format, and configured for dual-tone, multi-frequency (DTMF).
 - 2. The DACT shall be listed for "Central Station Fire Service" and for "Proprietary Station Fire Service" and shall be of the same manufacturer as the control panel.
 - 3. The DACT shall transmit the following information to the LANL Central Station:
 - Fire alarm per point addressable device (e.g., detector or water flow

- activation, manual pull stations, etc.)
 - Supervisory signal per addressable device (e.g., valve tamper)
 - General System Trouble (alarm panel trouble)
 - Loss of AC Power
 - Communication Line Failure (Primary and Backup)
 - Trouble per zone or point addressable device
 - Battery Failure
4. Restoration of each signal condition identified above shall be transmitted to the LANL Central Station.
 5. The secondary telephone line shall only be utilized for signal transmission in the event that attempts to communicate utilizing the primary line are unsuccessful.
 6. The secondary telephone line shall have the same account code and communication format as the primary line.
 7. A general alarm or supervisory signal shall not be transmitted by the DACT when specific point/zone information is transmitted.
 8. Loss of AC power shall be transmitted 3 hours after the detected failure.
 9. A test signal shall be sent once every 24 hours.
 10. For consistency, telephone wire color configuration shall be as follows: 2 - Two-pair wire

To DACT				To Premise Telephone			
Cable 1		Cable 2		Cable 1		Cable 2	
Tip 1	Ring 1	Tip 2	Ring 2	Tip House 1	Ring House 1	Tip House 2	Ring House 2
Green	Red	Green	Red	Black	Yellow	Black	Yellow

2.3 LED ANNUNCIATOR/SWITCH CARD

- A. Provide compatible components programmed per the pre-defined disable groups in Paragraph 1.2.E particular to this installation.
- B. Manufacturers: NOTIFIER Annunciator Control Module ACM-24AT.

2.4 ADDRESSABLE THERMAL DETECTORS

- A. Provide addressable, intelligent, fixed temperature or rate-of-rise thermal detectors that are compatible with and acceptable to the FACP manufacturer. The heat detection design documentation shall state the required performance objective of the system. The designer responsible for the strategy of the structure as a whole shall establish the "type" selection criteria.
 1. The detector shall be rated at 135 °F and shall be spaced according to the detector manufacturer's spacing guidance and the structure's attributes. For applications requiring other than 135 °F, consult the LANL Fire Protection Group.

- B. Manufacturers: NOTIFIER FST-951 or FST-951R, NO SUBSTITUTIONS.

2.5 ADDRESSABLE PHOTOELECTRIC DETECTORS

- A. Provide addressable, analog, intelligent, photoelectric type smoke detectors that are compatible with and acceptable to the FACP manufacturer.
 - 1. The photoelectric detector shall be rated for ceiling installation at a minimum of 30 ft (9.1m) centers and be suitable for wall mount applications.
- B. Manufacturers: NOTIFIER FSP-951. NO SUBSTITUTIONS.

2.6 DETECTOR MOUNTING BASES

- A. Provide standard bases suitable for mounting on 3-1/2" or 4" octagon box and 4" square box. The base shall contain no electronics and support all detector types. Removal of the detector shall not affect communications with other detectors.
- B. Manufacturers: match smoke, heat detector device (B501 white) Low profile base.

2.7 DUCT SMOKE DETECTOR AND HOUSING

- A. Provide addressable photoelectric detectors compatible with and acceptable to the FACP manufacturer and listed for the maximum air flow velocity anticipated.
- B. Provide detector wiring so that detector can be reset at FACP.

2.8 AUTOMATIC SPRINKLER SYSTEM

- A. Refer to Section 21 1313, *Wet-Pipe Sprinkler Systems*, for pressure switches, flow switches and valve supervisory switches associated with the automatic sprinkler system.
- B. Provide INTELLIGENT single-input or dual-input modules as required to connect pressure switches, flow switches, and valve supervisory switches to the addressable analog loop. Each input shall provide a supervised Class B input circuit.
- C. Manufacturers: NOTIFIER "FlashScan Monitor Module FMM-1" or "FDM-1 FlashScan dual monitor module." NO SUBSTITUTIONS.

2.9 ADDRESSABLE MANUAL PULL STATIONS

- A. Provide addressable double-action, non-coded manual pull stations that are acceptable to the FACP manufacturer and are compatible with the FACP.
- B. The fire alarm station shall be of Lexan or metal construction with an internal toggle switch. Provide a key locked test feature. Finish the station in red with white "PULL IN CASE OF FIRE" lettering. The manual station shall be suitable for mounting on 2-1/2" deep 1-gang boxes and 1-1/2" deep 4" square boxes with 1- gang covers.
- C. Provide the appropriate back boxes and mounting plates for flush-mounting or surface mounting (depending on the building construction).

- D. Manufacturers: NOTIFIER NBG-12LX. NO SUBSTITUTIONS.

2.10 ADDRESSABLE CONTROL RELAY MODULES

- A. Provide modules acceptable to the FACP manufacturer and compatible with the FACP.
- B. The control relay module shall provide one "Form C" dry relay contact rated at 2 amps at 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware.
- C. Manufacturers: FRM-1, NO SUBSTITUTIONS.
- D. Provide additional relays with voltage and current ratings as required to perform functions such as air handling system shutdown and elevator recall.
- E. Control relays should be installed in a "readily accessible location and height".

2.11 AUDIBLE AND VISUAL COMBINATION NAC DEVICES

- A. Provide NRTL-listed 24 VDC audio-visual combination-type electronic three-pulse temporal pattern sounder and strobe combination units that are acceptable to the FACP manufacturer and are compatible with the FACP.
- B. Sounder shall include three-pulse temporal pattern generating electronics, audio transducer, and screw terminals housed in a red housing. Acoustical output shall meet requirements of UL 464. The audible signal shall be the "American National Standard Audible Emergency Evacuation Signal" (three-pulse temporal pattern) in accordance with ANSI S3.41,
- C. Strobe signal output and flash rate shall meet UL 1971 and ADAAG requirements. Unit shall have a xenon flash tube enclosed in a clear Lexan lens with "FIRE" in white lettering, and shall produce a synchronized strobe flash. Provide strobes with flash output levels as required to meet NFPA 72 visual signal requirements for each space.
- D. Horn/strobe shall mount to a 4" x 2-1/8" deep electrical box with single device cover. Provide weatherproof wall boxes for outdoor mounting.
- E. Manufacturers: Wheelock "Exceder" series, or System Sensor "P" Series. NO SUBSTITUTIONS.

2.12 CONDUIT

- A. Install fire alarm wiring in conduit. Minimum conduit size 3/4 inch.
- B. Refer to Section 26 0533, Raceway and Boxes for Electrical Systems, for conduit systems.

2.13 JUNCTION BOXES

- A. Refer to Section 26 0533, Raceway and Boxes for Electrical Systems, for junction boxes.

2.14 WIRING

A. Color Code: Use the following color code for the fire alarm system wiring:

1. Black - 120-Volt AC phase wire.
2. White - 120-Volt AC neutral wire.
3. Green - System ground wire.
4. Brown - Negative connection for strobe device. (If wired separately from horns.)
5. Orange - Positive connection for strobe device. (If wired separately from horns.)
6. Blue - Negative connection for horn circuit or horn/strobe combination circuit.
7. Yellow - Positive connection for horn circuit or horn/strobe combination circuit.
8. Gray - Negative conventional alarm initiating device connection.
9. Violet - Positive conventional alarm initiating device connection.
10. Black - Negative circuit connection for duct smoke detector reset, HVAC interlock, and other auxiliary connections.
11. Red - Positive circuit connection for duct smoke detector reset, HVAC interlock, and other auxiliary connections.
12. Black/Red Twisted Pair - Addressable device data loop, evacuation speaker circuit.

B. Conductors: Provide alarm and supervisory signaling system conductors that meet the requirements of Article 760 in the NEC and are NRTL-listed for the type of service to which they will be subjected. Minimum conductor requirements:

1. Interior/Dry Locations: Red-jacketed NEC type FPL cable with No. 16 AWG (minimum) twisted-pair conductors for addressable devices (shielded if required by the FACP manufacturer), and listed per UL1424.
 - a. Low voltage binary signal conductors shall be type THHN, thermoplastic insulation, No. 16 AWG minimum, and solid copper conductor.
 - b. Other low voltage conductors shall be type TFN, No. 16 AWG (minimum), thermoplastic insulation, and single solid copper conductor.
2. Exterior/Wet Locations: Red-jacketed NEC type FPL cable with No. 16 AWG (minimum) twisted-pair conductors for addressable devices (shielded if required by the FACP manufacturer), and listed for WET locations per UL1424.
 - a. Low voltage binary signal conductors shall be type THWN-2, thermoplastic insulation, No. 16 AWG minimum, and solid copper conductor.
3. Power conductors shall be type THHN/THWN-2, No. 12 AWG, thermoplastic insulation, and single solid copper conductor.

4. Size conductors of the fire alarm systems as recommended by the manufacturer, based on the operating ampacity of the circuit and the permissible resistance and voltage drop characteristics that will allow proper operation of the equipment. Provide conductors selected to provide voltages within the manufacturer specification limits for the most remote fire alarm notification appliance or field device.
5. Design each addressable analog loop so device loading will not exceed 80% of loop capacity in order to leave for space for future devices.

2.15 TEST EQUIPMENT

- A. Provide any special test equipment manufactured by the fire alarm equipment manufacturer for maintenance, testing, or troubleshooting.

2.16 SURGE PROTECTION

NOTE: All surge protectors shall be installed to be readily accessible for servicing.

- A. Provide a UL 1449 listed 120V surge protective device for the main FACP, each sub-FACP, and each booster power supply that has a 120V supply circuit.
 1. Device shall be capable of absorbing a maximum single pulse of at least 6,500 amperes.
 2. Clamping voltage shall not exceed 330 volts line-to-neutral when tested in accordance with ANSI/IEEE C62.31 category C1/B3.
 3. Manufacturer: EDCO Model "FAS-120AC" or as recommended by the FACP manufacturer.
- B. Provide a UL 497B listed surge protective device for each analog initiating device signaling circuit entering/leaving each building that is monitored by the FACP.
 1. Device shall be capable of absorbing a peak 8x20 microsecond current of 10,000 amperes at least 10 times.
 2. Clamping voltage shall not exceed 30 volts.
 3. Capacitance shall not exceed 50pf.
 4. Provide matching receptacle for plug-in surge protective devices.
 5. Manufacturer: EDCO model "PC642C-030LC" (protects 2 pairs) and "PCB1B" socket, or as recommended by the FACP manufacturer.
- C. Provide a UL 497B listed surge protective device for each 24-volt initiating device circuit or control circuit entering/leaving each building that is monitored by the FACP.
 1. Device shall be capable of absorbing a peak 8x20 microsecond current of not less than 10,000 amperes at least 10 times.
 2. Clamping voltage shall not exceed 30 volts.
 3. Provide matching receptacle for plug-in surge protective devices.

4. Manufacturer: EDCO model "PC642C-030" (protects 2 circuits) and "PCB1B" socket, or as recommended by the FACP manufacturer.
- D. Provide a UL 497B listed surge four-wire protective device for each FACP RS-232 circuit entering/leaving each building monitored by the FACP.
1. Device shall be capable of absorbing a peak 8x20 microsecond current of 10,000 amperes at least 10 times.
 2. Clamping voltage shall not exceed 20 volts for RS-232 applications.
 3. Provide matching receptacle for plug-in surge protective devices.
 4. Manufacturer: EDCO model "PC642C-020" with "PCB1B" socket, or as recommended by the FACP manufacturer.
- E. Provide a UL 497B listed surge four-wire protective device for each FACP RS-485 circuit entering/leaving each building monitored by the FACP.
1. Device shall be capable of absorbing a peak 8x20 microsecond current of 10,000 amperes at least 10 times.
 2. Clamping voltage shall not exceed 8 volts for RS-485 applications.
 3. Line to line and line to ground capacitance shall not exceed 50pf.
 4. Provide matching receptacle for plug-in surge protective devices.
 5. Manufacturer: EDCO model "PC642C-008LC" with "PCB1B" socket, or as recommended by the FACP manufacturer.
- F. Provide a UL 497B listed surge protective device for each 24-volt notification appliance circuit entering/leaving each building that is monitored by the FACP.
1. Protective device shall have a series resistance not exceeding 0.2 ohms per pair and shall be capable of carrying a continuous current of 5 amperes.
 2. Device shall be capable of absorbing a peak 8/20 microsecond current of 5000 amperes and a 2000-ampere occurrence at least 50 times.
 3. Clamping voltage shall not exceed 43 volts.
 4. Provide matching receptacle for plug-in surge protective devices.
 5. Manufacturer: EDCO model "PHC-043" (protects 2 circuits) and "PCB1B" socket, or recommended by the FACP manufacturer.
- G. Provide a single-point ground bus for each enclosure containing one or more surge protective devices. Manufacturer: EDCO model "TER-BUS" or as recommended by the FACP manufacturer.

PART 3 - EXECUTION

3.1 FIELD CONDITIONS

- A. Prior to installation carefully inspect the installed work of other trades, whether pre- existing or part of this project and verify that such work is complete to the point where the installation of the fire alarm system may properly commence.
- B. Notify the LANL Subcontract Technical Representative (STR) if conditions exist, not resulting from work of this project, that prohibit the installation from conforming to applicable codes, regulations, standards, and the original, approved design.

3.2 INSTALLATION

A. General:

- 1. Install the fire alarm system in accordance with the NEC, NFPA 72, and this specification.
- 2. Follow Section 26 0529, Hangers and Supports for Electrical Systems, for anchorage requirements.
- 3. Verify dimensions in the field. Lay out work in the most direct and expeditious manner to avoid interference.
- 4. Coordinate necessary shutdowns of existing systems by notifying the LANL STR a minimum of seven working days before rendering such systems inoperative. Do not render inoperative any system without the prior approval of the LANL STR. The LANL STR will initiate and submit the LANL Utility Outage Request for Fire Protection.
- 5. Coordinate fire alarm detectors and associated equipment with existing ceiling or roof materials, lighting, ductwork, conduit, piping, suspended equipment, structural and other building components.
- 6. Coordinate installation of fire alarm system with work of other trades. Protect fire alarm equipment with suitable coverings until completion of Project.

B. Device Mounting Heights:

- 1. Install manual pull stations with center 44 inches above finished floor.
- 2. Install combination audible/visual notification appliances with the bottom 84 inches above finished floor or 6 inches below ceiling, whichever is lower. In high bay type areas the devices may be installed at a maximum of 96 inches above the floor. Any deviations from these heights require approval from the LANL AHJ.
- 3. Comply with ADA Accessibility Guidelines (ADAAG) for device mounting heights and locations.

C. FACP Installation

- 1. Install FACP following manufacturer's written instructions, NFPA 72, and the NEC.
- 2. Locate the FACP in the main building lobby or entry vestibule so fire department personnel entering the building can readily access it. Coordinate location of FACP with the LANL Fire Protection Group.

3. Install FACP with top of cabinet trim 66 inches above finished floor. Refer to manufacturer's recommended installation height.
 4. Mount FACP plumb and rigid without distortion of the box. Mount flush cabinets uniformly flush with wall surfaces.
 5. Install filler plates in unused spaces in FACP.
 6. Train conductors in cabinet gutters neatly in groups; bundle and wrap with cable ties after completion of testing.
 7. Tighten electrical connectors and terminals, including grounding connections, according to the manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.
- D. Control relays: Install in a readily accessible location and height acceptable to the AHJ.
- E. Wiring Installation:
1. Install fire alarm system wiring in conduit/raceway.
 2. Do not pull wire or cable until the conduit system is complete between pull points.
 3. Bundle conductors in panels and boxes into groups by service and destination.
 4. Run electronic cable continuous between termination points. No splicing is permitted without prior approval from the LANL AHJ. Where splicing is approved, use terminal strips that are acceptable to the LANL Fire Protection Group. Do not use "wire nuts."
 5. Do not install AC current-carrying conductors in the same raceway with the DC or digital fire alarm detection and signaling conductors.
 6. Circuit each addressable analog loop so device loading shall not exceed 80% of loop capacity in order to leave for space for future devices--the loop shall have Class B operation. Where it is necessary to interface conventional devices provide intelligent modules to supervise Class B wiring.
 7. Minimize the number of T-taps in fire alarm addressable data circuits and adhere to the manufacturer requirements/limitations. Make no T-taps in notification appliance circuits. T-taps shall only be made on device terminals or on terminal strips that are acceptable to the LANL Fire Protection Group, do not use "wire nuts."
 8. Make allowances in conductor length at panels and other enclosures to permit forming the conductors neatly within the enclosures. Where wiring troughs are not provided with the enclosures, neatly cable and adequately support the wiring.
 9. Ring out and identify power and control conductors before terminal connections are made. Check polarity and phasing and make changes as required before making terminal connections.
 10. Test conductors for continuity and for freedom from shorts or unintentional grounds.
- F. Junction Box and Conduit Installation: Refer to Section 26 0533, Raceway and Boxes for Electrical Systems, requirements. Provide minimum 3/4" fire alarm system conduit.
- G. Install audible and visual notification appliances in the following locations to obtain an audible

signal level that is at least 15 dB above ambient but does not exceed 120 dB at any location:

1. Corridors
2. Conference rooms
3. Mechanical equipment rooms
4. Computer rooms
5. Enclosed offices where dB levels are questionable
6. Common areas such as restrooms (strobes only)
7. Use a strobe-only device in the vicinity of the FACP

H. Surge Protective Device (SPD) Installation

1. Install a 120V SPD for the main FACP, each sub-FACP, and each booster power supply.
2. Install an SPD for each initiating device circuit, notification appliance circuit, data, and signaling line circuit entering/leaving each building that is monitored by the FACP.
3. SPDs shall be installed so that they are readily accessible for servicing.
4. If permitted by the FACP manufacturer, install SPDs in the FACP cabinet.
5. If the FACP manufacturer does not allow SPDs to be installed within the FACP cabinet, install one or more metal enclosures near the protected fire alarm equipment. Provide separate enclosures for 120V and signal voltage devices, or provide one enclosure with a metal partition to separate the 120V from the signal voltage devices.
6. Install a single-point ground bar in the enclosure for the SPD. Bond the ground bar to the enclosure and to the power circuit equipment-grounding conductor. Connect each SPD to the ground bar with a separate 12 AWG solid, green-insulated ground wire. Keep ground wires as short and straight as possible.
7. Install SPDs in accordance with manufacturer's instructions, keeping leads and ground conductors as short and straight as possible.

I. Identification

1. Follow Section 26 0553, Identification for Electrical Systems, for all system components.
2. Label each conductor at each terminal and junction point. Use wire markers specified in Section 26 0553, Identification for Electrical Systems. On wire markers indicate the type of fire alarm circuit (e.g. Pull Stations, Fan Shutdown, Alarm Strobes, etc.).
3. Mark floor in front of cabinet(s) to show the NEC required working clearances according to Section 26 0553, Identification for Electrical Systems.
4. Label fire alarm junction boxes with 2-1/4" x 1/2" (minimum size) pressure sensitive vinyl markers having "FIRE ALARM" in red letters on a white background.
5. Label all devices with address/zone information. Use self-adhesive vinyl labels with 3/4

inch (minimum) lettering easily visible without a ladder.

3.3 PAINTING

- A. Exposed Surfaces: Paint exposed fire alarm conduit, panels, cabinets, pullboxes, supports, and other electrical equipment as follows:
 - 1. Galvanized Surfaces: Paint for repairing galvanized materials shall be zinc- rich type.
 - 2. Refinishing: Thoroughly clean and touch up shop-primed or finish-painted surfaces damaged in handling or installation with paint supplied with the equipment or an approved matching paint.
 - 3. Interior Conduit: Paint new exposed interior conduit in rooms finished and/or occupied to match the existing background paint color. Paint conduit to be painted with one coat of primer. Paint conduit to match the existing background colors with two coats of paint to provide a minimum thickness of 6 mils.

3.4 EQUIPMENT INSTALLATION

- A. Install devices or equipment not specifically covered by these specifications in accordance with manufacturer's instructions.

3.5 CONNECTION TO LANL CENTRAL STATION

- A. Install 6 x 6 x 4 enclosure adjacent to the FACP with a conduit to the appropriate factory knockout.
- B. Install a 3/4 inch conduit with measuring pull tape from the 6 x 6 x 4 enclosure to the main telecommunications room.
- C. Install two GFE Category 5e telecommunications cables in the conduit and label each end of the cable as "emergency."
- D. LANL will terminate the telecommunications cable on two 8-pin RJ-31X telephone outlet jacks in a 2-port outlet that is mounted inside the 6 x 6 x 4 enclosure. LANL will label one jack as "primary," and the other as "backup."
- E. LANL will terminate the telecommunications cable pairs to two separate lines (numbers) at the telecommunications room, selecting dedicated numbers or low- usage (lobby, conference room, etc), voice-grade, loop-start DTMF numbers that provide timed-release disconnect.
- F. LANL will connect the "primary" and "secondary" number ports on the DACT to the corresponding telephone outlet jacks.

3.6 CLEANING

- A. Blow out junction boxes and fire alarm equipment not hermetically sealed with clear, dry, oil-free (15 psig maximum) air to remove dust and dirt prior to energizing.

3.7 FIELD QUALITY CONTROL

- A. Provide the services of a qualified factory trained and certified technician for the FACP installed on this project. The factory technician shall assure the completeness and correctness of the installation by performing the following:
1. Prepare as-built documentation of FACP indicating location of components, interconnection of components, and connections to alarm initiating, indicating and auxiliary circuits.
 2. Field-verify and mark as-built drawings of fire alarm layout, conduit and wiring plans, and point-to-point field-wiring diagrams.
 3. Verify correct labeling of fire alarm system conductors.
 4. Verify that conductor sizes are adequate for each alarm initiating, indicating and auxiliary circuit.
 5. Prepare as-built battery load calculations. Battery shall be sized to include the additional 50% safety margin above calculated system demand.
 6. Measure and adjust audible alarm signal in all spaces to comply with ADAAG requirements: minimum 15 dBA above ambient, but not over 120 dBA at any location.
 7. Test all devices for proper supervision and alarm operation.
 8. Test all interlocks with HVAC and elevator system for proper operation in normal and by-pass modes.
 9. Perform pre-final acceptance inspections and tests of the fire alarm system modifications.
 10. Prepare final acceptance test plan when required (see Section 1.4-D).
- B. After the pre-final test, provide a report to the LANL Project Leader indicating the status of the fire alarm system and any corrective actions required before the acceptance tests.
- C. Submit a detailed test plan for the final acceptance test.
1. Submit the test plan (when required, see Section 1.4-D) not less than 10 working days before the planned final acceptance date.
 2. Follow test methods outlined in NFPA 72.
- D. Submit FACP program at least two weeks prior to final acceptance test.
- E. Submit final drawings, calculations, and manufacturer's data at least one week prior to final acceptance test.
- F. Coordinate date of final acceptance test with installer, LANL Project Leader, LANL Fire Protection Group representative, and subcontractors for HVAC, sprinklers, and elevator controls. Make corrective actions before final acceptance test date.

3.8 FINAL ACCEPTANCE TEST

- A. Notify LANL STR at a minimum of 2 weeks in advance of final acceptance tests. The more advance notice will help minimize scheduling conflicts and delays. Perform final acceptance

tests in the presence of authorized representatives of LANL's STR, Fire Protection Division, and Facility Operations Director (FOD).

- B. Before the final acceptance test begins, present a preliminary copy of the Record of Completion to the authorized representative of the LANL Fire Protection Group.
 - 1. Preliminary Record of Completion shall be of the form required by NFPA 72.
 - 2. Indicate on the preliminary Record of Completion that the pre-final inspections and tests have been performed and all corrective actions have been completed.
 - 3. The final acceptance test shall not proceed before the Record of Completion is presented to the authorized representative of the LANL Fire Protection Group.
- C. Perform final acceptance tests on the completed fire alarm system:
 - 1. Follow the approved test plan and comply with NFPA 72 requirements.
 - 2. Test FACP and the connected initiating, alarm, and auxiliary devices.
 - 3. Perform 24-hour discharge test on the FACP batteries.
 - 4. LANL Fire Protection will perform tests on connections made by other LANL groups.
 - 5. LANL Telecommunications Group will perform the acceptance test of the telephone lines from the modular plug connectors, to verify telephone line continuity and switch features before turning lines over to the LANL Fire Protection Group.
- D. At the final acceptance test, have marked-up shop drawings and point-to-point wiring diagrams available for review and verification. Final acceptance test will not proceed without these as-built documents. If LANL verification of the as-built documents reveals errors, re-verify the complete fire alarm raceway and wiring system in the presence of a LANL Fire Protection Group representative.
- E. Correct deficiencies discovered in the final acceptance test and re-test fire alarm system until satisfactory test results are obtained.
- F. Upon successful completion of acceptance tests, submit final "Record of Completion" and "Inspection and Testing Form" and "recommended spare parts" list per Para 1.4.A.

3.9 SYSTEM IDENTIFICATION PLACARD

- A. Furnish and install a permanently mounted placard in or adjacent to the fire alarm control cabinet.
- B. Provide the following information typewritten or engraved on the placard:
 - 1. Name, address and telephone number of installing subcontractor.
 - 2. Reference to the standards, including date of issue to which the system conforms (e.g. NFPA 72 and NFPA 70, latest edition).
 - 3. Circuit number of power supply to FACP and location of the electrical panelboard.

4. Location of fire alarm system Operating and Maintenance Instructions if they are not stored in the FACP cabinet.
5. Location of fire alarm system as-built documents.

END OF SECTION

SECTION 31 10 00 SITE CLEARING

1.0 GENERAL

1.01 SUMMARY

- A. This Section requires the selective removal and subsequent off-site disposal of the following:
 - 1. Removal and offsite disposal of grass and root mat.
 - 2. Demolition of asphalt concrete and pavements as indicated on the drawings to straight, neatly saw cut surface.
 - 3. All other removals which may or may not been shown on plans as required for the project construction.

1.02 SITE CONDITIONS

- A. Protections: Contractor shall provide temporary barricades and other forms of protection to protect general public from injury due to demolition work.
- B. Traffic: Conduct demolition operations and debris removal to ensure minimum interference with roads, streets, walks, bike paths, and other adjacent occupied or used facilities. Access must be coordinated with City's Representative.
- C. Utility Services: Maintain all existing utilities to remain in service and protect them against damage during demolition operations.
- D. Environmental Controls: Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing regulations and County Air Pollution Control District pertaining to environmental protection. Do not use water when it may create hazardous or objectionable conditions such as flooding and pollution.

1.03 REFERENCES

- A. Standard Specifications for Public Works Construction (Green Book), latest edition.

2.0 PRODUCTS (NOT APPLICABLE)

3.0 EXECUTION

3.01 DEMOLITION

- A. General: Perform demolition work in a systematic manner. Use such methods as required to complete work indicated on drawings in accordance with governing regulations.

- B. Provide services for effective air and water pollution controls as required by County Air Pollution Control District regulations.
- C. Prior to commencing grading operations, soil containing debris, organics, pavement, or other unsuitable materials, shall be stripped from the foundation and pavement areas. Demolition areas shall be cleared of old foundations, slabs, abandoned utilities, tree roots, and soil disturbed during the demolition process. Depressions or disturbed areas left from the removal of such material shall be replaced with compacted fill under observation by the Geotechnical representative.

3.02 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove from Project site debris, rubbish, and other materials resulting from demolition operations. Transport and legally dispose of off site.
- B. If hazardous materials are encountered during demolition operations, contact City's Representative.
- C. Burning of removed materials is not permitted on project site.

3.03 HAZARDOUS MATERIALS

- A. Except as otherwise specified, in the event Contractor encounters on the Project site material reasonably believed to be asbestos, polychlorinated biphenyl (PCB), or other hazardous materials which have not been rendered harmless, Contractor shall immediately stop Work in the area affected and report the condition to the City's Representative in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the Contractor if in fact the material is asbestos, PCB, or other hazardous materials and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of asbestos, PCB, or other hazardous materials, or when such materials have been rendered harmless.
- B. Construction involving asbestos cement (transite) pipe shall be performed by qualified personnel in accordance with the standards and specifications set forth by American Water Works Association (AWWA), the Occupational Safety and Health Act (OSHA) and the Environmental Protection Agency (EPA), as well as location jurisdictional codes.

3.04 CLEANUP AND REPAIR

- A. General: Upon completion of demolition work, remove tools, equipment and demolished materials from site.
 - 1. Repair demolition performed in excess of that required. Return elements of construction and surfaces to existing condition prior to start of operations. Repair adjacent construction or surfaces soiled or damaged by demolition work.

END OF SECTION

**SECTION 31 20 00
EARTHWORK**

1.00 GENERAL

1.01 SUMMARY

- A. Section includes: Excavation, Compaction and Fill.

1.02 REFERENCE

- A. Standard Specifications for Public Works Construction (SSPWC), latest edition.
- B. Geotechnical Investigation, Sgt. John Pinney Memorial Pool Replacement Project, dated November 7, 2023, File No. 23-19224, prepared by Soils Engineering, Inc. and shall be superseded by the most current version.

1.03 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork in compliance with applicable requirements of governing authorities having jurisdiction.
 - 1. Standard Specifications for Public Works Construction (SSPWC), latest edition.
 - 2. CAL/OSHA Construction Safety Order Requirements.
- B. Soil Testing Service
 - 1. The City will engage a soil testing service to include testing soil materials proposed for use in the Work and for quality control testing during grading operations.
 - 2. Samples of materials shall be furnished to the testing service by the Contractor at least one week before their anticipated use.
 - 3. Work for this Section includes smoothing out areas for density tests and otherwise facilitate testing work, as directed.
 - 4. Shoring Systems: Pre-engineered systems, clearly labeled as such, may be used. Refer to the Geotechnical Study for further requirements.

1.04 PROJECT CONDITIONS

- A. The Contractor shall visit the site and familiarize himself with existing site conditions.
- B. Additional test borings and other exploratory operations may be made by the Contractor at no cost or liability to the City.
- C. Existing Utilities:

1. Where uncharted or incorrectly charted piping or other utilities are encountered during excavation, consult City's Representative immediately for directions. Cooperate with the City's Representative in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of the City's Representative at no cost to the City. Disturbed trench sections shall be replaced in kind.
 2. Contractor to coordinate with the City's Representative to obtain all required permits and schedule inspections.
- D. Protection of Subgrade: Do not allow equipment to pump, rut, or disturb subgrade, stripped areas, or other areas prepared for Project.
- E. Contractor shall implement measures to prevent soil erosion, and where possible, sediment shall be retained onsite.
- F. Contractor shall implement all necessary recommendations contained in the Geotechnical Study.

2.00 PRODUCTS (Not Applicable)

3.00 EXECUTION

3.01 SITE PREPARATION

- A. General:
1. Remove vegetation, improvements, or obstructions interfering with installation of new construction. Transport and legally dispose of off site. Removal includes stumps and roots. Contractor shall utilize the best construction method to minimize the erosive effect from the removal of site vegetation.
 2. Carefully and cleanly cut roots and branches of trees indicated to be left standing, where such roots and branches obstruct new construction. Paint cuts over one inch in size with tree pruning compound. Care shall be taken so as not to scar any area of the tree's bark.
 3. In order to protect from sediment transfer or contamination from urban run-off during construction, the following grading and erosion control practices shall be followed:
 - a. If grading occurs during the rainy season (November through April), sediment traps, barriers, covers or other methods shall be used to reduce erosion and sedimentation.
 - b. Excavated materials shall not be deposited or stored where the material can be washed away by high water or storm run-off.

- c. Grading operations on site shall be conducted so as to prevent damaging effects of sediment production and dust on the site and on adjoining properties.
- d. When vegetation has to be removed on site, the methods shall be one that minimizes the erosive effects from the removal.
- e. Exposure of soil to erosion by removing vegetation shall be limited to the area required for construction operations. The construction area shall be fenced to define the project.
- f. Temporary mulching, seeding, or other suitable stabilization shall be used to protect areas during construction or other land disturbance activities on site.
- g. Topsoil, removed from the surface in preparation for grading and construction activities on Campus is to be stored on or near the site and protected from erosion while grading operations are underway, provided that such storage may not be located where it would cause suffocation of root systems of trees to be preserved. After completion of such grading, topsoil is to be restored to exposed cut and fill embankments of building pads so as to provide a suitable base of seeding and planting.
- h. Sediment basins, sediment traps, or similar control measures shall be installed before extensive clearing and grading operations begin for site development.
- i. Water or dust palliatives shall be applied to exposed earth services as necessary to control dust emissions.
- j. Revegetation or stabilization of exposed earth surfaces shall take place as soon as possible.

B. Removals

- 1. Clear the site of trees, shrubs, and other vegetation, which is indicated to be removed.
- 2. Completely remove stumps, roots, and other debris to avoid problems with future utilities.
- 3. Use only hand methods for grubbing inside the drip line of trees indicated to be left standing.
- 4. Existing fills, soil containing debris, organics, pavement, or other unsuitable materials shall be excavated and removed prior to commencing grading operations. Demolition areas shall be cleared of old foundations, slabs, abandoned utilities, landscaping, and soils disturbed during the demolition process. Depressions or disturbed areas left from the removal of such material shall be replaced with compacted fill.

5. The limits and depths for removal of existing fill materials shall be evaluated by project soils engineer during grading.
6. Revegetation or stabilization of exposed earth surface shall take place as soon as possible.

C. Removal of Improvements

1. Remove above-grade and below-grade improvements necessary to permit construction and other work as indicated.
2. Remove from site and legally dispose of off-site, existing fill materials, soil debris, or other unsuitable materials prior to commencing grading operations.

3.02 EXCAVATION

- A. Excavation for Pavements: Cut surface under pavements to comply with cross-sections, elevations and grades as shown, within a tolerance of plus or minus 0.04 foot.
- B. Excavation for Planting Areas: Conform to cross-sections, elevations and dimensions shown, within a tolerance of plus or minus 0.10 foot.

3.03 COMPACTION

- A. General: Control soil compaction during construction providing minimum percentage of density specified for each area, under the provisions of the Geotechnical Study.
- B. Percentage of Maximum Density Requirements: Compact soil to not less than the percentages of maximum dry density specified in the Geotechnical Study and in accordance with ASTM D1557-91 method of compaction.
- C. Moisture Control:
 1. When moisture content of exposed scarified soil and/or fill material is below that sufficient to achieve recommended compaction, water shall be added to the soil and/or fill. While water is being added, soil shall be bladed and mixed to provide relatively uniform moisture content throughout the material.
 2. When moisture content of exposed scarified soil and/or fill material is excessive, material shall be aerated by blading or other methods. Fill placed in pavement areas shall be compacted at near optimum moisture content. Jetting is not permitted for compaction.

3.04 FILL

- A. In all excavations, use satisfactory excavated or borrow material sampled and tested by the City's Testing Laboratory. Fill selection shall be per Geotechnical Study.
- B. Fill excavations as promptly as Work permits, but not until completion of the following:

1. Acceptance by City's Representative of construction below finish grade including, where applicable, waterproofing, damp-proofing, and drainage pipe.
 2. Examination, testing, approval and recording locations of underground utilities.
 3. Removal of concrete formwork.
 4. Removal of shoring and bracing and backfilling of voids with satisfactory materials.
 5. Removal of trash and debris.
 6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
 7. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.
- C. Continual dust control, as required by the City, and in accordance with County Air Pollution Control District's Standards shall be required for the project construction.

3.05 GRADING

- A. General: To provide support for building floor slabs, all existing fill and unsuitable natural soils shall be excavated and replaced as properly compacted fill.
- B. Compaction: After grading, compact subgrade surfaces to the depth and percentage of compaction for each area classification.
- C. Fill placement and grading operations shall be performed only under the observation of the City's Testing Laboratory.
- D. The exterior grades around building areas shall be sloped to drain away from the buildings to prevent ponding of water adjacent to foundations.
- E. Grading operation shall be conducted so as to prevent damaging effects of sediment product and dust on the site and adjoining properties.

3.06 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. Transport excess excavated material and legally dispose of off site.

3.07 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction: City's Testing Laboratory will observe, test and approve subgrades and fill layers before further construction Work can be performed. The City's Representative will determine the frequency of tests. Subgrade: Allow at least one field density test of subgrade to be made for every 2000 sq. ft. of paved area, but in no case less than 3 tests.

- B. Field examination and testing will be performed by the City's Testing Laboratory. The Contractor shall cooperate with such testing and shall give the City's Representative advance notice of grading scheduling.
- C. Frequency of Tests for Trenching: As specified in Geotechnical Study Section 8 and as determined by the City's Representative.
- D. If in the opinion of the City's Representative, based on soil testing reports and observations, subgrades or fills which have been placed are below specified density, provide corrective work as specified at no additional expense to the City, and pay for retesting of the soil.

3.08 PROTECTION

- A. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, compact to required density and provide other corrective work as specified, with retesting, prior to further construction.

END OF SECTION

**SECTION 31 23 33
TRENCHING AND BACKFILLING**

1.00 GENERAL

1.01 SUMMARY

- A. Excavating trenches for construction of utilities.
- B. Trench backfill materials.
- C. Backfilling and compacting requirements.

1.02 REFERENCES

- A. Standard Specifications for Public Works Construction (SSPWC), latest edition.
- B. Geotechnical Investigation, Sgt. John Pinney Memorial Pool Replacement Project, dated November 7, 2023, File No. 23-19224, prepared by Soils Engineering, Inc. and shall be superseded by the most current version.

1.03 SUBMITTALS

- A. Materials source.
- B. Sand equivalent test reports per ASTM D2419.
- C. Certificates.
- D. Drawings for shoring, bracing, sloping, or other provisions for worker protection for any excavation shall conform to the requirements of the CAL/OSHA Construction Safety Orders Requirements.

1.04 EXISTING UTILITIES

- A. Drawings show existing major underground utilities from reference drawings. Prior to excavation, the Contractor shall notify the City's Representative to obtain any additional information which may be applicable to the Work.
- B. Any incident of a utility being inadvertently damaged by the Contractor shall be immediately shutoff and then be immediately repaired by the Contractor at no cost to the City.
- C. Contractor to pothole all utility connections and verify exact size, location and material prior to beginning construction and notify engineer of any discrepancies.

2.00 MATERIALS

2.01 APPROVALS

- A. Imported material shall be approved by the City's Representative prior to being brought to the site. Provide a sample of the material in sufficient quantity for the City's

Representative's use in evaluating the material.

2.02 TRENCH BACKFILL MATERIAL

- A. Sand bedding shall have a sand equivalent (SE) of 30 or greater. The SE shall be evaluated during grading. Materials shall conform to the specification of the Geotechnical Study.
- B. Backfill material shall conform to the requirements of Section 217-2 of the SSPWC.
- C. Aggregate base course shall be per Plan.
- D. Topsoil removed from trenches shall be stockpiled at locations approved by the City's Representative.

2.03 SOURCE QUALITY CONTROL

- A. Inspection and testing shall be performed by the City's Representative.

3.00 EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum.

3.02 TRENCH EXCAVATION

- A. All saw cutting shall be neat, straight cuts and shall conform to Section 306-3 of the SSPWC. All cuts shall be square unless otherwise specifically noted on plans.
- B. Trench excavation shall conform to Section 306-3 of the SSPWC and the following requirements:
 - 1. The bottom of the trench shall be graded and prepared to provide a firm and uniform bearing throughout the entire length of the pipe barrel. Suitable excavations shall be made to receive the bell of the pipe and the joint shall not bear upon the bottom of the trench. All adjustments to line and grade shall be made by scraping away or filling in with sand under the body of the pipe and not by wedging or blocking.
 - 2. If the trench is excavated below the required grade, correct any part of the trench excavated below the grade, at no additional cost to the City per the Geotechnical Study. Place the backfill material over the full width of trench in compacted layers not exceeding 6 inches deep to the established grade with allowance for the pipe base. If shoring is required, the trenches shall be shored and braced in accordance with the Trench Construction Safety Orders of the Division of Industrial Safety.
 - 3. When subgrade is encountered that in the opinion of the City's Representative is unsuitable for pipe support, the City's Representative may order the excavation to be carried to an approved depth below the bottom of the pipe and backfilled with sand, to the lines and grades shown on the drawings and specified by the City's Representative.

4. The minimum width of the trench at the top of the pipe zone shall be as necessary to install the pipe. The utility lines shall be centered in the trench. In the event of (1) actual physical interference between existing crossing subsurface utilities and the proposed utility lines and (2) vertical discrepancy in connecting proposed utility lines to existing utility system, a minimum clearance of 0.5 feet between the utility line and the crossing, interfering utility shall be provided, unless otherwise indicated on the plans.
5. Where existing utilities or tree roots are to be protected, trench excavation shall be by hand. No mechanical excavating equipment shall be used within 6 inches of any utility or root.
6. Trenching machinery may be used for excavations provided the specified trench width can be maintained.

3.03 TRENCH BACKFILL

- A. Pipe bedding and trench backfill materials: pipe bedding shall be either crushed rock or sand as specified on the plans. Sand bedding and backfill for utilities shall consist of material having a sand equivalent of at least 30. The backfill material shall be placed within the pipe zone that extends from the bottom of the pipe to at least 12 inches above the top of the pipe for the full width of the trench. The horizontal distance between the spring line of the pipe and the side walls of the trench shall be such that bedding material can be properly placed and compacted below the haunches of the pipe. Pipe bedding and pipe zone backfill shall be compacted to at least 95 percent relative compaction. Backfill material placement shall conform to provisions of Geotechnical Study.
- B. Trench backfill placed above the pipe zone shall consist of suitable onsite or imported soil per Geotechnical Study. Mechanical compaction of trench backfill shall be performed and water consolidation (jetting) methods of compaction shall not be permitted. Trench backfill in landscape areas shall be compacted to a minimum of 90 percent relative compaction or per landscape specifications.
- C. Trench Backfilling shall conform to the requirements of Sections 306-12 of the SSPWC and Geotechnical Study:
 1. During the process of laying pipe in trenches, sufficient material shall be carefully placed and hand tamped about the pipe to hold it firmly to established line and grade. Oversized material, broken rock or shale, if encountered, shall not be used for backfill.
 2. No motor driven mechanical compacting equipment shall be used over pipelines until the backfill has been compacted to 12 inches over the crown of the pipe.
 3. All backfill material shall be deposited in horizontal layers not exceeding the thickness specified in Section 306-12 of the SSPWC and not exceeding 8 inches in thickness. The distribution of materials shall be such that all material following compaction and consolidation will form a homogeneous mass free of voids, pockets, streaks or other imperfections. Backfilling shall be done with earth free from lumps, hardpan, chunks, paving material, organic matter or other deleterious substances.

4. Jetting of bedding or backfill material to obtain specific moisture content or for compaction shall not be permitted. If encountered, existing fill in the utility excavation shall be excavated and recompactd or removed and replaced with new fill materials per requirements of Section 2.02.
5. Compaction of all backfill material for trenches, pavements or structures, shall be per provisions of the Geotechnical Study. Appropriate warning detector tape shall be placed over all utilities.
6. Prior to final cleanup or resurfacing, the City's Representative shall take compaction tests in any backfill area and at any depth, with the Contractor providing equipment and operator to assist in such test. If any such compaction test fails, the Contractor shall correct such failure and pay for any retesting that is required. The City's Representative shall make as many tests as he feels is required to receive a satisfactory and acceptable job.

3.04 STOCKPILING

- A. Stockpiling of imported materials or excavated materials shall direct surface water away from approved stockpile site to prevent erosion.
- B. After stockpiles are removed, leave area in a clean and neat condition.

3.05 FIELD QUALITY CONTROL

- A. Inspection and testing shall be performed by City's Representative.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

1.00 GENERAL

1.01 SUMMARY

- A. Aggregate base course for curbs, gutters, sidewalks, and fire access driveway.

1.02 RELATED SECTIONS

- A. Section 02 31 90 Base Course.
- B. Section 31 20 00 Earthwork.
- C. Section 32 12 16 Asphalt Concrete Paving.
- D. Section 32 16 00 Curbs, Gutters, Sidewalks, and Driveways.

1.03 REFERENCES

- A. Standard Specifications for Public Works (SSPWC), latest edition.
- B. ASTM Standards.
- C. State Standard Specifications (SSS), Caltrans, latest edition.
- D. Geotechnical Investigation, Sgt. John Pinney Memorial Pool Replacement Project, dated November 7, 2023, File No. 23-19224, prepared by Soils Engineering, Inc. and shall be superseded by the most current version.

1.04 SUBMITTALS:

- A. Submit material samples and reports in accordance with requirements of District.
- B. Submit samples in sufficient quantities for material testing.

2.00 PRODUCTS

2.01 MATERIALS

- A. Aggregate Base Material shall be Class 2 Aggregate Base conforming to SSS Section 26-1.02B. Aggregate Base shall have a minimum sand equivalence of 22 and a minimum R-value of 78 and shall be free of organic materials and other deleterious substances.
- B. Aggregate Base materials used within building areas shall be free of asphaltic materials.

3.00 EXECUTION

3.01 EXAMINATION

- A. Verify substrate has been inspected; gradients and elevations are correct, and dry.

3.02 AGGREGATE BASE PLACEMENT

- A. Aggregate base placement shall conform to the provisions of the SSPWC, Section 301-2.
- B. Level and contour surfaces to elevations and gradients indicated.
- C. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- D. Where the required aggregate base thickness is 6 inches or less, the watered base may be spread and compacted in one layer. Where the required thickness is more than 6 inches, the aggregate base material shall be spread and compacted in 2 or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.
- E. Aggregate base course shall be dense and unyielding upon proof-rolling with full water truck.

3.03 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch.
- B. Scheduled Compacted Thickness shall conform to the provisions of the SSPWC Section 301-2.2.

3.04 FIELD QUALITY CONTROL

- A. Inspection and testing shall be performed by the City's Testing Laboratory. Compaction testing will be performed in accordance with ASTM D1557, latest edition.
- B. If tests indicate work does not meet specified requirements, remove work, replace and retest at Contractor's expense.

END OF SECTION

SECTION 32 12 16
ASPHALT CONCRETE PAVING

1.00 GENERAL

1.01 SUMMARY

- A. Asphaltic concrete paving for parking lots and driveway pavements.

1.02 RELATED SECTIONS

- A. Section 31 20 00 Earthwork.
- B. Section 32 11 23 Aggregate Base Course.

1.03 REFERENCES

- A. Standard Specifications for Public Works Construction (SSPWC), latest edition.
- B. ASTM Standards.
- C. Geotechnical Investigation, Sgt. John Pinney Memorial Pool Replacement Project, dated November 7, 2023, File No. 23-19224, prepared by Soils Engineering, Inc. and shall be superseded by the most current version.
- D. State Standard Specifications (SSS), Caltrans, latest edition.

1.04 SUBMITTALS

- A. Submit asphalt concrete mix design(s) for approval of the City Representative.

1.05 TESTING AND INSPECTION

- A. Testing and inspection of asphalt pavement mix(es) and testing of placed stabilizing base course and asphalt pavement will be performed by the City's Testing Laboratory. Testing and inspection will be performed so as to minimize disruption of work.
- B. Allow the City's Testing Laboratory access to the mixing plant for verification of weights or proportions, character of materials used and determination of temperatures used in the preparation of asphaltic concrete mix.

2.00 PRODUCTS

2.01 GENERAL

- A. Provide the aggregate base, and bituminous surface conforming to the requirements of the Standard Specifications for Public Works Construction (SSPWC).

2.02 PAVING MATERIALS

- A. Asphalt Concrete: Asphalt concrete material shall be $\frac{3}{4}$ " HMA PG 70-10 per Caltrans Standard Specifications. The grading and proportioning of aggregates shall be such that the combined mineral aggregate conforms to the specified requirements.
- B. Asphalt Emulsion (Tack Coat): SSPWC Section 203-3, Grade SS-1h.
- A. Aggregates for base course shall be Class 2 Aggregate Base conforming to SSS Section 26-1.02B. Aggregate Base shall have a minimum sand equivalence of 22 and a minimum R-value of 78 and shall be free of organic materials and other deleterious substances.

2.03 ASPHALT PAVEMENT MIX

- A. Combine mineral constituents in proportions to produce a mixture conforming to requirements of the SSS Section 39-2.02.
- B. Percentage by weight of asphalt cement in mixture shall be in accordance with SSS Section 39-2.02.
- C. Maintain thorough and uniform mixture.
- D. Bring asphalt and mineral constituents to required temperatures before mixing. Ensure aggregates are sufficiently dry so as not to cause foaming in mixture.

3.00 EXECUTION

3.01 GENERAL

- A. Execute Work in accordance with SSPWC Section 302 and the Geotechnical Study.

3.02 PREPARATION

- A. Ensure grading of subgrade to required elevation. Subgrade preparation shall be per SSPWC Section 301.
- B. Before final rolling, shape entire section, add additional sub-soil if necessary, and compact subgrade to provide grades, elevation and cross-section indicated. Points of finished subgrade surface shall be within 0.04 foot of elevations indicated on the Drawings.

3.03 BASE COURSE

- A. Place aggregate base in accordance with requirements of SSPWC Section 301 and to the thickness shown on the Drawings. Grade and compact in 6-inch layers to at least 95 percent of compaction (ASTM D1557).

3.04 MAINTENANCE

- A. Maintain the base course until the asphaltic pavement is in place. Maintenance shall include drainage, rolling, shaping and water as necessary to maintain the course in proper condition. Maintain sufficient moisture at the surface to prevent a dusty

condition. Areas of completed base course that are damaged shall be conditioned, reshaped and re-compacted in accordance with the requirements of the Specifications without additional cost to the City.

3.05 TACK COAT

- A. Prior to the application of the asphalt concrete, a paint binder (tack coat) shall be applied to all surfaces of walkway, curbs, gutters, manholes and drainage structures which will be in contact with asphalt pavement per SSPWC Section 302-5.8.
- B. Coat surfaces of catch basins which are to remain free of asphalt with oil, or provide equivalent protection, to prevent asphalt adhesion.

3.06 ASPHALT CONCRETE

- A. Requirements: The bituminous concrete shall consist of mineral aggregate, uniformly mixed with bituminous material in a central plant in accordance with SSPWC Section 203-6. The percentage of asphalt binder shall be in accordance with SSPWC Section 203-6. The mixing plant and construction equipment shall conform to the requirements of SSPWC Sections 203-6 and 302-5.
- B. Placing: Deliver bituminous mixtures to the work site temperatures specified in SSPWC Section 302-5.9. Spread and place in accordance with SSPC Section 302-5.9. Asphalt surface shall be fog-sealed.
- C. Compaction: Initial or breakdown rolling and the final rolling of the uppermost layer of the asphalt concrete shall be in accordance with SSPWC Section 302-5.10. Compaction shall be per SSPWC Section 302-5.11. Compaction by vehicular traffic shall not be permitted.

3.07 JOINING PAVEMENT

- A. Carefully make joints between old and new pavements or between successive days work in such manner as to insure a continuous bond between old and new sections of the course in accordance with SSPWC Section 302.
- B. Expose and clean edges of existing pavement. Cut edge to straight, vertical surfaces. Paint all joints with a uniform coat of tack coat before the fresh mixture is placed. Prepare joints in the new pavement in accordance with SSPWC Section 302-5.9.2.

3.08 JOINING NON-PAVED AREAS

- A. Where paving will join landscape or other non-hardscape area a redwood header shall be installed in accordance with SSPWC Section 302-5.5.

3.09 TOLERANCES

- A. Flatness: Maximum variation of 1/8 inch when measured with a 10-foot straight edge.
- B. Variation from True Elevation: Within 1/4 inch.

3.10 FIELD QUALITY CONTROL

- A. Inspection and testing shall be performed by the City's Testing Laboratory.
- B. Field inspection and testing will be performed by the City's Testing Laboratory. The Contractor shall cooperate with such testing and shall give the City Representative advance notice of paving scheduling. Sufficient "Advance Notice" shall be determined by the City Representative.
- C. If tests indicate materials do not meet specified requirement, replace material and retest at no additional cost to the City.
- D. Frequency of Test: As determined by the City's Testing Laboratory.

3.11 PROTECTION

- A. After placement, protect pavement from mechanical injury.

END OF SECTION

SECTION 32 16 00
CURBS, GUTTERS, SIDEWALKS

1.00 GENERAL

1.01 SUMMARY

- A. Concrete for curbs, gutters, sidewalks.

1.02 RELATED SECTIONS

- A. Section 31 20 00 – Earthwork

1.03 REFERENCES

- A. Standard Specifications for Public Works Construction (SSPWC), latest edition.
- B. Geotechnical Investigation, Sgt. John Pinney Memorial Pool Replacement Project, dated November 7, 2023, File No. 23-19224, prepared by Soils Engineering, Inc. and shall be superseded by the most current version.
- C. ASTM Standards.

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Product Data: Provide data on admixtures and curing compounds.
 - 2. Concrete mix design(s).
 - 3. Certificates from the batch plant.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with the SSPWC, latest edition; and ASTM Standards, latest edition.
- B. Obtain cementitious materials from same source throughout.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not place concrete when base surface temperature is less than 40 degrees F or surface is wet.

2.00 PRODUCTS

2.01 FORM MATERIALS

- A. Form Materials: Section 303-5 of the SSPWC.

2.02 CONCRETE MATERIALS

A. Concrete Material for Curbs and Walks (Path of Travel):

1. Class 520-C-2500. Portland cement concrete per Standard Specifications for Public Works Construction Section 201-1.
2. Concrete reinforcements shall be constructed per the Project Plans and Specifications.

B. Concrete Material for Traffic Loaded Concrete:

1. Class 650-CW-4000. Portland cement concrete per Standard Specifications for Public Works Construction Section 201-1.
2. Concrete reinforcements shall be constructed per the Project Plans and Specifications.

2.03 ACCESSORIES

- ### A.
- Curing Compound shall conform to SSPWC Section 201-4. Pigmented compound shall not demonstrate any residual coloring of the concrete after one week.

2.04 CONCRETE MIX

- ### A.
- Mix and deliver concrete in accordance with ASTM C94.
- ### B.
- Use accelerating admixtures in cold weather only when approved by the City's Representative. Use of admixtures will not relax cold weather placement requirements.
- ### C.
- Use calcium chloride only when approved by the City's Representative.
- ### D.
- Use set retarding admixtures during hot weather only when approved by the City's Representative.

2.05 CONCRETE REINFORCEMENT

- ### A.
- Concrete reinforcement shall conform to SSPWC Section 201-2.

2.06 SOURCE QUALITY CONTROL

- ### A.
- Provide certificates of compliance from the batch plant.

3.00 EXECUTION

3.01 EXAMINATION

- ### A.
- Verify compacted subgrade is acceptable and ready to support imposed loads.
- ### B.
- Verify gradients and elevations of subgrade are correct.

3.02 PREPARATION

- A. Moisten subgrade to minimize absorption of water from fresh concrete. Over-excavate subgrade to a depth of 12" below existing or finish grade whichever is deeper. Place engineered fill in lifts, compacted to 90% relative compaction with upper 1 foot compacted to 95% relative compaction in parking and drive areas. Refer to geotechnical report for site subgrade preparation recommendations.
- B. Coat surfaces of catch basin frames with oil to prevent bond with concrete pavement.
- C. Notify City's Representative a minimum of 24 hours prior to commencement of concrete placement operations.

3.03 FORMING

- A. Place and secure forms to correct location, dimension, and profile.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.04 PLACING CONCRETE

- A. Place concrete in accordance with SSPWC Section 303-5.
- B. Install ½" thick fiberboard expansion joint and snap cap. Seal with Sikaflex self-leveling sealant after removal of snap cap (typical).
- C. Construct weakened plane joints conforming to SSPWC Section 303-5.4.3, 1 ¼" inch deep, at intervals not exceeding 12 feet.
- D. The top edges of curbs shall have 0.5" radius.

3.05 FINISHING

- A. Concrete finishes shall be per SSPWC Section 303-5.5.
- B. Portland cement concrete paving in all accessible routes of travel shall have slip resistant finish.
- C. Walkway grades shall conform with the requirements of Section 11B-403.3 of the latest edition of the California Building Code.
- D. Walkways with grades in the direction of travel that are steeper than 5% shall conform with requirements of Section 11B-405 of the latest edition of the California Building Code.
- E. Place curing compound in accordance with SSPWC Section 303-5.6 on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.06 FIELD QUALITY CONTROL

- A. Inspection and testing shall be performed by the City's Testing Laboratory.
- B. City's Testing Laboratory will perform slump and compressive strength tests.
- C. Contractor shall maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.07 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, vandalism and mechanical injury.
- B. It is the Contractor's responsibility to replace all concrete work subject to vandalism and graffiti at no extra cost to the City.

END OF SECTION

SECTION 32 31 19
ORNAMENTAL FENCES AND GATES

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. The contractor shall provide all labor, materials and appurtenances necessary for installation of the welded ornamental steel fence system defined herein at Field Elementary School.

1.02 RELATED WORK

- A. Section 31 20 00 – Earthwork
- B. Section 03 30 00 – Cast-in-Place Concrete

1.03 SYSTEM DESCRIPTION

- A. Based on Montage II® **Welded and Rackable** (ATF – All Terrain Flexibility) Ornamental Steel Classic design by Ameristar. The system shall include all components, panels, posts, gates and hardware, required.

1.04 QUALITY ASSURANCE

- A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.05 REFERENCES

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
- C. ASTM D523 - Test Method for Specular Gloss.
- D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
- E. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- G. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- J. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.06 SUBMITTAL

- A. The manufacturer's literature shall be submitted prior to installation.

1.07 PRODUCT HANDLING AND STORAGE

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.08 PRODUCT WARRANTY

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. The fence system shall conform to Montage II® **Welded and Rackable** (ATF – All Terrain Flexibility) Ornamental Steel, Classic design, extended picket bottom rail treatment, 3-Rail style manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma.

2.02 MATERIAL

- A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft² (276 g/m²), Coating Designation G-90.
- B. Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.75" x 1.75" x .105". Picket holes in the rail shall be spaced 4.715" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.
- C. Material Specifications:

Table 1 – Minimum Sizes for Montage II Posts			
Fence Posts	Panel Height		
2-1/2" x 12 Ga.	Up to & Including 6' Height		
3" x 12 Ga.	Over 6' Up to & Including 8' Height		
Gate Leaf	Gate Height		
	Up to & Including 4'	Over 4' Up to & Including 6'	Over 6' Up to & Including 8'
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4'1" to 6'	3" x 12Ga.	4" x 11 Ga.	4" x 11 Ga.
6'1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10'1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12'1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
14'1" to 16'	6" x 3/16"	6" x 3/16"	6" x 3/16"

Table 2 – Coating Performance Requirements		
<u>Quality Characteristics</u>	<u>ASTM Test Method</u>	<u>Performance Requirements</u>
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

Table 3 – Montage II – Post Spacing By Bracket Type										
Span	For INVINCIBLE® 8' Nominal (91-1/2" Rail)				For CLASSIC, GENESIS, & MAJESTIC 8' Nominal (92-5/8" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Flat Mount (BB301)*		Industrial Line 2-1/2" (BB319) 3" (BB320)		Industrial Universal 2.5" (BB302) 3" (BB303)		Industrial Flat Mount (BB301)		Industrial Swivel (BB304)*	
Post Settings ± 1/2" O.C.	94-1/2"	95"	94-1/2"	95"	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"
*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.										

2.03 FABRICATION

- A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).
- C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).
- D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.
- E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 12ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6'.

- F. Pedestrian swing gates shall be self-closing, having a gate leaf no larger than 48" width. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5" x 6" footprint). Hinge-closer set (2 qty) shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5" - 1.375") and vertical (0 - .5"). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.

PART 3 – EXECUTION

3.01 PREPARATION

- A. All new installation shall be laid out by the contractor in accordance with the construction plans.

3.02 FENCE INSTALLATION

- A. Fence post shall be spaced according to Table 3, plus or minus ½". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36" (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.03 FENCE INSTALLATION MAINTENANCE

- A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

3.04 GATE INSTALLATION

- A. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

3.05 CLEANING

- A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

END OF SECTION

**SECTION 32 80 00
LANDSCAPE IRRIGATION**

PART 1 — GENERAL

1.1 SCOPE

- A. Includes furnishing all labor, materials, tools, and equipment required to provide and install the irrigation system specified herein and required to complete the work per the Plans.
- B. Related work:
 - 1. Section 32 90 00 – Landscape Planting.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with all local and state codes, ordinances, safety orders, and regulations of all legally constituted authorities having jurisdiction over this work.
- B. Obtain and pay for all necessary permits and all inspections required by authorities stated above.
- C. Notify the Landscape Architect in the event any equipment or methods indicated on the Drawings or in the specifications conflict with local codes, prior to installation. In the event this notification is not performed, the Contractor must assume full responsibility for revisions necessary.

1.3 PROTECTION

- A. Contractor shall call *DIG ALERT*, ((1) (800) 642-2444), a minimum of 48 hours prior to any excavation.
- B. Contractor shall check for located existing structures, electric cables or conduits, utility lines and other existing features or conditions above or below ground level that might be damaged as a result of this operation. Questions or conflicts arising out of such examination prior to or during operation shall be immediately directed to the attention of the Landscape Architect for necessary action or decisions before resuming operations. Contractor shall be responsible for repair or replacement, at no cost to Owner, for features or condition damaged through failure to comply with above procedures.

1.4 REFERENCES

- A. ASTM B88 – Seamless Copper Water Tube.
- B. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. California Electric Code
- D. NEC (National Electric Code)
- E. IAMPMO (International Association of Plumbing and Mechanical Officials)

1.5 SYSTEM DESCRIPTION

- A. Electric solenoid controlled underground irrigation system.
- B. Source Power: 120 volt, 3 phase.

C. Low Voltage Controls: 24 volt.

1.6 SUBMITTALS

A. Record Drawings: Maintain information daily. Keep updated drawings onsite at all times for review by the Owner's Representative(s).

1. The Contractor shall maintain on a daily basis a complete and accurate set of record drawings. These drawings must be kept up-to-date at all times with the progress of the work. The Owner shall furnish a set of drawings on which to record changed conditions.
2. The Contractor shall indicate clearly all work installed differently from that shown on the contract drawings. By dimensioning from two permanent points of reference (building corner, sidewalk or road intersections), show connection to existing water lines, connection to existing electrical power, gate valves, pressure supply pipe, control valves, control wiring, automatic controller, quick coupler valves, sleeve locations, and other related equipment as directed by the Owner's representative.
3. Use appropriate eradication methods for removing original lines and dimensions where changes are made. Completed reproducibles shall be equal to the original drawings. Mark record set(s) with red erasable pencil.
4. Submit 14 days prior to final inspection, one set of marked-up Contract drawings.
5. After approval, the Contractor shall obtain one (1) set of the contract drawings from the Landscape Architect, and all changes as noted on the redlined set shall be drawn on the drawings with waterproof ink. The Contractor shall sign the drawings as complete and accurate records of as-built work. This set of drawings shall be delivered to the Landscape Architect for final approval, after which the Contractor shall make copies for the Owner, Landscape Architect, and other applicable parties.

B. Controller Charts

1. Record drawings shall be approved by the Landscape Architect before charts are prepared.
2. Provide one controller chart for each controller supplied.
3. The chart shall show each area controlled by automatic controller and shall be the maximum size controller door will allow.
4. The chart is to be a reduced drawing of the actual constructed system. However, in the event the controller sequence is not legible when the drawing is reduced, it shall be enlarged to a size that will be readable. This may involve providing more than one chart.
5. The chart will be a blackline print and a different color shall be used to show area of coverage for each station.
6. When completed and approved, the charts shall be hermetically sealed between two pieces of plastic, each piece being a minimum of 20 mils thick.
7. One chart shall be mounted using Velcro, or an approved equal type of tape in the controller enclosure. If the controller door is constructed with a pre-

manufactured pocket for the controller chart, the Velcro mounting may be omitted. The second chart shall be delivered to the Owner for their files and/or maintenance personnel.

8. These charts shall be completed and approved prior to final inspection of the irrigation system.

C. Irrigation Submittals

1. Manufacturers Catalogs: Submit for approval, manufacturer's catalogs on all material to be used on the project (digital). These catalogs are to be submitted 30 days prior to the start of any work.
2. Material List: Complete list of all materials to be used on the job before starting job.

D. Additional Submittals

1. For any submittals which necessitate additional research on the part of the Landscape Architect, to prove the product is acceptable, the Contractor will be charged on an hourly basis for this additional work.

E. Approvals and Rejections

1. Equipment or materials furnished or installed without prior approval of the Owner's representative may be rejected and the Contractor required to remove and replace such materials from the site at no cost to the Owner.

1.7 DRAWINGS

- A. For purposes of legibility, sprinkler lines are essentially diagrammatic. Although size and location of irrigation equipment are drawn to scale wherever possible, the Contractor shall make use of all data in all of the contract documents and verify this information at construction site.
- B. Interpretations: Drawings and specifications are intended to be fully cooperative and to agree. However, if the Contractor observes that the drawings and specifications are in conflict, he shall promptly notify the Landscape Architect in writing (prior to bidding and/or construction). The specification calling for any higher quality material or workmanship shall prevail. Questions regarding interpretation of drawings and specifications shall be clarified by the Landscape Architect.

1.8 PERFORMANCE REQUIREMENTS

- A. Unless otherwise provided, irrigation system layout shown on the plan shall be considered schematic. With the Landscape Architect's approval, the Contractor may make adjustments where necessary to conform to actual field conditions. The irrigation system shall be operational, with uniform and adequate coverage of areas to be irrigated, prior to planting.
 1. Utility connections shall be as shown on the plan or designated by the utility company. The Contractor shall include in his bid all costs for such utility connections shown on the plans or designated by the utility company.
- B. Water Supply
 1. The sources of water supply shall be as indicated on the drawings as P.O.C., "Point of Connection".

C. Contractor Responsibility

1. The Contractor shall ensure full coverage of the irrigation system and shall make all approved modifications necessary to accomplish full coverage.
2. Contractor shall not willfully install the plumbing or sprinkler system as indicated on the drawings when it is obvious in the field that there are obstructions, grade difference and/or discrepancies in area dimensions until such conditions are brought to the attention of the Landscape Architect.

1.9 PRE-CONSTRUCTION CONFERENCE

- A. The Contractor shall schedule with the Landscape Architect and Owner's Representative a pre-construction conference at least seven (7) days before beginning work under this section. Purpose of this conference will be:
1. Review Contractor's questions regarding this project.
 2. Review administrative and inspection procedures that will occur during construction.
 3. Review Contractor's work schedule for this project.
 4. Verification of Contractor's C-27 License, Bonding and Insurance.

PART 2 — PRODUCTS

2.1 GENERAL

- A. All irrigation equipment: shall be new and unused prior to installation; and shall conform to the Irrigation Plan, Legend and Specifications.
- B. Irrigation equipment, which has been damaged in any way, shall be replaced by the Contractor at no additional cost to the Owner. If equipment has already been installed, it shall be removed and replaced by the Contractor at no additional cost to Owner.

2.2 PLASTIC PIPE AND FITTINGS

A. Plastic Pipe

Shall be rigid, high impact, Type I, unplasticized polyvinyl chloride (PVC) extruded from virgin parent material Geon 8700A or Geon 8714. Contractor shall furnish for each shipment delivered, a statement from the manufacturer certifying use of virgin material only. The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign materials, blisters, deleterious wrinkles or dents and shall conform to the following dimensions and physical properties:

1. All plastic pipe shall be continuously and permanently marked with the manufacturer's name, kind of pipe, material size, IPS NFS approval, schedule and type, and date of extrusion.
2. Plastic pipe shall be as manufactured by Lasco, Celanese, Pacific Western, John Manville, Brownline, Inc. or approved equal.

B. Main Line

1. Piping on the pressure side of irrigation control valves to be PVC 1120-1220, Schedule 40 and shall conform to ASTM D1785-73.

2. Rubber gasket PVC pipe shall conform to ASTM D-1784 Type I, Grade I, 200 psi design stress. Standard dimensional ratio for pipe shall be SDR 21 Class 200. All pipe shall conform to commercial standard CSS-256-64 (pressure rated pipe) and National Sanitation Foundation ASTM 1869.
3. All UVR-PVC piping (above grade) shall be Sch.80.
4. All reclaimed water piping shall be purple-colored PVC Schedule 40, meeting ASTM-D1784, Type I, Grade I PVC-1120 Cell Class 12454-B specifications.

C. Lateral Lines

1. Piping under intermittent pressure shall be PVC 1120, Type 1, Grade 1, Sch.40 and shall conform to ASTM D1785.
2. All UVR-PVC piping (above grade) shall be PVC 1120, Type 1, Grade 1, Sch.40 and shall conform to ASTM D1785.
3. All reclaimed water piping shall be purple-colored PVC Schedule 40, meeting ASTM-D1784, Type I, Grade I PVC-1120 Cell Class 12454-B specifications.

D. Control Wire Conduit

1. Plastic pipe used as conduit for 24v. direct burial wire shall be PVC 1120-1220, Sch. 40 and shall conform to ASTM D1785 (use gray Sch.80 wherever conduit is exposed, and sweep ells at all corners, above and below grade).

F. Fittings and Connections

1. Plastic PVC slip fittings shall be standard weight Schedule 40 (2" and smaller) and Sch. 80 (2-1/2" and larger) to meet ASTM D2466-73 and D2467-73.
2. All threaded fittings and nipples shall be standard weight Schedule 80 with molded threads. All threaded nipples exposed above grade shall be gray in color.
3. All UVR-PVC fittings shall be PVC 1120, Type 1, Grade 1, Sch.40 manufactured in accordance with ASTM D-2246.

2.3 GALVANIZED PIPE AND FITTINGS

- A. Where indicated on the drawings, use galvanized steel pipe ASA Schedule 40 mild steel screwed pipe.
- B. Fittings shall be medium galvanized screwed beaded malleable iron. Galvanized couplings may be a merchant coupling.

2.4 WATER METERS

- A. Shall be installed by the general contractor at Owner's expense.

2.5 BACKFLOW PREVENTION

- A. The backflow prevention device shall be as designated on the drawings or as approved by local governing body. The device shall be equipped with gate valve shutoffs and test cocks.
- B. "Y" Strainer: When specified, shall be of bronze construction and shall be of the same manufacturer as that of the backflow prevention device.

- C. Pressure Gauge: When specified, shall be liquid filled, impact, weather & chemical resistant, and installed on downstream side of backflow prevention device. Gauge shall read from 0-160 psi.
- D. Insulated Cover: When specified, cover shall have waterproof canvas exterior with grommet(s) for padlock(s). Available from Worldwide Canvas Products, (800) 333-6721. Install lock and provide 2 keys to owner.
- E. Insulated Enclosure: Insulated enclosure shall be stainless steel (lockable), permanently mounted on a reinforced concrete pad. Available from Strong Box and/or LeMuer. Install lock and provide 2 keys to owner.

2.6 SLEEVE MATERIAL

- A. For control wires: PVC Schedule 40 (of sufficient diameter for ease of pulling, with minimum 50% expansion area).
- B. For water lines: PVC Schedule 40 (minimum 2 times line diameter).

2.7 AUTOMATIC CONTROLLERS

- A. Automatic controller shall be of the size and type shown on the plans.
 - 1. Unless otherwise noted on the plans, the 120 volt electrical power to the automatic controller location to be furnished by others. The final hookup shall be the responsibility of the Contractor. Plastic pipe used as conduit for 120v. electrical wire shall be grey PVC Sch.80 manufactured in accordance with NEMA, UL and WC specifications.
 - 2. The final hookup of any/all low-voltage control wires installed shall be the responsibility of the Landscape Contractor.
 - 3. Controller(s) shall be grounded per details and manufacturer's requirements. Minimum grounding requirements are as follows:

The Controller Assembly shall be provided with a 4" x 36" x 0.0625" Copper Ground Plate, and 10' of #6 ground wire for the purpose of providing grounding protection to the controller electrical components (one per controller). The #GP3-K Kit shall be used primarily on two wire decoder system path grounding along with the specific manufacturer's surge suppression device per each specific manufacturer's grounding requirements. Includes 1- 50 lb. bag of PowerFill™ or PowerSet® backfill material for ground plate installation.
 - 4. Automatic controller assembly shall be wall-mounted per plans and details.
- B. Remote control for automatic controller(s) shall be Irritrol ProMax. Provide/install transmitters, permanent receiver cards, antennas, and all cables and adapters necessary for clock. Program all access codes prior to turnover to Owner.

2.8 CONTROL WIRING

- A. Connections between the automatic controllers, sensors, and the electric control valves shall be made with direct burial wire AWG – U.F. No. 14-600 volt (No. 12-600v. where specified on plan). Install in accordance with valve manufacturer's specifications.
 - 1. Waterproof dry-splice connectors shall be 3M #DBY-054007-09053 or approved equal.

2. Common wires shall be white in color with a different color stripe for each controller.

2.9 TRACER WIRES

- A. No.12 Green Type TW plastic-coated copper tracer wire shall be installed with non-metallic mainlines.

2.10 ELECTRIC CONTROL VALVES

- A. All electric control valves shall be as noted on plans and installed per details and manufacturer's specifications. Locate all valves in shrub areas unless otherwise noted.
- B. Provide one valve box for each remote control valve.

2.11 SHUT-OFF VALVES

- A. Shut-off valves shall be as indicated on the drawings and installed per the details and manufacturers recommendations.

2.12 VALVE BOXES

- A. Quick Coupler Valves: NDS Pro-Spec #312 (10" round box). Locate 12" max. from walks/parallel walks, 3" above grade in shrub areas (top of box flush with top of bark). Use 10" diameter PVC pipe for extension. The cover shall be heat branded with letters QCV, 2" high.
- B. Control valves, Ball and Gate valves ($\leq 1\frac{1}{2}$ "): NDS Pro-Spec #322 (13"x24"x15"). Locate 12" max. from walks/parallel walks, 3" above grade in shrub areas (top of box flush with top of bark). Install 1" above grade in shrub areas without bark mulch. Install $\frac{1}{2}$ " above grade in turf areas (only where designated). Provide and install lock bolt at the end of the maintenance period. The cover shall be heat branded with the valve number, 2" high (for ball and gate valves brand "IRG").
- C. Control valves, Ball and Gate valves (≥ 2 "): NDS Pro-Spec #326 (17"x30"x18"). Locate 12" max. from walks/parallel walks, 3" above grade in shrub areas (top of box flush with top of bark). Install 1" above grade in shrub areas without bark mulch. Install $\frac{1}{2}$ " above grade in turf areas (only where designated). Provide and install lock bolt at the end of the maintenance period. The cover shall be heat branded with the valve number, 2" high (for ball and gate valves brand "IRG").
- D. Control Wire Splice Boxes, Flow Sensor, Master Valve: NDS Pro-Spec #314 (14" X 19"). Locate 12" max. from walks/parallel walks, 3" above grade in shrub areas (top of box flush with top of bark). Install 1" above grade in shrub areas without bark mulch. Install $\frac{1}{2}$ " above grade in turf areas (only where designated). Provide and install lock bolt at the end of the maintenance period. The cover shall be heat branded with the letters IRG, 2" high.
- E. Traffic Area boxes: Concrete box and lid designed for vehicular traffic use. Size to match plastic boxes. Paint concrete lids with 2" high lettering and/or numbers as noted above.
- F. Screen for rodent protection shall be 16-gauge galvanized ($\frac{1}{2}$ " x $\frac{1}{2}$ " openings), placed at base of box extension (above soil and below gravel).

2.13 QUICK COUPLING VALVES

- A. Quick coupling valves shall have a brass body with locking cover as indicated on the drawings.

2.14 SWING JOINTS

- A. Pre-manufactured triple-swing assemblies shall be Rainbird SA series, NDS TSA-TT series, or approved equal (12" length minimum. Match sprinkler inlet size.).

2.15 SPRINKLER HEADS

- A. Sprinkler heads shall be as designated on the plans and in the irrigation legend.
- B. Sprinkler heads on the same valve shall deliver matched precipitation and shall be of the same type, size and manufacturer.
- C. Minimum pop-up height: 6" height for turf sprinklers and shrub edge sprinklers; and 12" height for full-circle shrub sprinklers.

2.16 PRESSURE REGULATION

- A. Pressure regulator shall be as designated on the drawings with output psi as specified.

2.17 SPRING CHECK VALVES

- A. Mainline and lateral line spring check valves shall be made of high-impact Sch.40 PVC Type II with reinforced poppet (1/4 lb. spring). Install per manufacturer's recommendations.

2.18 ANTI-FREEZE DRAIN VALVES

- A. Irrigation systems in areas subject to freezing weather shall include an anti-freeze drain valve, such as Rainbird 16A-FDV-075 or approved equal.

2.19 SOLVENT CEMENT

- A. Solvent cement used for bonding rigid PVC pipe and fittings up to 12" size shall be Weld-On #711 as manufactured by IPS Corporation or an approved equal. Primer for Weld-On #711 shall be Weld-On P-70 as manufactured by IPS Corporation or an approved equal.

2.20 MATERIALS TO BE FURNISHED

- A. Prior to final inspection furnish the following materials to the Owner:
 - 1. Two keys for each automatic controller;
 - 2. One key for each five quick coupler valves (one min.) with bronze garden hose bib;
 - 3. Two sets of special tools required for removing, disassembling, and/or adjusting each type of sprinkler and valve supplied on the project;
 - 4. As-built drawings;
 - 5. Controller operating manual and colored sectioning chart;
 - 6. Two keys for each backflow preventer cover;
 - 7. ProMax Remote Control Assembly;
 - 8. Contractor's guarantee form.

PART 3 — EXECUTION

3.1 SITE CONDITIONS

- A. Before starting work on the irrigation system, carefully check all dimensions and grades to determine that work may safely proceed, keeping within the specified material depths.

- B. Do not willfully install the irrigation system as indicated on the drawings when it is obvious in the field that unknown obstructions or grade differences exist, that might not have been considered in the engineering. Such obstructions or differences shall be immediately brought to the attention of the Landscape Architect.
- C. The installation of all irrigation materials, including pipe shall be coordinated with the landscape drawings to avoid interfering with the trees, shrubs, or other plantings.
- D. Layout irrigation system and make minor adjustments required due to differences between site and drawings. Any such deviations in layout shall be within the intent of the original drawings, and without additional cost to the Owner. When directed by the Landscape Architect, the layout shall be approved before installation.
- E. Manufacturer's requirements for installation of products shall apply when;
 - 1. No other direction is given;
 - 2. It is a more stringent requirement than the Standard Specifications and these special provisions.
- F. Work Space:
 - 1. The Contractor shall erect fences and/or retain guards as required for the protection of the public and construction materials, and maintain same in good repair until the completion of the work under the contract.
- G. Drawings of Record
 - 1. Keep record drawings on site daily for observation by the Owner Representative. All dimensions shall be taken and recorded prior to backfill. On the date of the final observation, deliver corrected drawings to the Owner Representative. Final drawings shall be prepared by the Contractor on new prints obtained from the Owner's Representative, showing all field notes in India ink and finalized by a competent draftsman. Delivery of prints does not relieve the Contractor of responsibility for providing any information that may have been omitted from the prints.

3.2 PIPE AND CONTROL WIRE INSTALLATION

- A. Trenching
 - 1. Dig trenches straight and support pipe continuously on bottom of ditch. Shade pipe in trench to an even grade. Trenching excavation shall follow layout indicated on drawings and as noted. Where lines occur under paved areas, these dimensions shall be considered below subgrade.
 - 2. Provide minimum cover of 18 inches for all pressure supply lines 2-1/2 inches and smaller, and 24" for all pressure supply lines 3 inches and larger.
 - 3. Provide minimum cover of 18-24 inches from top of pipe to finish grade for all control wires.
 - 4. Provide minimum cover of 12 inches from top of pipe to finish grade for all non-pressure lines.
 - 5. All lines under driveway and roadway pavement shall have a 24-30 inch minimum cover.

B. Cutting and Patching

1. If cutting or breaking of any paving is necessary, it shall be done and replaced with like materials, at the Contractor's expense. Paving work shall match the original work in every respect, including type, strength, texture and finish. Obtain approval from the Owner's Representative prior to any cutting and/or breaking. Hydraulic driving will not be permitted under asphalt paving. All sleeves set in place under paving shall extend 18" minimum beyond such paving and be capped hand tight. No fittings, including couplings, will be permitted under surfaces to be paved except where length of the line under the paving exceeds 20-feet and/or where the lines are encased in sleeves.
2. In new paved areas, coordinate installation of piping and wires under paving with the General Contractor.

C. Backfilling

1. Backfill shall not be placed until the installed sprinkler irrigation system has been inspected, tested, and approved by the Landscape Architect and Project Inspector. Trenches shall be backfilled promptly after the open trench inspection.
2. Backfill for trenching consisting of earth, loam, sandy clay, or other approved materials shall be compacted to a dry density equal to the adjacent undisturbed soil, and shall conform to the adjacent grades without dips, sunken areas, humps or other irregularities. Initial backfill on all lines (bottom 3") shall be of a fine granular material with no foreign matter larger than 1/2 inch size.
3. Irrigation lines under paving shall be backfilled with a 3" sand layer below the pipe and a 3" layer above, compacted in layers to 95% relative density, using mechanical tamping devices only. The remaining backfill shall be per Section 02 31 00 and the Geotechnical Engineer's recommendations. Compact trenches equal to the compaction of the existing adjacent undisturbed soil and leave in a firm unyielding condition. Leave trenches flush with the adjoining grade.
4. All sand backfill shall terminate 3 feet from end of trench prior to building complex (backfill last 3 feet of all trenches with 50-50 clay/bentonite mix to prevent water migration next to buildings).

D. Water Supply

1. Connections to existing outlets shall be at the approximate location (s) shown on the drawings and indicated by P.O.C. "Point of Connection".

E. Pipe Fittings and Controls

1. Plastic to Plastic Fittings
 - a. All plastic threaded pipe and fittings shall be assembled using Teflon tape or equivalent, applied to the male threads only.
 - b. All plastic slip fittings shall be solvent welded as per pipe manufacturer's recommendations. Thoroughly clean PVC pipe and fittings of dirt, dust, and moisture prior to gluing.
 - c. UVR-PVC Pipe on-grade: Anchor with the specified pipe stabilizers and ties (if no stabilizers/ties are specified, anchor with "J" shaped #4 rebar, 18" long). Pipe crossing over concrete swales or drainage ditches shall be galvanized Sch.40, one size larger than PVC pipe size indicated on

drawings.

- d. Slip-fix and/or compression fittings shall not be used to repair line breaks.

2. Plastic to Steel Fittings

- a. Male thread plastic into female thread steel shall be used.
- b. Work the steel connection first. A non-hardening pipe dope shall be used on threaded plastic-to-metal joints.

3. Galvanized Steel Pipe and Fittings

- a. Galvanized pipe threads shall be cut with clean, sharp dies conforming to ASA Specification B-2.
- b. Threaded joints shall be made up with the best quality pure joint compound or lead paste (on the male threads only) throughout the system.
- c. Any leaky joints shall be remade with new material. Use of thread cement or caulking to make joints tight will not be permitted.
- d. Pipe installed on grade shall be anchored with "J" shaped #4 rebar, 18" long at 10 feet on center.
- e. Galvanized pipe in contact with the soil shall be wrapped with 20 mil black PVC tape.

4. Copper Pipe and Fittings

- a. Cut pipe square with a wheel type cutter, cleaned, free of burrs or other extraneous materials, and treated with the recommended flux before joining. Pipe should be inserted firmly to the fitting stop; fitting should be heated uniformly until solder is drawn completely into joint and forms a uniform bead at the outer edge. Connections to threaded fittings should be made by using threaded adapters or fittings soldered to the pipe.

F. Line Clearance

- 1. All lines shall have a minimum clearance of 3 inches from each other, and 12 inches from lines of other trades. Parallel lines shall not be installed directly over one another.

G. Control Wires

- 1. Wiring shall occupy the same trench and shall be installed along the same route as pressure supply or lateral lines wherever possible. Place wire under water lines.
- 2. Where more than one (1) wire is placed in a trench, the wiring shall be taped together at intervals of ten (10) feet. Tape to the bottom of the mainline at ten-foot intervals where in common trench. Common and lead wires shall be a different color, with the same color being carried throughout from controller to valve.

3. An expansion curl shall be provided within three (3) feet of each wire connection and at least every one hundred (100) feet in length. Expansion curls shall be formed by wrapping at least five (5) turns of wire around a one-inch pipe (or more) in diameter, then withdrawing pipe.
4. Splices shall be made with 3M waterproof connectors or equal, and done in valve boxes or pull boxes only.
5. Provide one additional wire between the controller and the furthest valve in each direction (north, south, east, and west) as a minimum (4 extra wires possible), unless shown differently on the irrigation plans.
6. If wires under paved areas cannot be continuous, all splices shall be enclosed in an approved box.
7. Tracer wire shall be placed on the bottom of the trench, under the pipe. Wire shall be continuous length throughout the length of the pipe. All splices shall be soldered at joints and covered with exterior wire insulation tape, manufactured for this purpose. Tracer wire shall follow the mainline and branch line and terminate in an irrigation valve box. Provide enough length of wire to reach the surface grade, plus 24". Bend wire to create a loop and attach an approved label with the designation of "Tracer Wire".

H. Thrust Blocks

1. All lines 1-1/2" and larger shall receive concrete thrust blocks at all corners, tees, elbows, and end caps. Use a minimum of 1/2 c.f. of concrete per diameter inch of pipe (i.e. 2" pipe = 1 c.f. concrete). Do not encase pipe or fittings!

I. Sleeving

1. All lines under paving (concrete and asphalt) shall be sleeved. Sleeves shall be installed in straight runs from planter to planter. Install (pre-pipe) lines in sleeves for future connections at the time of sleeving installation. Sleeves and lines shall extend a minimum of 18" beyond any existing and/or future hardscape.
2. All control wires under paving (concrete and asphalt) shall be sleeved (use sweep ells at all corners). Install a nylon pull cord in sleeving for all wire pulls.

I. Flushing the System

1. After new irrigation pipe lines and risers are in place and connected, all necessary division work has been completed, and prior to installation of emitters, the control valves shall be opened and a full head of water used to flush out the system.

3.3 ELECTRIC CONTROL VALVES

- A. Install as indicated on the drawings.
- B. Install each valve in a separate valve box.
- C. When grouped together, allow at least 6 inches between valve boxes.
- D. Attach identification tags to each remote control valve, indicating number that corresponds with controller station number.

3.4 SPRINKLER HEADS AND DRIP EMITTERS

- A. Install heads as indicated on details. Adjust locations of heads to accommodate site conditions and to provide full coverage.
- B. Sprinkler locations shall be flagged by a licensed surveyor prior to installation (locations determined utilizing GPS). Perimeter heads shall be set 3" from edge as shown on the rotor detail.

3.5 ANTI-FREEZE DRAIN VALVES

- A. Install anti-freeze drain valves per manufacturer's instructions and recommendations.

3.6 ADJUSTING OF SYSTEM

- A. Adjust the control valve to obtain the design rated pressure for the system installed.
- B. Set all flow-controls on the control valves in the system to the full open position, minus 2 turns.
- C. Adjust all irrigation heads in each section for equal height sprays, and minimum overspray on walks, buildings, and windows.
- D. If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, make necessary changes without additional cost to Owner, prior to planting. Adjustments may also include changes in nozzle sizes and degrees of arc as required.
- E. The entire system shall be operating properly before any planting operations commence.

3.7 EXISTING TREES

- A. Where it is necessary to excavate adjacent to existing trees, use all care possible to avoid injury to trees and tree roots. Where root diameter exceeds 2 inches, excavate by hand. Tunnel under roots 2 inches and larger in diameter (wrap root with wet burlap to prevent excessive drying while the trench is open). Where a ditching machine is run close to trees having roots smaller than 2 inches in diameter, hand-trim the wall of the trench adjacent to the tree, making clean cuts through. Paint roots 1 inch and larger in diameter with 2 coats of Tree Seal, or equal. Close trenches adjacent to tree within 24 hours; and where that is not possible, shade the side of the trench adjacent to the tree with burlap or canvas.

3.8 INSPECTION AND TESTING

- A. General
 - 1. In no event cover up any work prior to approval of the Landscape Architect. Any work covered prior to inspection shall be opened to view by the Contractor at his expense. Re-examination of questionable work may be ordered by Landscape Architect, and if so ordered, any work must be uncovered by Contractor. If the work is not in accordance with the drawings and specifications, Contractor shall pay the costs of re-examination and replacement.
 - 2. When observations have been conducted by other than the Landscape Architect, submit documentation showing when and by whom these observations were made.
 - 3. No site inspections shall occur without updated record drawings.

4. All observations called for by the Contractor shall be requested in writing at least seven (7) days prior to the anticipated observation.
 5. Contractor shall provide "walkie-talkie" equipment and/or personnel to maintain communication from the review area to the automatic controller(s).
 6. In the event the Contractor has scheduled an inspection, and the specified work is not completed or deficient, the Contractor shall pay all costs involved for re-examination.
- B. Pressure Testing - All mainlines; (and lateral lines under paving)
1. As soon as lines are connected and flushed-out (and prior to attaching valves), cap all outlets and hydrostatically test at 150 psi for a continuous twenty-four (24) hour period, at the end of which the lines and joints shall be inspected by the Landscape Architect and or the Project Inspector (locate pressure gauge at the center of mainline system and shut off water point of connection). The Contractor shall furnish all pumping and test equipment. If leaks develop, the pipe and/or joints shall be replaced and the tests repeated in the presence of the Project Inspector until all leaks are repaired (allowable 5-psi drop in 24-hour period. Pressure must stabilize at max. 5-psi drop).
- C. Operation Testing
1. Prior to planting, the entire irrigation system shall be placed in automatic operation and tested in the presence of the Landscape Architect for proper functioning and coverage. If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, make necessary changes without additional cost to Owner, prior to planting.

3.9 CLEAN UP AND REPAIR

- A. Upon completion of the work, make the surface level, remove excess materials, rubbish debris, and remove construction and installation equipment from the premises.
- B. Replace and/or repair to the satisfaction of Landscape Architect existing paving disturbed during the course of work. New paving shall be the same type, texture, finish and be equal in every way to the material removed.

3.10 PRE-MAINTENANCE ACCEPTANCE

- A. Work under this section will be accepted by the Landscape Architect upon satisfactory completion of all work. Upon pre-maintenance acceptance, the Landscape Architect will give written notification to commence 90-day maintenance period.

3.11 MAINTENANCE

- A. The entire irrigation system shall be maintained for a period of 90-days following the date of pre-maintenance acceptance of the work. System shall be in good working order at the end of the maintenance period.
- B. Landscape Contractor shall be responsible for any and all damage and/or vandalism to the irrigation system, which may occur during the maintenance period or the course of work (regardless of fault). Make all repairs and provide all replacement materials and labor to the satisfaction of the Owner.

3.12 FINAL ACCEPTANCE

- A. Work under this section will be accepted by the Landscape Architect upon satisfactory completion of all work (including maintenance). Upon final acceptance and written notification, the Owner will assume responsibility for maintenance of the work.

3.13 GUARANTEE

- A. The entire irrigation system shall be guaranteed by the Contractor as to materials and workmanship, including settling of backfilled areas for a period of one (1) year following the date of final acceptance of the work. Guarantee shall also cover damage to any part of the premises resulting from leaks or other defects in, materials, equipment, and workmanship to the satisfaction of the Owner.
- B. A guarantee form shall be re-typed in the following onto the Contractor's letterhead and contain the following information:

"GUARANTEE FOR THE IRRIGATION SYSTEM"

We hereby guarantee that the irrigation system we have furnished and installed is free and clear from defects in materials and workmanship, and the work has been completed in accordance with the Drawings and Specifications. We agree to repair and/or replace all defects in material or workmanship which may develop during the period of one-year of acceptance and also to repair and/or replace all damages resulting from the repair of such defects at no additional cost to the Owner, after receipt of written notice. In the event of our failure to make repairs or replacements within a reasonable amount of time after receipt of written notice, we authorize the Owner to proceed to have said repairs and/or replacements made at our expense, and we will pay the costs and charges therefore upon demand.

Project: _____
Location: _____
Contractor/Company: _____
License Number: _____
Address: _____
Office Phone: _____
Cell Phone: _____
FAX: _____
E-mail: _____
Date of Final: _____

Acceptance: _____

Signed: _____ Date: _____

END OF SECTION

**SECTION 32 90 00
LANDSCAPE PLANTING**

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all labor, materials, equipment, and services to complete the finish grading, planting, maintenance of planting and related items, as indicated on the drawings and specified herein, providing landscaping with plants in vigorous growth condition, ready for the Owner's use.
- B. Related work specified elsewhere includes but may not be limited to:
 - 1. Section 32 80 00 - Landscape Irrigation.
- C. Sample:
 - 1. Decomposed Granite: Submit a photographic sample of the decomposed granite to be installed for this project. The sample must be submitted and approved by the Landscape Architect prior to ordering and/or installation.

1.2 SUBMITTALS

- A. Furnish original material invoices and original truck delivery tickets indicating the quantities of fertilizers and soil amendments delivered to the job site. Material invoices must be approved by the Landscape Architect prior to installation. Photocopies will not be accepted and the Landscape Architect must be on site to verify all deliveries.
 - 1. Furnish material invoices or documentation to the Landscape Architect at least 30 days prior to start of work indicating that all plant material has been ordered.
- B. Soil Fertility and Agricultural (Horticultural) Suitability Analysis
 - 1. After completion of rough grading and prior to soil preparation, the Contractor shall obtain agronomic soils tests for planting areas. A minimum of two (2) samples of planting areas shall be required. Tests shall be performed by an approved agronomic soils testing laboratory and shall include a complete soil suitability analysis with written recommendations for soil amendment, fertilizer and chemical conditioner, application rates for soil preparation, and post-maintenance fertilizer program.
 - 2. The agronomic soils report recommendations shall take precedence over the minimum soil amendment and fertilizer application rates, as specified, when they exceed the specified minimums. Additional materials required by the soils report shall be paid for by Change Order.
 - 3. Submit the name, address, and phone number of the consulting soil testing laboratory for approval by the Landscape Architect prior to obtaining services.

1.3 PROTECTION

- A. Contractor shall call *UTILITY ALERT*, (1) (800) 642-2444, a minimum of 48 hours prior to any excavation.

- B. Contractor shall check for location of cables or conduits, utility lines and other existing features or conditions above or below ground level that might be damaged as a result of his/her operation. Questions or conflicts arising out of such examination prior to or during operation shall be immediately directed to the attention of the Landscape Architect for necessary action or decisions before resuming operation. Contractor shall be responsible for repair or replacement, at no cost to the Owner, for features or conditions damaged through failure to comply with above procedures.

1.4 ALTERNATES

- A. Alternates will not be permitted unless authorized by the Landscape Architect at least 30 days prior to start of work. The Landscape Architect will assist the Contractor in the selection of the nearest equivalent size and variety of plant.

1.5 DRAWINGS

- A. Interpretations: Drawings and specifications are intended to be fully cooperative and to agree. However, if the Contractor observes that the drawings and specifications are in conflict, (s)he shall promptly notify the Landscape Architect in writing (prior to bidding and/or construction). The specification calling for any higher quality material or workmanship shall prevail. Questions regarding interpretation of drawings and specifications shall be clarified by the Landscape Architect.

1.6 INSPECTIONS

- A. The Contractor shall notify the Landscape Architect 24 hours in advance of all soil preparation, planting and maintenance inspections.
- B. The Contractor shall schedule with the Landscape Architect a preconstruction conference at least 7 days before beginning work under this section. The purpose of this conference will include:
 - 1. Review of Contractor's questions regarding this project;
 - 2. Review administrative and inspection procedures that will occur during construction;
 - 3. Review the Contractor's work schedule for this project;
 - 4. Verification of Contractor's C-27 License, Bonding and Insurance.
- C. Fine Grading and Soil Preparation
 - 1. Furnish certificates for soil amendments at this time (per Section 1.02);
 - 2. The fine grading and soil preparation of all planted areas must be approved prior to installation of plant material.
- D. Plant Material
 - 1. Plant material quality will be inspected prior to planting. Plants that are found to be rootbound, of insufficient size, or of irregular shape may be rejected by the Landscape Architect. Rejected plants will be replaced at no extra expense to the Owner.
 - 2. The Contractor will field locate all box and container stock before planting. The Landscape Architect will then be allowed to adjust the locations of any plant materials prior to installation.

- E. Pre-Maintenance Inspection

1. The pre-maintenance inspection will occur after all work has been completed as indicated on the drawings and in the specifications. If approved, this will be the starting date of the 90 day maintenance period.

F. Final Inspection

1. The final inspection will occur after the 90 day maintenance period and all work is completed. If approved, this will be the date of final acceptance.

1.7 GUARANTEE AND REPLACEMENT

- A. All specimen trees in 24 inch box and larger shall be guaranteed for one (1) full year; all 15 gallon plants for one (1) year; all 1 gallon and 5 gallon plants for one (1) year; lawns for one (1) year; 4" or 5½" pots and flatted groundcover for one (1) year, from date of final acceptance.
- B. The Contractor shall replace all dead plants and all plants not in a vigorous, thriving condition as determined by the Landscape Architect during and at the end of the guarantee period. Replacement plants shall be of the same quality as the original specified plants.
- C. Landscape Contractor shall be responsible for any and all damage and/or vandalism to planting which may occur during the maintenance period or the course of work (regardless of fault). Make all repairs and provide all replacement materials and labor to the satisfaction of the Owner.

PART 2 - MATERIALS

2.1 PLANT MATERIAL

- A. Plants shall be grown in nurseries inspected by the State Department of Agriculture. Plants shall be grown in accordance with good horticultural practices under climatic conditions similar to those of the project.
- B. Plants shall be fresh, well-established, vigorous, of normal habit of growth, free of disease, insects, insect eggs and larvae. Plants shall be healthy, with a normal root system, well filling their containers, but not to the point of being rootbound.
- C. The height and spread of all plant material shall be measured with branches in their normal position when plant is installed. Multi-trunked trees, as noted on the drawings, shall mean trees with three or more trunks and all trunks shall be equal in caliper. All multi-trunked trees shall be true multis. Made up multis where 3 separate plants are grown together are not acceptable.
- D. Minimum caliper for all 24" box trees shall be 1-1/2", and measured 6" from top of rootball. Minimum height from the top of rootball to the bottom of canopy shall be 8' for a 24" box tree.
- E. Pruning shall not be done prior to inspection.
- F. The size of plants shall conform to the plan or the plant list. Oversized plants may be used at no additional cost to the Owner. Plants shall be well rooted in their containers. Rootbound plants and plants with poorly formed root systems, as a result of a recent shift in container size, will not be accepted.

- G. Tree trunk calipers and taper shall be sufficient so that the tree will remain vertical without a stake. Trunk caliper at 6 inches above the soil media (substrate) surface shall be within the diameter range shown for each container size below:

Container Size -----Trunk Diameter			
5 gal.....	0.5"	to	0.75"
15 gal.....	0.75"	to	1.5"
24-inch box.....	1.5"	to	2.5"

2.2 TOPSOIL (IF REQUIRED FOR IMPORT)

- A. Topsoil shall be fertile, friable, sandy loam free from weeds and seeds per USDA 7th approximation classification method. Acceptable soil from the site may be used. Should topsoil be imported, an agricultural suitability test shall be conducted by an approved soils laboratory and results submitted to the Landscape Architect for approval prior to delivery to job site.
- B. Identify source location, percentages of silt, clay, sand, organic matter, pH, mineral and plant nutrient content of soil. Particle size shall fall within the following desired range:
- Clay and silt, 20% - 50%; fine sand, 30% - 40%; coarse sand, 5% - 20%; gravel (maximum aggregate size 3/4"), 0% - 8%; decomposed organic matter, 2% - 50%. All sandy loam must pass through a one inch sieve. The sand fraction shall have 85% falling within the medium to fine sand range. Soils unsuitable for planting shall be rejected.
- C. Provide soils analysis expressed in parts per million including the following:
- Organic content; nitrogen; phosphorous; potassium; magnesium; calcium; sodium; sulfur; zinc; manganese; copper; iron; boron; pH; ammonium; sodium absorption rate (SAR); ECe; and USDA particle size.
- D. Suitability of soil and chemical deficiencies will be determined by Landscape Architect (Landscape Architect may submit a list of what additives should be installed to correct these problems). Soils deemed unsuitable for planting shall be rejected.

2.3 SOIL AMENDMENT

- A. Pre-plant fertilizer shall consist of Live Earth First Green 5-3-1 fertilizer. Retain all bags for inspection by Landscape Architect prior to disposal.
- B. Top-dress fertilizer shall consist of LESCO Fertilizer 18-3-18 on hydroseeded turf areas; Live Earth First Green 5-3-1 fertilizer on flatted groundcover areas; LESCO 14-14-14 Landscape and Ornamental Plant Fertilizer on 4" or 5½" pot areas. Retain all bags for inspection by Landscape Architect prior to disposal.
- C. Tree and shrub fertilizer shall consist of Best "Best-Paks" 20-10-5 fertilizer packets, used with the backfill of every plant as follows:
1. 1 gallon - 1 packet;
 2. 5 gallon - 3 packets;
 3. 15 gallon - 9 packets;
 4. Box plants - 1 packet per every 2" of box size.

- D. Organic amendment shall consist of nitrolized redwood sawdust. Submit sample and analysis to Landscape Architect for approval prior to delivery to site.
1. Nitrogen stabilized: .4 - .6% N (dry weight for redwood sawdust), .56 - .84% N (dry weight for fir or cedar), .8 - 1.2% N (dry weight for fir or pine).
 2. Particle size: 95 - 100% passing 6.35mm standard sieve, 80 - 100% passing 2.33mm standard sieve.
 3. Salinity: Saturation extract conductivity shall not exceed 3.5 millimhos/centimeter at 25 degrees centigrade.
- E. Gypsum shall be powdered calcium sulfate (clay soils only).

2.4 MIXES

- A. Backfill mix for each plant shall consist of 6 parts native soil (or approved imported soil), 4 parts nitrolized organic amendment, Live Earth First Green 5-3-1 fertilizer (2 lbs./c.y. fill), Agricultural Gypsum (15 lbs./c.y. fill) if clay soil, and "Best-Paks" fertilizer packets as noted.

2.5 MULCH

- A. Planter Basin/Shrub Area Mulch: "Gorilla hair" bark mulch, free of sticks, dirt, dust or other debris (KEEP 2" MINIMUM FROM BARK OF PLANT).

2.6 HERBICIDE

- A. Post-emergence (existing weeds): "Roundup" or equal/approved.
- B. Pre-emergence (non-turf areas only, prior to seed germination): "Ronstar" or equal.
- C. Post-emergence (turf areas): "Ortho Weed-B-Gon" or equal/approved.

2.7 DEEP ROOT PLANTERS

- A. All trees planted within 7½ feet of paving or curbing, or in tree wells, shall have deep root planters.
- B. Deep root planters shall be Deep Root Corporation Model "UB 18-2" for 15 gallon trees, Model "UB 24-2" for 24" box trees, or equivalent (high-density polyethylene). Install per manufacturer's instructions.

2.8 DECOMPOSED GRANITE

- A. Decomposed granite shall be "pit sand", or approved equal, and shall be clean and free from clay or organic materials and shall be of such nature that it can be readily compacted under watering and rolling to form a firm stable base.

2.9 CONCRETE MOW STRIP

- A. Concrete mow strip shall comply with details on the plan.

PART 3 - EXECUTION

3.1 SOIL PREPARATION

- A. Remove from all planted areas rocks over 1 inch diameter, sticks and other debris, weeds and foreign growth of any kind.
- B. In the event actively growing common bermuda grass or bermuda stolens are encountered, an "irrigation - germination - weed eradication" program shall be performed until all non-specified plant material has been removed. Upon acceptance of irrigation system by the Landscape Architect, Contractor shall apply sufficient amounts of irrigation water to initiate germination of any and/or all non-specified seeds. The "irrigation - germination - weed eradication" program shall be performed a minimum of two (2) times or until all non-specified plant material has been removed.
- C. Contractor shall chemically eradicate all germinated weed seeds. (See Section 2.06 Herbicide A. Post-emergence.)
- D. To all planted areas apply the following per 1000 s.f. and till into the top 6" of soil:
 - 1. 15 lbs. Live Earth First Green 5-3-1 Fertilizer;
 - 2. 4 cubic yards of organic amendment;
 - 3. 200 lbs. Gypsum (clay soils only).

3.2 FINISH (FINE) GRADING

- A. No plant materials shall be installed until all operations in conjunction with the installation of the irrigation system have been completed, finish grades have been established and planting areas have been properly prepared and graded.
- B. Finish grading operations shall include establishment and/or re-establishment of all surface drainage patterns, as indicated on the grading and drainage plans. All areas shall have a uniform gradient, with no abrupt changes and/or undulations. All low-spots shall be filled to establish positive drainage to appropriate drainage facilities.
- C. Finish grade includes, but is not limited to, the removal of all foreign material of any kind, 1" and larger, within the top 6" of the soil surface.
- D. Establish finish grade for hydroseeded turf areas 1" (sodded areas 1½") below header board, edging, mow strips and/or adjacent pavement areas.
- E. Establish finish grade for planting areas 3" below header board, edging, mow strips and/or adjacent pavement in areas to receive minimum 2" layer of mulch.
- F. Establish finish grade for planting areas 1" below header board, edging, mow strips and/or adjacent pavement in 4" or 5½" pot and flatted groundcover areas to receive minimum 1" layer of mulch.
- G. All areas shall be compacted with a water-filled roller to provide a smooth finish surface. Final compaction shall range between 85% for level areas, and up to 90% for 2:1 slopes.
- H. All finish grades shall be completed and accepted by the Landscape Architect prior to any planting, sodding and/or hydroseeding operations.

3.3 PLANTING - TREES AND SHRUBS

- A. Trees and shrubs shall be set in the field in locations shown on the drawings. All planting locations shall be approved or adjusted as necessary by the Landscape Architect before planting holes are excavated.
- B. Tree and shrub planting shall comply with details on the plan.
- C. Contractor shall provide photo documentation of 24" box and 36" box trees to the Landscape Architect for review and approval prior to ordering and shipping.
- D. Excavate pits of circular outline with vertical sides for all plants. Scarify sides and bottoms of all plant pits.
- E. After removing plant from container, make several 1" deep vertical cuts along the root ball to scarify it to prevent root bound conditions. Protect roots or balls of plants at all times from sun and drying winds.
- F. Use backfill mix to backfill plant pits (thoroughly mix prior to use). Set plants plumb and brace rigidly in position until planting soil has been tamped solidly around the ball and roots. When plant pits have been backfilled approximately 2/3 full, water thoroughly, saturating rootball, before installing remainder of the planting soil to top of pit, eliminating all air pockets.
- G. Place "Best-Paks" fertilizer packets evenly distributed in plant pits when backfilled 2/3 according to the schedule specified.
- H. Stake plants in accordance with the details on the plans. Stakes shall not interfere with the root ball area. Stake immediately after planting. Plants shall be plumb after staking. Stakes and ties shall be adjusted to prevent girdling and chafing and shall be removed as soon as trees show signs of inherent stability.
- I. If directed by the Landscape Architect, the Contractor shall prune plants in accordance with standard horticultural practice. Cuts over 1/2" in diameter shall be painted with approved tree paint.
- J. Form water wells around tree and shrub pits according to details on plans. NOTE: Do not form basins in turf areas.
- K. Mulch all water wells with a 2" layer of specified mulch.

3.4 PLANTING – FLATTED GROUND COVER AND 4" OR 5 1/2" POTS

- A. All plants shall be well rooted and shall be evenly spaced distances as indicated on the drawings and shall be staggered in rows.
- B. Dig good sized pockets for planting so that the root system lies free without doubling and so that roots are planted vertically, not horizontally.

3.5 DECOMPOSED GRANITE

- A. Path area
 - 1. Spread and thoroughly blend decomposed granite, after achieving proper moisture content.
 - 2. Lifts shall not exceed 4 inches in uncompacted thickness.

3. Prior to compaction, bring fill to proper moisture content (3 to 5% above optimum) by aeration or moistening.
4. Compact each lift to uniform compaction throughout each lift.
5. Finish grade all surfaces where indicated and within the construction areas to elevations indicated and as required to ensure proper drainage and disposal of surface water.
6. All finish grading shall be placed to a vertical tolerance of plus or minus 1/20 (.05) foot.

3.6 WEED CONTROL

- A. Keep all planting areas, including areas to receive hydroseeding or sodding, free from weeds at all times. Contractor shall be responsible for weed control throughout the installation period and prior to the pre-maintenance acceptance.
- B. After planting is completed, a pre-emergence herbicide shall be applied to all shrub, 4" or 5½" pot and groundcover areas. Water to a depth of ¼". Do not apply to seeded areas, or areas to receive sod.

3.7 CLEAN-UP

- A. Keep all areas of work clean, neat and orderly at all times. Keep all paved areas clean during planting and maintenance operations. Clean up and remove all deleterious materials and debris from the entire work area prior to final acceptance to the satisfaction of the Landscape Architect. All clippings and debris shall be removed (at contractor's expense) and disposed of off-site in a legal manner.
- B. Comply with all applicable storm water pollution prevention plans.

3.8 PRE-MAINTENANCE ACCEPTANCE

- A. Work under this section will be accepted by the Landscape Architect upon satisfactory completion of all work. Upon pre-maintenance acceptance, the Landscape Architect will give written notification to commence 90 day maintenance period.

3.9 MAINTENANCE

- A. After all work indicated on the drawings and specifications has been completed, inspected and approved by the Landscape Architect, the maintenance period shall begin. The Contractor shall maintain all planted areas by means of continuous watering, weeding, mowing, re-seeding, cultivation, spraying, mulching, pruning, edging and/or any other operation necessary for their care and upkeep for the period of ninety (90) calendar days.
- B. All areas shall be kept weed free during the maintenance period. Groundcover, 4" or 5½" pot and shrub areas shall be cultivated regularly to maintain a loose, attractive soil.
- C. The Contractor shall immediately replace any and all plant materials, which, for any reason, die or are damaged while under his care. Replacement plants shall be of the same quality as the original specified plants.

- D. Damage to planting areas shall be repaired immediately. Any settling of the soil shall be repaired, design grades re-established and areas replanted. Depressions caused by foot traffic will be filled with soil and leveled.
- E. Top-dress fertilizer shall be applied at 8 pounds per 1000 s.f. to all hydroseeded turf and flatted groundcover areas; 2 pounds per 100 s.f. to 4" or 5½" pot areas, at 30 and 45 days after the maintenance period is started (provide invoices and delivery tickets).
NOTE: Wash all fertilizer material from leaves.
- F. To all shrub, 4" or 5½" pot and groundcover areas apply a pre-emergence spray or granular application at the start and end of the maintenance period.
- G. At completion of the maintenance period, all areas included in this contract shall be clean and free of debris and weeds, all plant materials shall be live, healthy and free of infestation.
- H. Turf areas shall be mowed at least once during maintenance period. No grass or weed growth shall be allowed to exceed 3" in height and shall be cut back each time to 1½" in height. Spot cutting shall also be done so that no part exceeds 3" in height at any time.
- I. To all turf areas apply a broad-leaf herbicide after three mowings. If weeds reappear, a second application shall be required prior to the end of the maintenance period.

3.10 FINAL ACCEPTANCE

- A. Work under this section will be accepted by the Landscape Architect upon satisfactory completion of all work (including maintenance). Upon final acceptance, and written notification, the Owner will assume responsibility for maintenance of the work.

END OF SECTION

**SECTION 32 92 00
TURF SODDING**

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. All labor, materials, tools and the transportation and the performance of all the work required as indicated on the drawings and specifications, and reasonably incidental to:
 - a. Furnish all plant material;
 - b. Preparation and placing of sodded areas;
 - c. Clean-up;
 - d. Guarantee.

B. Requirements

1. Obstructions to landscaping operations: If rock, plaster, concrete debris, electrical cables, conduits or utility lines are encountered and cause conflict with landscaping operations, notify the Landscape Architect immediately to arrange relocation or to perform clean-up work.
2. Guarantees: The Contractor shall repair or replace any or all of the work, together with any other adjacent work which may be displaced by so doing, that may prove to be defective in its workmanship or material for the period of 90 days for all sodded areas from date of acceptable or substantial completion of the work by the Owner; ordinary wear and tear expected.

PART 2 - PRODUCTS

2.1 TURF DESCRIPTION

- A. "Bandera Bermuda" by West Coast Turf or approved equal.
- B. Contractor is responsible to overseed sod with a perennial rye, as detailed below:
 1. Sod shall be overseeded if the installation is during the months of September through November.
 2. Sod shall come with perennial rye actively growing in the sod if the installation is during the months of December through March.
 3. Contractor is responsible to ensure proper germination of the perennial rye.

PART 3 - EXECUTION

3.1 SOIL PREPARATION

- A. All areas shall be compacted with a water-filled roller to provide a smooth finish surface. Final compaction shall range between 85% for level areas, and up to 90% for 2:1 slopes.

- B. Soil shall be left 1½" (one and one-half inch) below finish grade as the sod will bring the level up to the proper height.
- C. After preparation of soil, the area must be pre-irrigated to wet it to a depth of four (4) inches. It shall be damp but not muddy and without depressions.

3.2 SOD PLACEMENT

- A. Initial placement of sod shall be laid within two (2) days after it is delivered. It shall not be left in the hot sun nor left in rolls or stacked overnight.
- B. Prior to placing of sod, broadcast 6-20-20 complete fertilizer at a rate of ten (10) pounds per 1,000 square feet over surface.
- C. Sod shall be unrolled and placed carefully in a staggered pattern. A piece of 2 x 4 shall be used to tamp each roll against the adjacent strips to eliminate joints and edges.
- D. Sod shall be trimmed to conform to lawn shapes designated in planting plan.
- E. After sod is laid, it shall be irrigated thoroughly to provide good moisture penetration.
- F. All sod areas shall be rolled with a Ryan Manufacturing Company sod roller not later than five (5) days after installation. Sod shall conform with finish grade, existing sidewalk and contours. A second rolling will be necessary if the first does not meet specifications.
- G. All perimeter and border areas shall not be laid with less than full width sod nor less than one-half length sod. (Sod width - 12"; sod length - 48").
- H. All sod in sodded areas shall be handled and laid in a high standard workmanship manner. All ends, joints, and cuts to be fit and tightly joined so there are no voids and the final appearance is one of continuous lawn.

END OF SECTION

**SECTION 32 93 00
HYDROSEEDING**

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included:

1. All labor, materials, tools and the transportation and the performance of all the work required as indicated on the drawings and specifications, and reasonably incidental to:
 - a. Furnish all plant material;
 - b. Preparation and seeding of hydroseeded areas;
 - c. Clean up;
 - d. Establishment period;
 - e. Guarantee.

B. Requirements

1. Obstructions to landscaping operations: If rock, plaster, concrete debris, electrical cables, conduits or utility lines are encountered and cause conflict with landscaping operations, notify the Landscape Architect immediately.
2. Guarantees: The Contractor shall repair or replace any or all of the work, together with any other adjacent work which may be displaced by so doing, that may prove to be defective in its workmanship or material for the period of 120 days for all hydroseeded areas from the end of the maintenance period.

PART 2 - PRODUCTS

2.1 HYDROSEED MIX – EROSION CONTROL MIXTURE

A. All hydroseed mixes shall consist of the following (in lbs./acre):

- | | | |
|-----------|---|--|
| 2000 lbs. | - | Wood Fiber Mulch (green in color) |
| 900 lbs. | - | Gro-Power Humus Base Fertilizer 5-3-1 |
| 400 lbs. | - | Gro-Power Controlled Release Fertilizer 12-8-8 |
| 100 lbs. | - | R2400-400CL Tackifier |

Seed Mix (non-irrigated, in lbs./acre):

- | | |
|---------------|--|
| 6 lbs. | Gaillardia pulchella (Indian Blanket) |
| 6 lbs. | Linum perenne lewisii (Blue Flax) |
| 5 lbs. | Eschscholzia californica (California Poppy) |
| 4 lbs. | Penstemon palmeri (Palmer Penstemon) |
| 4 lbs. | Ratibida columnifera pulchra (Mexican Hat) |
| 3 lbs. | Sphaeralcea ambigua (Desert Globemallow) |
| 3 lbs. | Cleome lutea (Yellow Bee Plant) |
| 2 lbs. | Thelesperma filifolium (Greenthread) |
| 2 lbs. | Dalea candida (White Prairie Clover) |
| 1 lbs. | Penstemon parryi (Parry's Beardtongue) |
| 1 lbs. | Polanisia dodecandra (White Beeplant) |
| <u>1 lbs.</u> | <u>Penstemon eatonii (Firecracker Penstemon)</u> |
| 38 lbs. | TOTAL |

- B. Deliver total seed requirements in unmixed, unopened bags to the site prior to seeding, with the producer's certificates attached showing purity/germination rates and weed content.
- C. Supply Landscape Architect with seed test reports from a certified testing laboratory showing purity/germination rates and weed content 30 days prior to seeding.
- D. All seed certificates are to be detached by the Landscape Architect and retained for permanent records. Landscape Architect may take samples of all specified seed for testing purposes, if testing is deemed necessary at a future date.
- E. Seed mix shall contain no noxious weed species. Seed will be rejected if it is found to be wet, moldy, or damaged, or if weed content exceeds 0.5% by weight.

PART 3 - EXECUTION

3.1 COMBINATION OF MATERIALS

- A. Mixing shall be performed in a tank, with a continuous agitation system of sufficient operating capacity to produce a homogeneous slurry of fiber, seed, fertilizer, humectant, tackifier and water in the designated unit proportion.
- B. With the agitation system operation at part speed, water shall be added to the tank.
- C. The seed shall be added first; then fertilizer shall be added, and then the fiber. If a centrifugal pump and recirculation is employed, fiber is added before seed.
- D. The fiber shall not be added until the tank is at least one-third filled with water.
- E. The mixture shall be agitated at full speed when the tank is half-filled with water.
- F. All fiber shall be added by the time the tank is two-thirds to three-fourths full.
- G. Maximum permissible time of mix of fertilizer and seed shall be one hour in order to prevent deterioration of seed.

3.2 HYDROSEEDED AREAS

- A. The areas to be hydroseeded are as shown on the drawings.
- B. Soil surface in the areas to be hydroseeded shall be loose, friable and roughened to a depth of 2" so that seed will remain in place prior to seeding.
- C. Seed mix shall be uniformly seeded at rates specified in Section 2.00 - 2.01 and/or plan.
- D. Seed mix shall be applied prior to November 15 to take advantage of seasonal rainfall.

3.3 WEED CONTROL

- A. Subsequent to seed germination (and throughout the maintenance period) Contractor shall mechanically and/or chemically eradicate all weeds as soon as they can be identified.
- B. Remove all weeds from site before they set seed.

3.4 GUARANTEE

- A. All seeded areas shall be 100% established by the end of the maintenance period. Final acceptance will be postponed (maintenance period will be extended) until 100% establishment is achieved or approved by Owner.

END OF SECTION

**SECTION 33 10 00
WATER UTILITIES**

1.00 GENERAL

1.01 SUMMARY

- A. Pipe and fittings for site water lines.
- B. Valves.
- C. Fire Hydrant
- D. Water meter
- E. Backflow preventer.

1.02 RELATED SECTIONS

- A. Section 31 20 00 Earthwork.
- B. Section 31 23 33 Trenching and Backfilling.

1.03 REFERENCES

- A. American Water Works Association Standards (AWWA).
- B. Indian Wells Valley Water District - Design Standards.
- C. Standard Specifications for Public Works Construction (Green Book), latest edition.

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories.
 - 2. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 3. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations. Turn over to the project manager one set of drawings with all deviations from the plans shown in neat, clean and readable red ink.
 - 4. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
 - 5. Disinfection Report:
 - a. Type and form of disinfectant used.
 - b. Date and time of disinfectant injection start and time of completion.

- c. Test locations.
 - d. Name of person collecting samples.
 - e. Initial and 24-hour disinfectant residuals in treated water in ppm for each outlet tested.
 - f. Date and time of flushing start and completion.
 - g. Disinfectant residual after flushing in ppm for each outlet tested.
6. Bacteriological Report:
- a. Date issued, project name, and testing laboratory name, address, and telephone number.
 - b. Time and date of water sample collection.
 - c. Name of person collecting samples.
 - d. Test locations.
 - e. Initial and 24-hour disinfectant residuals in ppm for each outlet tested.
 - f. Coliform bacteria test results for each outlet tested.
 - g. Certify water conforms, or fails to conform, to bacterial standards of AWWA C651 Section 7.1 Standard Conditions
7. Water Quality Certificate: Certify water conforms to quality standards of the City's Representative, suitable for human consumption.

1.05 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of piping mains, valves, connections, fire hydrant, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with Indian Wells Valley Water District Standards, AWWA, Standard Specifications for Public Works Construction California, Fire Code Chapters 5 & 33 and NFPA 24.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.

1.07 QUALIFICATIONS

- A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this section with minimum three years' experience.
- B. Testing Firm: Company specializing in testing potable water systems, certified by State of California.
- C. Submit bacteriologist's signature and authority associated with testing.

1.08 DELIVERY AND STORAGE

- A. Deliver and store valves in shipping containers with labeling in place.

2.00 PRODUCTS

2.01 GENERAL

- A. All fire water lines shall be designed for a minimum working pressure of 305 psi unless otherwise indicated on plans. All fittings appurtenant piping materials shall be designed for a minimum working pressure of 305 psi unless otherwise indicated on plans.
- B. All domestic water lines shall be designed for a minimum working pressure of 250 psi unless otherwise indicated on plans. All fittings appurtenant piping materials shall be designed for a minimum working pressure of 250 psi unless otherwise indicated on plans.

2.02 PIPE

- A. Joints: Mechanical joints shall be used for the waterline construction unless otherwise shown on plans and standard details. Gaskets for mechanical joints shall be rubber conforming to ANSI A21.11 and AWWA C111.
- B. Fittings: Fittings shall be ductile iron rated for 250 psi working pressure for domestic water lines and 305 psi working pressure for fire water lines. Mechanical joint fittings shall conform to ANSI A21.10 or AWWA C110 (short short body style, not approved). Lining for fittings shall be Plastic Engineering P.E.I. 100 epoxy to a minimum thickness of 10 mils. Fittings shall be wrapped with 6 mil. polyethylene sheet. Grease all underground nuts and bolts before wrapped with the polyethylene sheet.
- C. Polyvinyl Chloride (PVC) potable water pipe: Pipe material shall be (Polyvinyl chloride (PVC) pressured pipe shall be manufactured in accordance with AWWA Standard Specification C-900).

2.03 GATE VALVES

- A. Conform to AWWA C-509-01.
- B. Gate valves shall be iron body, NRS valves with O-ring seals, and shall open when the stem is rotated counterclockwise. The valves shall be designed for a minimum working pressure of 250 psig, have a bronze stem, and have a cast iron wedge with styrene butadiene rubber permanently bonded to the wedge. The valves shall have full port openings for unobstructed flow, be designed for underground service, and be in full compliance with the latest revision of AWWA C509. The valve linings and coatings shall be in accordance with AWWA C210-84. Linings and coatings shall be factory applied. Valves shall be furnished with 2-inch square operating nut. Valve shall be wrapped with 6 mil. polyethylene sheet. Grease all underground nuts and bolts before wrapping with the polyethylene sheet.

2.04 FIRE HYDRANT

- A. Fire hydrants shall be Mueller A-421A or Clow 850 (wet barrel only) or approved equal. 1 - 4 ½" and 2 - 2 ½" individually valved outlets

2.05 WATER METER

- A. Water meter shall be dictated per Indian Wells Valley Water District.

2.06 BACKFLOW PREVENTER

- A. Make and model per plans.

2.07 ACCESSORIES

- A. Concrete for Thrust Blocks: Contractor shall construct concrete thrust block per Indian Wells Valley Water District Construction Plates.
- B. Thrust blocks shall be constructed to bear against undisturbed earth and shall not bear against adjacent pipe, fittings, or valves. Where concrete must be poured around adjacent pipe, a block out or a short pipe length shall be used such that a flexible joint exists within 12 inches of each side of thrust block, unless indicated otherwise on the plans. Concrete shall not be allowed to set in contact with pipe surfaces or to enter or come in contact with any joint.
- C. Valve Appurtenances: The Contractor shall furnish and install all valve appurtenances. Provide two galvanized T-handled operating wrenches, 4 feet total length or as required to easily access valve from grade.
- D. Valve box shall be Christy G5 traffic valve box with bolt down cast iron lid or approved equal. The cover shall be marked "water." The extension piece shall be 6" diameter minimum SDR 35.
- E. Appropriate warning detector tape shall be placed over all utilities.
 - 1. Underground detectable warning tape shall be placed over all non-metallic underground utilities.
 - 2. 12-gauge copper continuous location wire shall be placed on all water mains.
- F. Corrosion-Protection Encasement for Piping
 - 1. Encasement for Underground Metal Piping and Fittings: AWWA C105, Polyethylene film, 10 mil minimum thickness, tube or sheet. Plastic wrap shall be clear or black. Purple wrap shall not be used.

3.00 EXECUTION

3.01 EXAMINATION

- A. Maintenance records in accordance with NFPA 25.
- B. Verify the existing water main sizes, class of pipes, and locations as indicated.
- C. Verify piping system has been cleaned, inspected, and pressure tested.

- D. Perform scheduling and disinfecting activity with start-up, water pressure testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.02 PREPARATION

- A. Remove scale and dirt, on inside and outside, before assembly.
- B. Prepare pipe connections to equipment with flanges or unions.

3.03 BEDDING

- A. Excavate pipe trench in accordance with Specification Section 31 23 33 for work of this section. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth, compact to a minimum of 90 percent relative compaction.
- C. The compaction of the backfill material along the sides and one foot above the pipe shall be done with hand tampers to protect the pipe. Jetting is not permitted to obtain required compaction.
- D. Maintain optimum moisture content of bedding material to attain required compaction density.

3.04 INSTALLATION - PIPE

- A. Route pipe in straight line.
- B. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- C. Install access fittings to permit disinfection of water system.
- D. Form and place concrete for thrust blocks at each elbow or change of direction of pipe main in accordance with Indian Wells Valley Water District Plans & Specifications.
- E. Protect metal restrained joint components against corrosion by applying a bituminous coating by coating with non-oxide corrosion resistant greased 10 mil plastic wrap.
- F. Establish elevations of buried piping to ensure cover conforming to City Standards. The minimum cover from the finish grade to the top of pipe is 30 inches for potable waterlines and 36 inches for fire waterlines, any shallower cover to clear with the existing utility crossings shall be reviewed and approved by the City's Representative.
- G. Install 12-gauge copper continuous location wire over top of pipe.
- H. Backfill trench in accordance with Specification Section 31 23 33.
- I. Maintain separation of water main from sewer piping in accordance with the State Department of Health Services, Criteria for the Separation of Water Mains and Sanitary

Sewers (Section 64630, Title 22 California Administrative Code), and State Regional Water Quality Control Board.

- J. All pipe laid in trench which is to be left for further extension (i.e., end of work day) shall have its open end covered to protect from possible rodent intrusion.

3.05 INSTALLATION - VALVES

- A. Set valves on solid bearing per Indian Wells Valley Water District Plans & Specifications.
- B. Center and plumb valve box over valve. Set box cover flush with finished grade.
- C. Install brass valve 1 ½" diameter tags and imprint valve number per City.

3.06 SERVICE CONNECTIONS

- A. Not Applicable.

3.07 PRESSURE TEST OF WATER PIPING SYSTEM

- A. Water piping system shall be pressure tested for 2 hours at 200 psi, with no allowable drop in water pressure.
- B. All leakage tests shall be completed and approved prior to placing of permanent resurfacing.
- C. Pressure test shall be witnessed by City's inspector.

3.08 DISINFECTION AND BACTERIA TESTING OF WATER PIPING SYSTEM

- A. Water piping system shall be disinfected and flushed per AWWA Section C651.
- B. Upon completion of retention period required for disinfection, flush pipeline until chlorine concentration in water leaving pipeline is no higher than that generally prevailing in existing system or is acceptable for domestic use.
- C. Legally dispose of chlorinated water. When chlorinated discharge may cause damage to environment, apply neutralizing chemical to chlorinated water to neutralize chlorine residual remaining in water.
- D. After final flushing and before pipeline is connected to existing system, or placed in service, employ an approved independent testing laboratory to sample, test and certify water quality suitable for human consumption.

3.09 TEST RECORDS

- A. Records shall be in accordance with NFPA 13 & 24. Records shall be made of each piping system installation during the test. These records shall include:
 - 1. Date of test.

2. Description and identification of piping tested.
3. Test fluid.
4. Test pressure.
5. Remarks to include such items as:
 - a. Leaks (type, location).
 - b. Repairs made on leaks.
6. Certification by Contractor and signed acknowledgment by the City's Representative.

3.10 FIELD QUALITY CONTROL

- A. Inspection and testing shall be performed by City's Representative.
- B. Perform pressure test on potable water distribution system in accordance with Indian Wells Valley Water District Plans & Specifications except that there is no allowable leakage for the duration of the test.
 1. Slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test. Do not open or close valves at differential pressures above rated pressure.
 2. Examine exposed piping, fittings, valves, hydrants, and joints carefully during hydrostatic pressure test. Repair or replace damage or defective pipe, fittings, valves, hydrants, or joints discovered, following pressure test.

END OF SECTION

**SECTION 33 30 00
SANITARY SEWERAGE UTILITIES**

1.00 GENERAL

1.01 SUMMARY

- A. Site sanitary sewerage piping, fittings, accessories and bedding.
- B. Cleanouts.

1.02 RELATED SECTIONS

- A. Section 31 20 00 Earthwork.
- B. Section 31 23 33 Trenching and Backfilling.

1.03 REFERENCES

- A. Standard Specifications for Public Works Construction SSPWC (Green Book), latest edition.
- B. ASTM Standards.
- C. Indian Wells Valley Water District - Design Standards.

1.04 SUBMITTALS

- A. Submit:
 - 1. Product Data: Provide data indicating pipe, pipe accessories and appurtenances, and manhole covers.
 - 2. Manufacturer's Installation Instructions: Indicate special procedures required to install products specified.
 - 3. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 4. Manufacturer's Certificate: Certify that installers are certified for installing plastic pipe.

1.05 PROJECT RECORD DOCUMENTS

- A. Submit Record Drawings: Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 REGULATORY REQUIREMENTS

- A. Conform to California Title 24 (CCR) Part 5, latest edition, for installation of the Work of this section.
- B. Minimum separation distance and requirements between water, reclaimed water and sewer pipes per the State of California, Department of Health Services shall be established.

2.00 PRODUCTS

2.01 SEWER PIPE MATERIALS AND ACCESSORIES

- A. Polyvinyl Chloride (PVC) Pipe for Gravity Sewer: ASTM 3034-SDR35 Ring-Tite Polyvinyl Chloride (PVC) gravity sewer pipe and fittings; inside nominal diameter as indicated on Drawings. PVC pipe shall use "locked-in" rubber sealing ring conforming to ASTM D-3212. Joints using flexible Elastomeric Seals. Minimum pipe stiffness at 5% deflection shall be 46 psi for all sizes when tested in accordance with ASTM Method of Test D2412.

2.02 CLEANOUTS

- A. Form and cast-in-place, Class 618-CLE-4000 P concrete base pad, with provisions for sewer pipe end section.
- B. Frame and cover shall be Christy G3 or equal, lettered "sewer".

2.03 BEDDING MATERIALS

- A. Refer to Specification Section 31 23 33 Trenching and Backfilling for Bedding Material.

3.00 EXECUTION

3.01 EXAMINATION

- A. Verify that trench cut and/or excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.02 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with granular fill.
- B. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.

3.03 BEDDING

- A. Excavate pipe trench in accordance with Specification Section 31 23 33. Hand trim excavation for accurate placement of pipe to elevations indicated on drawings.

- B. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches compacted depth, compact to minimum of 95 percent of maximum dry density.
- C. Maintain optimum moisture content of bedding material to attain required compaction density.

3.04 INSTALLATION - PIPE

- A. Install pipe, fittings and accessories in accordance with manufacturer's instructions.
- B. Sewer pipeline shall be placed from downstream to upstream beginning at the downstream connection to the existing sewers.
- C. Lay pipe to slope gradients noted on drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Install bedding along sides and over top of pipe to minimum compacted thickness of 12 inches; compacted to a minimum of 95 percent of maximum dry density.
- E. Refer to Specification Section 31 23 33 for Trenching Requirements. Do not displace or damage pipe when compacting.
- F. The compaction of the backfill material along the sides and one foot above the pipe shall be done with hand tampers to protect the pipe.

3.05 INSTALLATION – CLEANOUTS

- A. From bottom of excavation clean and smooth to correct elevation.
- B. Establish elevations and pipe inverts for inlets and outlets as indicated on drawings.
- C. Mount lid and frame level in grout, secured to cone section to elevation indicated on drawings.

3.06 FIELD QUALITY CONTROL

- A. Preliminary Tests: The Contractor may perform any tests desired which are not harmful to the lines before backfilling is completed.
- B. Cleaning: Before final tests are performed for acceptance of any sewer pipe, clean the pipe by inflatable rubber ball method.
- C. Perform air pressure test per SSPWC Section 501-6.4.
- D. Repairs, if necessary: If the leakage or infiltration is greater than the amount specified, the pipe shall be overhauled and re-laid if necessary, by the Contractor, at its own expense, until the joints will hold satisfactorily.

- E. Regardless of the results of the above tests, any visible evidence of individual leaks shall be corrected by the Contractor to the satisfaction of the City's Representative.
 - F. Cleaning Sewer: After all backfilling, compaction testing and paving is completed, sewer lines shall be cleaned by Inflatable Rubber Ball Method, flushed and cleaned, before acceptance by the City's Representative and connection to their sewer system is made.
 - G. The Contractor shall furnish all sewer line plugs necessary for blocking off all lines as required by the City's Representative until final acceptance.
- 3.07 PROTECTION
- A. Protect finished installation.
 - B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 40 00
STORM DRAINAGE UTILITIES

1.00 GENERAL

1.01 SUMMARY

- A. Storm drainage piping, fittings, accessories, and bedding.
- B. Catch basins.
- C. Manholes.
- D. Inlet and outlet structures.

1.02 RELATED SECTIONS

- A. Section 31 20 00 Earthwork.
- B. Section 31 23 33 Trenching and Backfilling.

1.03 REFERENCES

- A. Standard Specifications for Public Works Construction (SSPWC), latest edition.
- B. ASTM Standards.
- C. Kern County Drainage Standards

1.04 SUBMITTALS

- A. Submit the following in accordance with provisions in Division 1:
 - 1. Product Data: Provide data indicating pipe, pipe accessories and catch basin grates.
 - 2. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
 - 3. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 4. Layout diagram for storm drain components per plan.

1.05 PROJECT RECORD DOCUMENTS

- A. Submit record drawings. Accurately record locations of pipe runs, connections, catch basins, structures, manholes and invert elevations.

- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 FIELD MEASUREMENTS

- A. Verify that field measurements and elevations are as indicated on drawings.
- B. Complete pothole work per plans and notify the City of any discrepancy prior to commencing construction.

1.07 COORDINATION

- A. Coordinate the work with connection to existing storm drain mains, and trenching.

2.00 PRODUCTS

2.01 PIPE MATERIALS

- A. 12" Dia and Under: Polyvinyl Chloride (PVC) Pipe with water tight joints, per SSPWC Section 207-17.
- B. 18" Dia and Larger: High Density Polyethylene (HDPE) Pipe (N-12 WT) with water tight joints, per SSPWC Section 207-18.

2.02 PIPE ACCESSORIES

- A. PVC: Elastomeric Gasket water tight joints per SSPWC Section 207-17.3.2.
- B. HDPE: Water-Tight Joints per SSPWC Section 207-18.4.1.

2.03 CATCH BASINS AND MANHOLES

- A. Precast catch basins shall include grate, as manufactured by Brooks Precast or approved equal.
- B. Manholes shall be per SPPWC Std Plan 321-2.

2.04 METAL

- A. All exposed metal parts are to be galvanized in accordance with SSPWC, Section 210-3.

2.05 CONCRETE

- A. All concrete shall be Class 560-C-3250, per SSPWC Section 201.

2.06 BEDDING MATERIALS

- A. Refer to Specification Section 31 23 33 Trenching and Backfilling for Bedding Material.

2.07 FILTER FABRIC

- A. Filter fabric shall be non-woven geotextile filter fabric Mirafi 140N or approved equal.

3.00 EXECUTION

3.01 EXAMINATION

- A. Verify that trench cut is ready to receive Work and excavations, dimensions, and elevations are as indicated on Drawings.

3.02 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with compacted bedding material.
- B. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

3.03 BEDDING

- A. Excavate pipe trench in accordance with Specification Section 31 23 33. Hand trim excavation for accurate placement of pipe to elevations indicated on Drawings.
- B. Place bedding material in trench bottom, level materials in continuous layer. Bedding shall be 4" thickness for pipe diameters less than or equal to 24" and 6" thickness for pipe diameters greater than 24" and shall be per SSPWC Section 217-1.2.

3.04 INSTALLATION - PIPE

- A. Install pipe, fittings, and accessories in accordance with manufacturer's instructions and per SSPWC Section 207.
- B. Lay pipe to slope gradients noted on drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- C. Install backfill along sides and over top of pipe. Provide backfill over top of pipe to minimum compacted thickness of 12 inches, compacted to a minimum of 95 percent of maximum dry density.
- D. Refer to Specification Section 31 23 33 for Trenching Requirements. Do not displace or damage pipe when compacting.
- E. The compaction of the backfill material along the sides and one foot above the pipe shall be done with hand tampers or equal to protect the pipe.

3.05 INSTALLATION - CATCH BASINS, MANHOLES

- A. Form bottom of excavation clean and smooth to correct elevation.

- B. Form and place cast-in-place concrete base with provisions for storm drainage pipe end sections.
- C. Level top surface of concrete base to receive shaft sections.
- D. Establish elevations and pipe inverts for inlets and outlets as indicated on drawings.
- E. Compact top 12" of native materials below the bottom of catch basins and manholes to minimum 95 percent of maximum dry density.

3.06 FIELD QUALITY CONTROL

- A. Inspection and testing shall be performed by the City's representative.
- B. Request inspection prior to and immediately after placing backfill cover over pipe.
- C. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to the City.

3.07 PROTECTION

- A. Protect pipe and backfill cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SPECIAL PROVISIONS

SIGNING, STRIPING, AND PAVEMENT MARKERS

All equipment, materials, and components for signing and striping, and the installation thereof, shall conform to the 2023 Caltrans Standard Plans, and Standard Specifications, Section 81, "Miscellaneous Traffic Control Devices," Section 82 "Signs and Markers", and Section 84, "Markings", unless otherwise noted in these Special Provisions and on the Plans. These Plans and Specifications are hereinafter referred to as State Standard Plans and State Standard Specifications. Copies of these documents are available from Caltrans, District 7 office at 100 South Main Street, Los Angeles, California 90012 or from Caltrans, 6002 Folsom Boulevard, Sacramento, California 95819, (916) 445-3520.

All materials required for the completion of work as shown on the Plans shall be provided by the Contractor.

SECTION 81 - MISCELLANEOUS TRAFFIC CONTROL DEVICES

81-3 PAVEMENT MARKERS

81-3.02 Materials.

81-3.02E Epoxy Adhesive. Adhesive for raised pavement markers shall be rapid set type epoxy.

Removal of pavement markers shall be per Section 81-8.03B, "Remove Pavement Markers," of the State Standard Specifications.

81-3.04 Payment. Payment for pavement markers shall be included in the lump-sum price bid for signing and striping, and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in completing the operations as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer. No additional compensation shall be allowed.

SECTION 82 – SIGNS AND MARKERS

82-3 ROADSIDE SIGNS

82-3.03 Construction. Relocated signs shall be installed using existing posts at new locations and shall be set at a minimum 30-inch depth and at a minimum 12-inch square portland cement concrete (PCC). The post depth of the concrete footing shall be sufficient to extend at least 6-inches below the bottom of the

posts. ¼-inch expansion paper shall be placed between the sign foundation and sidewalk.

New signs shall be installed using metal posts set at a minimum of 30-inch depth in a minimum 12-inch square PCC, except as specified otherwise, the metal post shall be a 2-inch square 12 gauge "Qwik Punch" posts. The length of the metal post shall be sufficient to extend from the top of the sign to 30-inches below the top of the concrete footing and provide a 7-foot clearance between the finished grade and the bottom of the sign. The depth of the concrete footings shall be sufficient to extend at least 6-inches below the bottom of the posts. ¼-inch expansion paper shall be placed between the sign foundation and sidewalk.

Drill holes for bolts, threaded rods, or expansion anchorage devices drilled in existing concrete by a method that will not shatter the concrete adjacent to the holes.

Repair any spalling or chipping of concrete structures at contractor's expense.

Marker and delineators shall conform to the provision in Section 81, "Miscellaneous Traffic Control Devices."

82-3.04 Payment. Payment for signing shall be included in the lump sum price bid for signing and striping, and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in completing the operations as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer. No additional compensation shall be allowed.

SECTION 84 - MARKINGS

84-2 TRAFFIC STRIPES AND PAVEMENT MARKINGS

84-2.02 Materials.

84-2.02A General. Traffic stripes, pavement markings, crosswalks, and arrow markings shall be thermoplastic, unless otherwise shown on the Plans. Curb markings shall be paint, two (2) coats.

84-2.02B Glass Beads. The 1st layer of glass beads shall be **Bonded Core Reflective Elements manufactured by 3M** and must be on the Authorized Material List for high-performance glass beads. The color of the glass beads must match the color of the stripe or marking to which they are being applied. The 2nd layer of glass beads must comply with AASHTO M 247, Type 2.

The glass beads used in both layers must be surface treated for use with thermoplastic under the bead manufacturer's instructions.

84-2.02G Paint.

Curb markings shall be paint. Paint shall be ready-mixed rapid dry type.

Ready-mixed paints shall be suitable for use on either asphalt concrete or Portland cement concrete.

84-2.03 Construction.

84-2.03A General. The Contractor shall furnish the necessary control points for all striping and markings and shall be responsible for the completeness and accuracy thereof to the satisfaction of the Engineer.

The Contractor shall establish all traffic striping between these points by stringline or other method to provide striping that will vary less than ½-inch in 50-feet from the specified alignment.

When no previously applied figures, markings, or traffic striping are available to serve as a guide, suitable layouts shall be spotted in advance of the permanent paint application. Traffic lines may be spotted by using a rope as a guide for marking spots every 5-feet, by using a marking wheel mounted on a vehicle, or by any other means satisfactory to the Engineer.

The Contractor shall mark or otherwise delineate the traffic lanes in the new roadway or portion of roadway, or detour before opening it to traffic.

The Contractor shall provide an experienced technician to supervise the location, alignment, layout, dimensions, and application of the paint.

Spotting shall be completed prior to the removal of any existing stripes. Existing stripes and markings shall be removed prior to painting new stripes and markings, but in no case shall any section of street be left without the proper striping for more than 24 hours, or over weekends or holidays.

The installation of traffic stripes includes placement of raised pavement markers when called for on the plans.

Adhesive for raised pavement markers shall be per Section 81, "Pavement Markers."

Existing traffic stripes (including raised pavement markers), pavement legends, and markings that do not conform to the plans shall be removed by grinding per Section 81-8.03B, "Remove Pavement Markers," and Section 84-9.03A, "General" of the State Standard Specifications.

84-2.04 Payment. Payment for striping details, pavement markings, and curb markings shall be included in the lump sum price bid for signing and striping, and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in completing the operations as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer. No additional compensation shall be allowed.

SPECIAL PROVISIONS

ELECTRICAL WORK AND SYSTEMS

All equipment, materials, and components for traffic signal loop replacement shall conform to the 2023 Caltrans Standard Plans and Revised Standard Specifications, Section 86, "Electrical Work" and Section 87 "Electrical Systems" unless otherwise noted in these Special Provisions and on the Plans. These Plans and Specifications are hereinafter referred to as State Standard Plans and State Standard Specifications. Copies of these documents are available from the Caltrans, District 7 office at 100 South Main Street, Los Angeles, California 90012 or from Caltrans, 6002 Folsom Boulevard, Sacramento, California 95819, (916) 445-3520.

All materials required for the completion of work as shown on the Plans shall be provided by the Contractor.

SECTION 86 – GENERAL

86-1.01 General.

86-1.01C Submittals. The schedule of values (cost breakdown) shall be submitted to the Engineer in conjunction with equipment list and drawings.

Equipment List and Drawings shall be submitted to the Engineer within ten (10) working days after the date of the Notice of Contract Approval.

Materials lists, manufacturer's data, brochures, technical data, etc., shall be labeled and identified, and shall be submitted in bound booklet form.

The Contractor shall retain one copy of all approved material lists and samples at the job site, readily accessible for inspection by the Engineer. Said materials lists and samples shall be the basis for approval or rejection of work.

The Contractor shall guarantee the entire work constructed under this contract and will fully meet all requirements as to quality of workmanship and materials furnished by him. The Contractor shall make, at the Contractor's expense, any repairs or replacements made necessary by defects in workmanship or materials that becomes evident within 1 year after acceptance of work by the Agency and to restore to full compliance with the requirements of these Specifications, any part of the work which during the 1-year period is found to be deficient with respect to any provision of the Plans and Specifications. The Contractor shall make all repairs and replacements promptly upon receipt of written orders from the

Engineer. If the Contractor fails to make the repairs and replacements promptly, the City may do the work and the Contractor and his surety shall be liable to the City for the cost.

Whenever any work or equipment is to be guaranteed or maintained by a manufacturer, supplier, or subcontractor, said obligation shall be that of the Contractor.

All guarantees shall be in writing and delivered to the Engineer by the Contractor prior to final acceptance of the work.

Contractor shall pothole all mast arm pole locations prior to ordering poles. Should there be a utility conflict, the contractor shall note top and bottom depth of the utility, location of utility from the curb face and back of sidewalk, including pictures. The contractor shall continue to pothole an additional location as directed by the Engineer to locate a non-conflicting area to install the pole and foundation. The cost for one (1) additional pothole (per mast arm pole location) due to a utility conflict shall be considered as included in the lump-sum price bid for Pedestrian Hybrid Signal (HAWK) Installation, and no additional compensation will be allowed.

86-1.01D Quality Assurance.

86-1.01D(3) Department Acceptance. Materials and equipment furnished by the Contractor shall be tested at an independent testing facility designated by the City. Cost for testing and delivery to and from the test site shall be considered as included in the lump-sum price bid for Pedestrian Hybrid Signal (HAWK), and no additional compensation will be allowed.

86-1.02 Materials.

86-1.02B Conduit and Accessories. Conduit shall be Schedule 80 PVC.

86-1.02C Pull Boxes. Pull boxes shall be pre-cast reinforced concrete. Grout-in bottom of pull boxes will not be required.

Electrical pull boxes, unless noted otherwise on the Plans, shall be No. 5 or larger and shall have plastic lined lids. Lids shall be labeled "Traffic Signal".

86-1.02F Conductors and Cables. Wiring shall be per manufacturers requirements. Any additional signal equipment wiring shall conform to the following:

86-1.02F(2) Conductors.

86-1.02F(2)(c) Copper Conductors.

86-1.02F(2)(c)(i) General. Circuit conductors shall be THW PVC type.

86-1.02J Standards, Poles, Pedestals, and Posts. Where the State Standard Plans refer to the side tenon detail at the end of the signal mast arm, the applicable tip tenon detail may be substituted.

86-1.02K Luminaires.

86-1.02K(1) General. Luminaire shall be LED, solar powered unless otherwise noted on the plans.

Solar powered lighting LED luminaires shall be 6400 lumen LED with dimmable capabilities, auto-dimming profile shall be set to the hours specified by the City Engineer.

First Light Technologies Model – BFL-TM-GY-00-HT-GY-T4-WW, or city approved equal.

LED luminaires shall have a Type IV distribution and a 3000k temperature.

86-1.02M Photoelectric Controls. Photoelectric control shall be Type IV for all intersection lighting.

86-1.02P Enclosures. Service equipment shall be 120V/240V Type III-BF, as shown on Plans.

Contractor shall furnish and install 1-100 Amp Breaker (Main), 1-50 Amp Breaker for metered signal, and 1-30 Amp Breaker for metered safety lighting & install in enclosure, for future use.

86-1.02Q Cabinets.

86-1.02Q(2) Controller Cabinets. Lane Light Solar Hawk System Controller as shown on the Plans with all necessary equipment for the intended operation, see appendix.

The Lanelight HAWK controller cabinet shall be pre-installed with A/C power capability & spare 1-30 Amp (1P) Breaker (Luminare) for future use.

86-1.02R Signal Heads.

86-1.02R(3) Backplates. Backplates shall be aluminum alloy with 2" yellow reflective strip on the face around the perimeter.

The strip must be Type XI fluorescent yellow retroreflective sheeting on Caltrans' Authorized Material List, 3M Diamond Grade.

86-1.02R(4) Signal Faces. Vehicle indications shall be 12-inch LED with visors and backplates.

86-1.02R(4)(d) Visors and Directional Louvers. Visors shall be aluminum alloy and tunnel type.

86-1.02T Accessible Pedestrian Signals.

Accessible Pedestrian Signal (APS) shall be a Polara iNS system and carry an audible message recorded in a soundproof studio or room. For custom messages, see appendix.

Button shall have raised arrow with vibrotactile device and touch-free technology.

Full assembly including button shall be color Yellow.

Pedestrian push button signs shall be a modified R10-3 sign "Push or Wave at Button", 5"x7" in size. Braille for the street name is not required.

APS system shall include all miscellaneous auxiliary equipment required for the intended operation as shown. Installation shall also include the contractor to program and upload all applicable crossing messages to each APS unit. Contractor shall work with manufacturer representative for training and required applications as required to upload the custom message to each APS unit.

SECTION 87 – ELECTRICAL SYSTEMS

87-1 GENERAL

87-1.03 Construction.

87-1.03A General.

No work shall commence and no material or equipment shall be stored at the jobsite until such time that the Contractor notifies the Engineer in writing of the date that all electrical materials and equipment are to be received. Upon receipt of said notification by the Engineer, the Contractor may commence work within 5-working days prior to said delivery date.

Contractor shall coordinate with an Edison certified contractor to comply with minimum overhead clearances for the removal and/or installation of traffic signal poles. The cost to hire an Edison certified contractor to perform work shall be included in the lump sum price bid for Pedestrian Hybrid Signal (HAWK) installation and no additional compensation will be allowed therefore.

Where the Contractor-installed facilities are damaged prior to final acceptance by the Engineer, the Contractor shall repair or replace such facilities at his own expense.

The pedestrian Hawk signal must be operational within 5 days after erection of standards.

The job site shall be maintained in a neat and orderly condition at all times and areas of sidewalk removal to be left open for less than 5 days shall be covered with plywood sheeting and barricades. Areas to be left open more than 5 days shall be patched with temporary AC pavement, smoothed to provide a level finished walking surface.

All striping, pavement markings, and signing shall be in place prior to signal turn on.

Turn on of the pedestrian Hawk signal system shall not be made on a Friday or the day preceding a legal holiday, and will be permitted between the hours of 9 a.m. and 2 p.m. only. The City shall be notified at least 48 hours prior to the intended turn on and the City's signal maintenance company must be present.

87-1.03 Conduit Installation. Bends shall be factory bends.

Conduit shall be installed using directional drilling (boring) method. Trenching in Pavement is not allowed.

87-1.03C Installation of Pull Boxes. No pull box shall be located in or within 1-foot of any curb ramp.

87-1.03E Excavation and Backfilling for Electrical Systems. Excavation for foundation shall be hand dug until clear of obstructions.

87-1.03H Conductor and Cables Splices.

87-1.03H(2) Splice Insulation Methods. Splices shall be Type C insulated by Method B, as shown on State Standard Plan ES-13A, except detector conductor (video, loop, et cetera) splices shall be Type S or T insulated by Method B, as shown in the Standard Plans, and shall also be soldered.

87-1.03L Utility Service. Electrical service equipment installation shall be installed per Caltrans Standard Plans ES-2E with breakers as specified in these special provisions and on the plans.

PAYMENT

Payment for traffic signal poles, equipment, conduit, wiring, pull boxes and all appurtenances in this section shall be included in the lump-sum price bid for Pedestrian Hybrid (HAWK) signal installation, and shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in completing the operations as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer. No additional compensation shall be allowed.

Appendix

PPB Assembly



iNS2: "iNS" iNavigator 2-Wire Push Button Station

The "iNS" iNavigator 2-Wire Push Button Station (iNS2 PBS) is the pedestrian interface to the iNavigator Accessible Pedestrian System. A system consists of a Control Unit (PN iCCU-S2, iCCU-C2, iCCU-S, or iCCU-C) and a Push Button Station. The iNS2 PBS is an MUTCD compliant PBS and provides valuable information and cues via both a vibrating arrow button and audible sounds, making the intersection accessible for all pedestrians. All sounds emanate from the front and back of the unit. A sunlight-visible red LED latches "ON" along with a tactile feedback "bounce" to confirm the button has been pushed. The vandal-resistant design of the iNS2 PBS includes the body, which houses the ADA compliant push button (shown), a faceplate (5X7 sign shown), and mounting hardware.

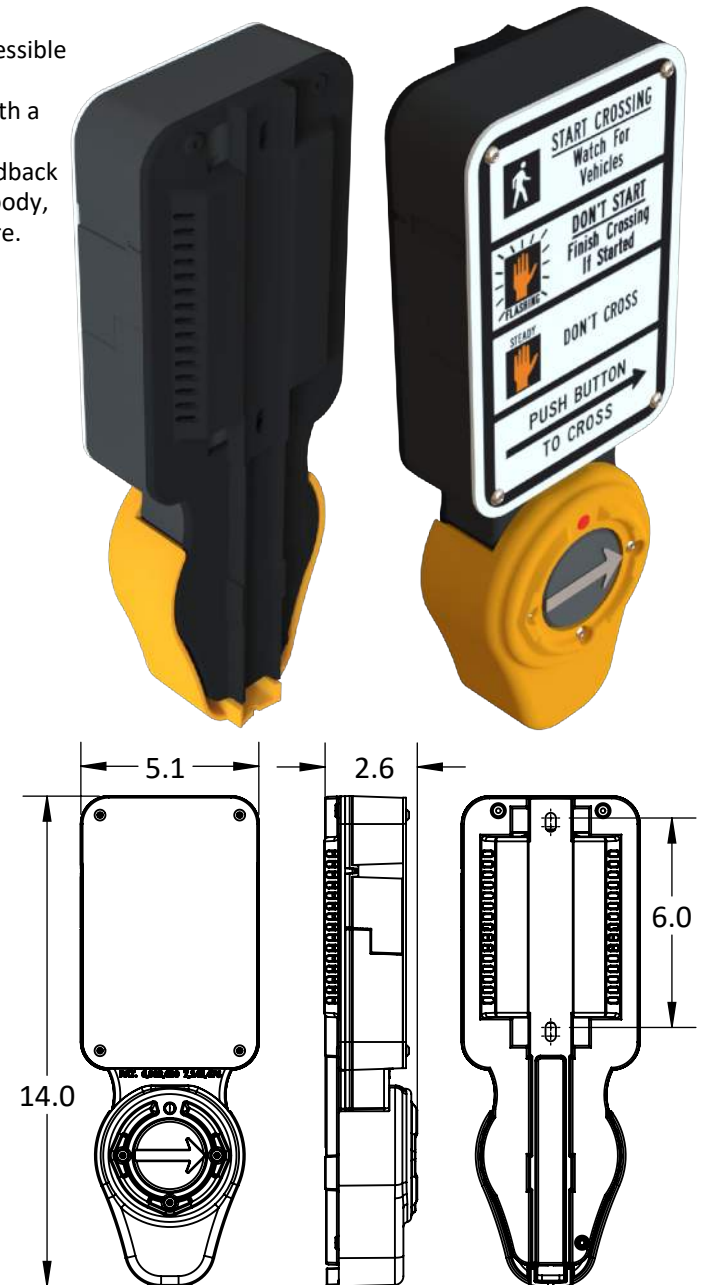
By interfacing with the Central Control Unit (CCU) that installs in the Traffic Cabinet, the iNS2 PBS can provide the following standard features:

- Operates over a single pair of wires
- All PBS wired in parallel, individually assignable to any phase
- 16 buttons can operate on a single iCCU (dependent on power requirements and wire runs)
- All sounds are synchronized
- 4 Locate Tone selectable options
- 13 Walk Sound selectable options, 3 of them custom options
- 7 Clearance Sound selectable options
- Walk, Clearance, and Don't Walk sounds automatically adjust to ambient
- Separate ambient response settings for Locate Tone (for quiet ambient conditions)
- Most sounds have independent Min/Max settable limits
- Button vibrates during Walk
- Button push confirmed by latching LED, tactile bounce, and audible "wait" sound
- Extended button push can boost volume for next Walk and Clearance
- Direction of travel message with extended button push, capable
- Extended Push Priority: mutes all but selected crosswalk, capable
- Extended Push activation settings: 0-6 second range, 0.5 second increments
- Beacons and Ping Pong features available
- Select audio messages, change settings, and perform firmware updates wirelessly using iOS (9.0+) or Android (5.0+) devices, or a Windows PC with Polara's Bluetooth Dongle (PN iN-DGL, purchased separately)
- Built in health/event logging feature, up to 1000 events
- False walk detection: four independent checks
- External speaker option at time of order
- External button input for bike lanes, horses, etc.
- Warranty: 3 year limited

An iNS2 PBS can operate as an iNS3 (Ped-Head Based System). It comes with a 3-position terminal block to connect to a Ped-Head Control Unit. See iNS3 Quick Start Guide for more information.

For optimum functionality, Polara recommends a dedicated pair of wires be routed to each PBS. Using IMSA 50-2 Cable is an ideal choice. The ground shield does not need to be connected.

Dimensions are in inches. iNS25BN0-Y unit shown.





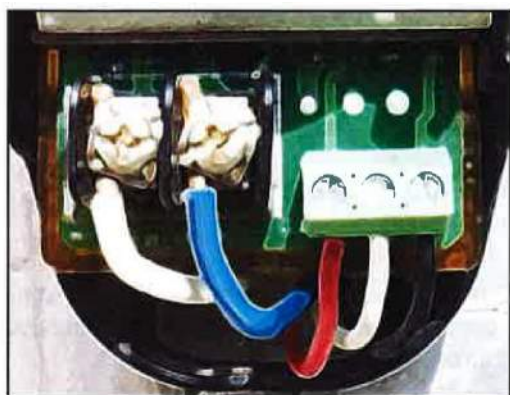
Operating Specifications	
Parameter	Rating
Operating Temp. Range	-34°C to +74°C (-30°F to +165°F)
Storage Temp. Range	-45°C to +85°C (-50°F to +185°F)
Operating Force	3.0 lbs max, option of 3 adjustable programmed forces
Switch Operating Life	Greater than 20 million operations
Max. Volume	100 dB @ 1 meter

Design Compliance	
Functionality Test Type	Compliance
Temperature and Humidity	MUTCD 2009-4E
Transient Voltage Protection	NEMA TS2
Transient Suppression	NEMA TS2
Mechanical Shock and Vibration	NEMA TS2
iNS3 PBS Enclosure	NEMA 250 Type 4X
Electrical Reliability	NEMA TS2

Notes:

1. Lab tested to applicable sections of referenced standards
2. All specifications are subject to change without notice
3. All specifications are typical unless otherwise specified

Termination View: iNS2 Operating as iNS3 PBS



Ped Call Terminal on left. 3-position terminal block on right (for operating as iNS3)

iNS2 5 A N 0 - B - BD-ES

Additional Options

Button Options

NA - No Arrow

BD - Bi-Directional Arrow

Other Options

WPC - With pole cap

ES - External Speaker option

Button Cover Color

Back plate is always black.

B - Black

G - Green

Y - Yellow

Audio Message Option

0 - Standard messages

1 - Custom Messages

Braille

N - No braille on faceplate

B - Braille on faceplate

Faceplate

MUTCD Compliant

V - 9x12 R10-3

U - 9X12 R10-3b

T - 9x15 R10-3e

Non-MUTCD Compliant

A - 5x7- International

B - 5x7- International

C - 9X12- Countdown

D - 5X7 or 9x12- International

O - No Faceplate

Size of Front Plate Adapter

5 - 5" x 7"

9 - 9" x 12"

3 - 9" x 15"

Navigator Family

iNS2 - iNavigator S 2-Wire Push Button

Dimensions are in inches.

APS Voice Message Form

Pinney Pool Xing at Warner St

Qty

VOL: **Wait to Cross** at **Wait**
(Street Being Crossed) (Intersecting Street)

Walk Message: **Walk sign is on to cross**
(Street Being Crossed) (Street Being Crossed)

Arrow Direction (R/L) Street Name Being Crossed in BRAILLE

☐ - Braille Only ☐ - Custom Text Only ☐ - Braille & Cust. Text

Lane Light Pedestrian Hybrid Signal (HAWK)
Pedestrian Crosswalk System
Specifications, Product Manual



BID #####

SGT. JOHN PINNEY MEMORIAL POOL REPLACEMENT PROJECT

Ridgecrest, California

Pedestrian Hybrid Signal (HAWK)
Pedestrian Crosswalk System

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Contents

1	Terms	1
2	Project Location.....	1
3	Installer Responsibilities	1
4	Warranty.....	1
5	System Regulatory Requirements (per FHWA – MUTCD).....	1
6	Technical Specifications	1
6.1	System Controller.....	2
6.2	Communication.....	2
6.2.1	Communication from controller to opposite road side.....	2
6.3	Power Supply	3
6.3.1	Solar PV Powered System.....	3
6.4	Traffic Signal Assemblies	3
6.5	LED Pedestrian Countdown Signals (Quantity: 2).....	3
7	Signs	4
8	Activation	4
8.1	Basic APS Pushbutton.....	4
9	Cabinet.....	4
9.1	Side of Pole Cabinet.....	4

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System Specifications

1 Terms

The system shall conform to the current edition of the MUTCD.

2 Project Location

The system consists of the materials for the installation of a Pedestrian Hybrid Signal (HAWK) Pedestrian Crosswalk System to be used for the pedestrian crossing in Ridgecrest, CA at SGT Pinney Memorial Pool crossing, to alert motorists that they are approaching an active pedestrian crossing occupied or about to be occupied by one or more pedestrians.

3 Installer Responsibilities

The installer's responsibilities would consist of installing system and auxiliary components such as poles, supplementary signs, automatic detection, and the construction of facilities to support the system, as outlined in these specifications and in strict adherence to the manufacturer's installation requirements as outlined in, but not limited to, the manufacturer's installation instructions.

Several utilities may exist in the area; any and all utilities' locations shown in any plans should be considered approximate. The installer shall be responsible for contacting the appropriate authority and all affected utility companies prior to any drilling or excavation for this project.

The installer shall stake all proposed accessible push button station locations, ground box locations, conduit, and pole locations after utility locations are finalized. The engineer having authority must approve these locations prior to any drilling or excavation for the project.

4 Warranty

System components shall have a non-pro-rated warranty period of five (5) years against manufacture defects and failure under normal use.

5 System Regulatory Requirements (per FHWA – MUTCD)

The Pedestrian Hybrid Signal (HAWK) system specified herein shall fully comply with FHWA MUTCD Section 4F and be designed and verified by the manufacturer for full compliance.

6 Technical Specifications

IMPORTANT: If the installer wishes to submit an alternate system for an approved equal ("equal" is defined herein as meeting or exceeding all the specifications shown in this document), specifications of the proposed alternate that fully conform to the following specifications shall be submitted to the Engineer having jurisdiction at least sixty (60) working days prior to the bid opening date as determined in the bid solicitation notice. No proposed "equal" product proposed after the 60 day advance will be accepted, and it is therefore assumed the successful bidder on this project will install the specified product if no approval has been issued by the Engineer Having Jurisdiction.

6.1 System Controller

The system controller for this system shall be as follows:

1. Type: LaneLight™ MK10 equipped with MK10 HAWK system driver
2. Casing material: Anodized aluminum
3. Operating temperature range: -40°C to 65°C (-40°F to 149°F)
4. Operating voltage: 10-30 VDC
5. Supply voltage: 110 to 240 volts AC line voltage with factory supplied power converter/12VDC Solar
6. Output voltage: 12 VDC
7. Transient/Inrush current limiting – internal on all outputs
8. Overload –internal, auto-reset circuit breakers on outputs, 10A threshold on two output channels
9. Power Factor Correction – provided, Power Output limiting – 120%
10. Short Circuit – Continuous protection, intermittent cycle permitted
11. Activation time: 0 to 120 seconds, or continuous
12. Pattern Mode: Signal pattern shall comply with FHWA MUTCD
13. Configuration: On board menu or remote
14. Diagnostics: On board menu or remote
15. Remote access: Any modem (if applicable) or LaneLight™ Connect cloud service
16. Terminal connection type: Screw terminals
17. Standards compliance: NEMA

6.2 Communication

This section describes communication between system control units, local and/or from system to cloud or network.

1. Stand-alone, hard-wired to signal and activation devices
2. Cellular network connectivity if LaneLight™ Connect cloud service equipped

6.2.1 Communication from controller to opposite road side

- Wired, using direct burial rated proprietary cable, to be provided by manufacturer, contained in conduit (Solar, to one side only).

6.3 Power Supply

6.3.1 Solar PV Powered System / AC (Grid) Powered Capability (For Future Use)

1. System shall be solar powered with manufacturer designed and supplied solar/battery power package. The system shall consist of a solar panel or panel array and pole mount, MPPT solar charge regulator, circuit breakers for panels, Lithium Iron Phosphate (LiFePO₄) battery, capacity determined by the manufacturer, load terminal strip for all connections pertaining to the solar power equipment. NEMA 3R cabinet with #2 Corbin lock, with LaneLight™ HAWK controller and any auxiliary activation controllers or equipment interfaces capable of being mounted within. Solar system autonomy shall exceed 5 days operation at 300 30 second cycles per 24 hour day.

System shall be pre-installed for A/C capability for future use; internally converted to appropriate control voltage DC and controller provided AC to suit the connected components.

2. Cabinet shall be supplied with mounting hardware suitable for banding to a pole (or other, as specified herein).
3. The solar panels shall be specifically sized by the HAWK system manufacturer according to the regional solar conditions and shall include all necessary mounting hardware for side of pole mounting.
4. The solar panel aiming direction and aiming angle shall be fully adjustable and installed according to the manufacturer's angle and direction specifications for the geographical location of the crosswalk.
5. Replacement solar panels shall be available and replaceable independent of other system components.

6.4 Traffic Signal Assemblies

All vehicle indications shall be 12 inch LED (300 mm) line voltage (120V) provided by the HAWK system manufacturer; furnished with visors and back plates, and shall conform to the following specifications:

1. Luminous Intensity acc. to EN12368: RED > 200 cd; Yellow > 200cd
2. Color acc. To EN12368: RED 613.5–631 nm; Yellow 585-597nm
3. LED Type: High Flux
4. Power Consumption: RED – 6 to 8W; Yellow – 6 to 8W
5. Material (lens and housing): UV-stabilized polycarbonate
6. LED signal modules shall be fully compliant with the Institute of Transportation Engineers (ITE) Vehicle Traffic Control Signal Heads (VTC SH) LED Circular Supplement specifications dated and adopted June 27, 2005.

6.5 LED Pedestrian Countdown Signals (Quantity: 2)

LED pedestrian count down signal face modules shall have the following specifications:

1. Meets or exceeds ITE intensity, color and uniformity specification, including 49°C / 74°C requirements at 120 VAC.
2. Manufactured with anti-capillary wires.

3. Reduced off state icon visibility results in increased pedestrian safety by eliminating the potential to misinterpret the signal.
4. Conformal coated power supply.
5. One piece housing design.
6. All units operate at 90-130VAC.
7. Countdown and Hand – Portland Orange @ 1400 cd/m².
8. Person – Lunar White @ 2200 cd/m².

7 Signs

1. Sign Type: PER CA MUTCD
2. Sign Size: Per Plans
3. Pushbutton signs: Per Plans

8 Activation

8.1 Basic APS Pushbutton

1. Type: Polara INS Annunciating Pushbutton
2. Model: Polara INS 2 wire
3. Quantity: 2
4. Casing color: Yellow
5. Dynamic volume level control
6. Touchless Activation

9 Cabinet

9.1 Side of Pole Cabinet

1. NEMA 3R cabinet with Corbin #2 lock, with controller and any auxiliary activation controllers or equipment interfaces capable of being mounted within.
 - Model No – ASM-EN-251715 (25" X 17" X 15")
2. Cabinet shall be supplied with mounting hardware for a variety of poles, or as specified by the client.
3. Fully equipped weight shall not exceed 30 lb. AC, or 80 lb. solar.

PRODUCT MANUAL

HAWK Pedestrian Crosswalk System

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Table of Contents

1	Welcome to LaneLight	1
1.1	Warranty	1
1.2	Customer Responsibility	1
1.3	Safety Symbols	2
1.4	Safety Notices	2
1.5	About this Document	3
1.5.1	Contents	3
1.5.2	Purpose and Scope	3
1.5.3	Assumptions	3
2	System Overview	4
3	Installation	6
3.1	Equipment/Tools Required	6
3.2	Warnings and Notifications	6
3.3	Installation Overview	7
3.4	Determine Equipment Mounting Locations and Requirements	8
3.4.1	Pole Location Guidelines	8
3.4.2	Equipment Mounting Location Guidelines	8
3.5	Mark and Drill Holes for Cables and Mounting Hardware	9
3.6	Install The Solar Panel (If Required)	10
3.7	Install the Control Cabinet	12
3.7.1	Universal Hub Plate Mounts	12
3.7.2	U-Bolt Mount	12
3.8	Install Flasher and Activation Devices	12
3.9	Connect Cables	13
4	System Configuration	17
4.1	LCD Menu	17
4.1.1	LCD Interface Overview	17
4.1.2	Parameter Descriptions and Options	18
4.1.3	LCD Menu Configuration Procedure	20
4.2	Configuration Utility Program	22
4.2.1	Configuration Utility Installation	22
4.2.2	Configuration Utility Procedure	22
5	Maintenance	25
5.1	Activities and Schedules	25
5.2	Maintenance Procedures	25
5.2.1	Replace the Controller Battery	25
6	Troubleshooting	26
6.1	General Troubleshooting	26
6.2	Input/Output Port Descriptions	26
6.3	Diagnostic Menu – LCD Screen	28
6.4	Configuration Utility Program	29
7	Specifications	30
8	Technical Support	31
8.1	Proof of Warranty	31
8.2	Service Tickets	31

8.3	Replacement Units	31
8.4	Technical Support	31

List of Figures

Figure 1: HAWK system controller	4
Figure 2: HAWK beacon signal sequence	5
Figure 3: Hub plate mounting options	8
Figure 4: U-bolt mounting option	8
Figure 5: Solar panel orientation	10
Figure 6: Solar panel assembly with U-bolt fasteners	11
Figure 7: Solar panel angles	11
Figure 8: Control cabinet U-bolt installation	12
Figure 9: SAMPLE control cabinet wiring	14
Figure 10: SAMPLE HAWK beacon wiring	15
Figure 11: SAMPLE pedestrian signal wiring	15
Figure 12: SAMPLE pushbutton wiring	16
Figure 13: SAMPLE LaneLight IRWL wiring	16
Figure 14: Configuration menu – LCD	18
Figure 15: Setting parameters via LCD and Menu dial	21
Figure 16: Configuration utility - Timings tab	23
Figure 17: Configuration utility – Status tab	24
Figure 18: Diagnostic menu – LCD	28

List of Tables

Table 1: Controller panel connection ports	4
Table 2: LCD screen layout, RUN mode	17
Table 3: Maintenance activities and schedules	25
Table 4: General troubleshooting matrix	26
Table 5: Activation Input ports	26
Table 6: Markers Output ports	26
Table 7: Aux Out 1	27
Table 8: Aux Out 2	27
Table 9: Aux Out 3	27
Table 10: Power	27
Table 11: HAWK controller specifications	30

1 WELCOME TO LANELIGHT

Thank you for choosing LaneLight. To help ensure many years of trouble-free operation, read this manual carefully and follow its instructions and recommendations. All of us at LaneLight have a continuing interest in road and pedestrian safety and in your full satisfaction with our products.

1.1 WARRANTY

LaneLight provides a 5-year limited warranty on the supplied equipment (excluding batteries) **only if** the warranty report is completed correctly, signed, and received by LaneLight. To activate your warranty, complete a warranty registration form and fax it or email a scanned copy or photo of it to LaneLight.

Email: info@lanelight.com

Fax: 250-381-4830

NOTE: The warranty period begins from the date of product **delivery**, not the date the registration form is received.

1.2 CUSTOMER RESPONSIBILITY

The customer (or authorized representative) is responsible for the following:

- ensuring any electrical devices are installed correctly, safely and as per industry standards
- performing all system maintenance and operation
- addressing any unit damage caused by improper installation and incorrect wiring
- reading all instructions and requirements in this manual before going to the installation site
- contacting LaneLight if there is confusion regarding, disagreement with, or inability to perform any given instruction in this manual

Always keep a copy of this product manual on site.

1.3 SAFETY SYMBOLS

Watch for these important symbols within this manual:



WARNING: This symbol indicates that serious bodily harm or death may result from failure to adhere to precautions.



CAUTION: This symbol indicates that damage to equipment may result if the instructions are not followed.

NOTE: This paragraph indicates additional information or suggests optimal conditions under which the equipment will operate the most efficiently.

1.4 SAFETY NOTICES



WARNING: Batteries are shipped fully charged and can generate short circuit currents. Use caution with tools and remove all metal accessories/jewelry before handling the batteries.

WARNING: Solar panels produce DC electricity when exposed to light (natural or artificial) and have the potential to generate enough electricity to shock or burn. To mitigate this risk, cap or insulate the solar panel's wire ends until power from the panel is required.

WARNING: Ensure that all equipment is disconnected from any power source during the installation and wiring of the system.

WARNING: When working with AC power systems, ONLY qualified electricians should make connections between the controller and the AC power source.



CAUTION: Inspect all wiring for correct polarity before energizing the system.

CAUTION: If the system installed is equipped with a surge suppressor, ensure that the surge suppressor's ground terminal is connected directly to ground; follow appropriate local electrical grounding practices. Use AWG12 wire (minimum) and label the wire accordingly. Do not bend sharply or break the conductors of the grounding wire. Consult the wiring diagram included with the system.

1.5 ABOUT THIS DOCUMENT

1.5.1 Contents

Product manuals may contain any or all of the following information, depending on the product/system:

- System description
- Safety notices
- Preparation information, including required tools and equipment
- Installation instructions
- Configuration and setup instructions
- Operation instructions
- Maintenance schedule and tasks
- Troubleshooting information

1.5.2 Purpose and Scope

The purpose of this manual is to provide the following information for the HAWK controller:

- Unit/system description
- Installation procedures
- Operating procedures
- Troubleshooting procedures

1.5.3 Assumptions

It is assumed that the reader and user of this manual and the hardware described herein are authorized by the local traffic governing body to work in and around traffic cabinets. The reader should be familiar with the operation and wiring of traffic control cabinets in their area, and must be aware of, and follow, all safety and other operational protocols of the local traffic agency.

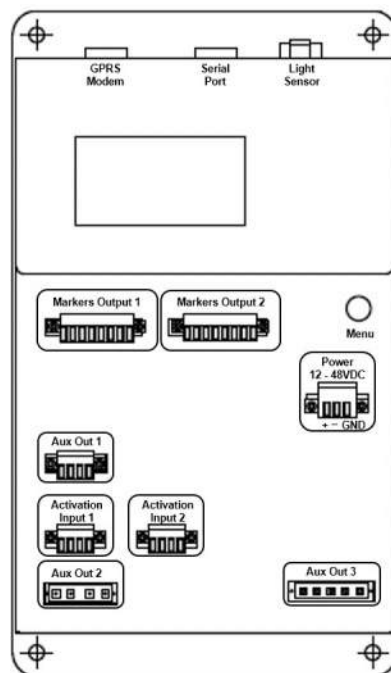
2 SYSTEM OVERVIEW

The LaneLight™ HAWK Pedestrian System Controller is a solid-state programmable controller designed for use in solar/DC or AC powered applications. The HAWK controller can output signals for HAWK signal beacons, LaneLight In-Road Warning Lights (IRWLs), or both. The controller has two inputs for contact closure circuits, two dedicated outputs for IRWLs, and several auxiliary output ports. The controller monitors the output currents on each channel constantly to protect the system against damage.

The HAWK controller contains the required hardware and software to interpret output signals from standard contact closure switches. Upon detection of a trigger event, the controller can output the required activation signals to HAWK signal beacons and/or LaneLight IRWLs according to the parameters defined in the controller's configuration software menu.

The compact HAWK controller mounts vertically and is designed for use in panel mount traffic cabinets.

Figure 1: HAWK system controller

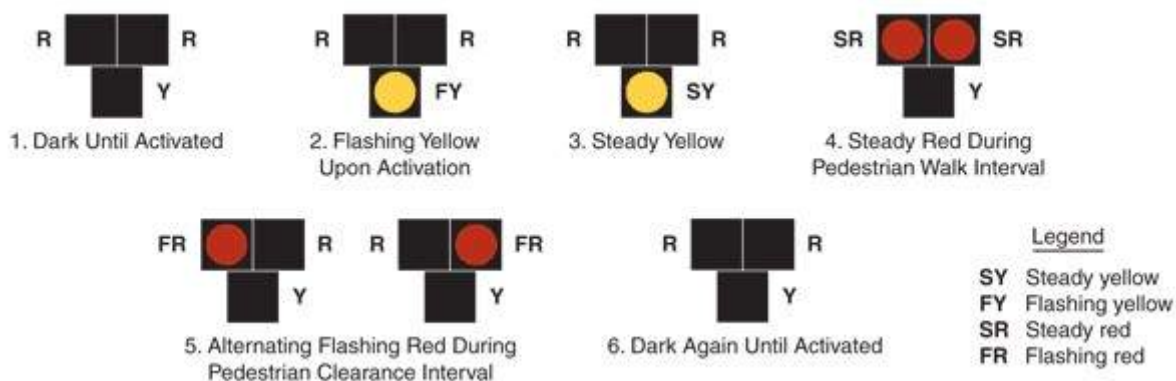


NOTES:

- The controller can be monitored and configured via the LCD screen and the multi-function menu rotary dial/pushbutton located on the front of the unit.
- The controller can also be configured via a custom configuration utility program installed on a laptop. A serial to USB adapter is required for this method. Refer to section 4 *System Configuration* on page 17 for more information.
- Communication ports and the port for the optional light sensor are located on the top of the controller.
- Voltage at the output ports is 0.7 – 1.0 V below the supply voltage.

Table 1: Controller panel connection ports

Panel Element	Description
GPRS Modem	9-pin male serial port for connecting to a laptop for configuration and diagnostics
Serial Port	9-pin female serial port for firmware programming only
Light Sensor	2-connector port for an optional light sensor component
Markers Output 1	Output port for LaneLight MLK150 In-Road Warning Lights (IRWL)
Markers Output 2	Output port for LaneLight MLK150 In-Road Warning Lights (IRWL)
Menu	Combination rotary dial/pushbutton Used to access the controller's Configuration and Diagnostic menus on-screen
Power 12-48 VDC	Power connection for the controller
Aux Out 1	Optional high side output DC, current monitored
Aux Out 2	Optional AC relay, 120VAC, 1A max, NO, 1 Form A
Aux Out 3	Optional low side switch output, 2A max
Activation Input 1	Input port for contact closure activation devices
Activation Input 2	Input port for contact closure activation devices

Figure 2: HAWK beacon signal sequence


3 INSTALLATION

Note: Installation instructions for LaneLight In-Road Warning Lights (IRWLs) and other flasher devices are contained in a separate document.

3.1 EQUIPMENT/TOOLS REQUIRED

The following tools/equipment are required to install the HAWK controller into an existing control cabinet:

- Screwdriver set
- 4 x stainless steel machine screws ¼ in. (supplied)
- 4 x stainless steel washers, ¼ in. (supplied)

NOTE: The HAWK controller is normally shipped pre-mounted within a LaneLight control cabinet.

The following tools/equipment may be required for installing solar panels, LaneLight control cabinets, and flasher devices:

- Ladder or bucket truck
- Wrench kit and screwdriver kit
- BAND-IT® tool with minimum 1/2 in. stainless steel banding (3/4 in. recommended)
- Drill with step bit from 1/2 in.-1 in.
- Fish tape

Optional: The following is required if a laptop will be used to connect to the system controller:

- DB-9 null-modem cable
- Serial to USB adapter and connection cable
- Laptop with Microsoft Windows™ operating system (minimum Windows XP; Windows 10 recommended)
- LaneLight's custom configuration utility program (installed onto the laptop before going on site)

3.2 WARNINGS AND NOTIFICATIONS



WARNING: The enclosure must be properly grounded when installing the controller. If mounting the controller on a non-conductive panel, provide a separate grounding wire (minimum AWG #14) that runs from the enclosure to the system ground.

WARNING: All electrical connections must be made in accordance with governmental and local codes for electrical installations.

WARNING: Ensure that all equipment is disconnected from any power source during the installation and initial wiring of the system.



CAUTION: Inspect all wiring for correct polarity before energizing the system.

CAUTION: If the system installed is equipped with a surge suppressor, ensure that the surge suppressor's ground terminal is connected directly to ground; follow appropriate local electrical grounding practices. Use AWG12 wire (minimum) and label the wire accordingly. Do not bend sharply or break the conductors of the grounding wire. Consult the wiring diagram included with the system.

NOTE: The HAWK controller contains a lithium cell battery (3V, CR2025 or similar), which powers the internal Real Time Clock (RTC) and SRAM where user settings are stored.

3.3 INSTALLATION OVERVIEW

The HAWK system controller is typically part of an overall system and is normally pre-mounted within a LaneLight control cabinet.

This section describes general installation guidelines and procedures for installing typical system assemblies, including a solar panel (if applicable) and the control cabinet.



WARNING: **DO NOT make any electrical connections until instructed to do so.**

NOTE: This section contains general installation instructions only. Actual installation procedures may vary depending on site conditions and equipment installed.

1. Determine the pole locations (if required).
2. Determine the mounting locations on the poles for all equipment.
3. Drill and prepare access holes for mounting and/or cabling as required in the poles.
4. Install the solar panel (if applicable).
5. Install the control cabinet.
6. Install HAWK beacons, LaneLights and any other flasher devices as applicable.
7. Install activation devices (e.g. pushbuttons, bollards).
8. Make all required device connections at the control cabinet.

3.4 DETERMINE EQUIPMENT MOUNTING LOCATIONS AND REQUIREMENTS

Refer to site plans and engineering documents.

3.4.1 Pole Location Guidelines

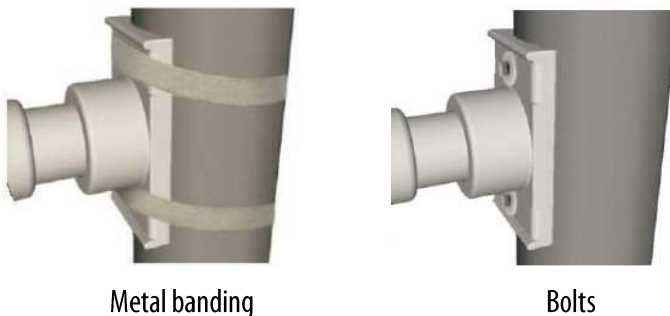
- When determining **pole locations**, consider the following factors:
 - For solar powered systems, ensure that the solar panel, when installed, will not be obstructed by trees, hills, buildings, walls, poles or other objects that will block sunlight. **The solar panels require direct sunlight to operate efficiently.**
 - Consult appropriate traffic signage regulations for placement locations.

3.4.2 Equipment Mounting Location Guidelines

- When planning the **equipment mounting locations on the poles**, consider the following factors:
 - Determine the type of mounting method to be used for each piece of equipment.
 - Determine the equipment mounting locations for all assemblies before drilling holes for mounting hardware (if applicable) and access holes for the cables.
 - To help prevent vandalism, mount equipment 8 ft. or higher where possible and appropriate.

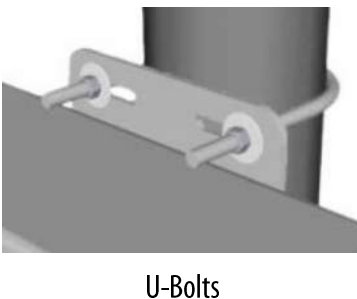
How equipment is mounted may vary depending on local requirements and site conditions.

Figure 3: Hub plate mounting options



NOTE: If using metal banding, use a BAND-IT® tool with minimum 1/2 in. stainless steel banding (3/4 in. recommended). Consult BAND-IT resources for usage of the tool as that is beyond the scope of this manual (<https://www.band-it-idex.com>).

Figure 4: U-bolt mounting option



Some LaneLight assemblies, i.e. solar panels and some models of control cabinets, are shipped with U-bolt mounting hardware.

NOTE: Backup nuts are required to prevent deformation of the bracket.

3.5 MARK AND DRILL HOLES FOR CABLES AND MOUNTING HARDWARE

This section assumes that the equipment location and mounting requirements have been determined.

NOTE: Whenever possible, run all cables into the rear of the control cabinet from inside the pole. A standard control cabinet has at least two (2) conduit blanks, and more can be added at this time if required to accommodate additional cables if access at the rear cabinet is not available.

NOTE: Run cables through conduit.

1. **AS REQUIRED:** Mark and drill 3/4 in. cable access holes in the pole(s) for the power/control cables for all assemblies to be installed and connected to the HAWK system controller.
This will vary depending on the number and type of equipment assemblies to be installed.
2. Deburr the edges of the hole and install a conduit fitting or grommet as appropriate to prevent sharp edges from damaging the cables.
3. **AS REQUIRED:** Mark and tap holes for mounting hardware; sizes will vary.

3.6 INSTALL THE SOLAR PANEL (IF REQUIRED)



WARNING: Solar panels produce DC electricity when exposed to light (natural or artificial) and have the potential to generate enough electricity to shock or burn. To mitigate this risk, cap or insulate the solar panel's wire ends until power from the panel is required.

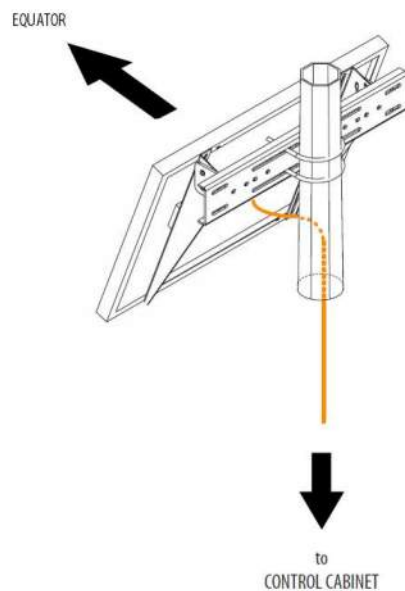


CAUTION: Ensure that the solar panel, when installed, will not be obstructed by trees, buildings, walls, poles or other objects that will block the sun. The solar panels require direct sunlight to operate efficiently.

NOTE: This procedure assumes that the mounting location for the control cabinet has been determined and that any access holes have been drilled and prepared appropriately.

1. Orient the solar panel assembly so that it faces the equator.
Northern hemisphere installation = panel faces south
Southern hemisphere installation = panel faces north

Figure 5: Solar panel orientation



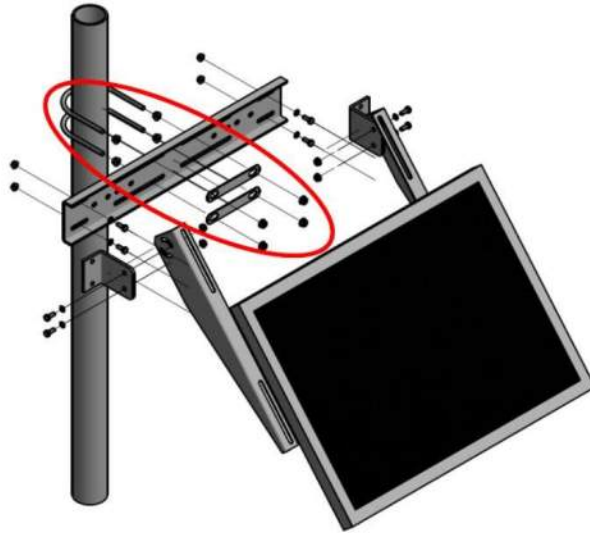
2. Secure the solar panel to the pole.
NOTE: Solar panels may vary depending on site conditions and customer requirements. Standard LaneLight solar panels are shipped with U-bolt mounting hardware. For U-bolt installation:
 - a. Install the backup nuts and washers on both U-bolts. Set one aside.
 - b. Place the solar panel mounting bracket against the pole.
 - c. Slide the upper U-bolt through the upper slot on the solar panel's mounting bracket. Install the flat plate, then the fastening washer and nut. Tighten the fastening nuts to hand-tight.
 - d. Still supporting the panel, insert the lower U-bolt through the lower slot on the panel's mounting bracket. Install the flat plate, then the fastening washers and nuts. Tighten all fastening nuts fully.

CAUTION: Do not over-tighten the fastening bolts. The flat plate should not bend or deform.

CAUTION: AVOID using metal banding to mount the solar panel assembly.

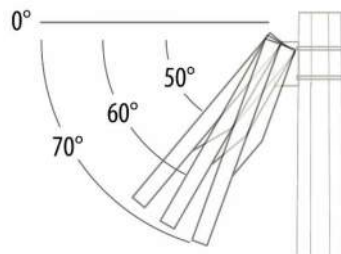


Figure 6: Solar panel assembly with U-bolt fasteners



3. Support the weight of the solar panel, then loosen the bolts at the **hinges** of the solar panel assembly.
4. Set the tilt angle of the solar panel.

Figure 7: Solar panel angles



Set the tilt angle based on the geographic location of the installation to maximize winter solar collection.

ANGLE	LAT	EXAMPLE CITY
55°	35	Los Angeles, CA
60°	40	New York, NY
65°	45	Portland, OR
70°	50	Vancouver, BC
75°	55	Grande Prairie, AB
80°	60	Whitehorse, YK

5. Tighten the hinge bolts securely. **DO NOT OVERTIGHTEN.**

3.7 INSTALL THE CONTROL CABINET

This procedure assumes that the mounting location for the control cabinet has been determined and that any cable access holes have been drilled and prepared appropriately.

NOTE: If possible and practical, install the control cabinet on the pole BEFORE running cables through the pole to the control cabinet access hole. This will avoid the risk of crushing or pinching cables when installing the cabinet.

3.7.1 Universal Hub Plate Mounts

For control cabinets with universal hub plate mounts, use metal banding or bolts as appropriate for the site. See section 3.4.2 *Equipment Mounting Location Guidelines* on page 8.

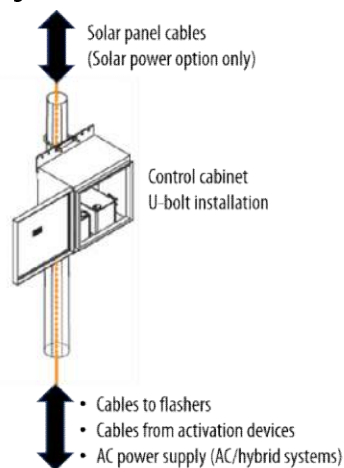
3.7.2 U-Bolt Mount

1. Install the backup nuts and washers on the U-bolt.
2. Place the control cabinet against the pole.
3. Supporting the cabinet, slide the U-bolt through the mounting plate, install the flat plate, then install the fastening washers and nuts. Tighten the fastening nuts fully to support the cabinet's weight.



CAUTION: Do not over-tighten the U-bolt mounting bolts. The flat plate should not bend or deform.

Figure 8: Control cabinet U-bolt installation



3.8 INSTALL FLASHER AND ACTIVATION DEVICES

If required, consult product manuals for the devices to be installed.

1. Install flasher devices (HAWK beacons, LaneLights, pedestrian signals.) as required.
2. Install activation devices (pushbuttons, bollards) as required.
3. Run all equipment assembly cables through the pole to the control cabinet but do not connect them yet.
4. Seal the cable holes in the pole with appropriate sealant so there is no gap between the hole's edges and the cable.
5. Verify that cables have not been pinched or crushed during installation procedures.

3.9 CONNECT CABLES



WARNING: Batteries are shipped fully charged and can generate short circuit currents. Use caution with tools and remove all metal accessories/jewelry before handling the batteries.

Solar panels produce DC electricity when exposed to light (natural or artificial) and have the potential to generate enough electricity to shock or burn. To mitigate this risk, cap or insulate the solar panel's wire ends until power from the panel is required.

Ensure that all equipment is disconnected from any power source during the installation and wiring of the system.

When working with AC power systems, **ONLY** qualified electricians should make connections between the controller and the AC power source.



CAUTION: Inspect all wiring for correct polarity before energizing the system.

CAUTION: If the system installed is equipped with a surge suppressor, ensure that the surge suppressor's ground terminal is connected directly to ground; follow appropriate local electrical grounding practices. Use AWG12 wire (minimum) and label the wire accordingly. Do not bend sharply or break the conductors of the grounding wire. Consult the wiring diagram included with the system.

This procedure assumes that all required cables for flasher and activation devices and the solar panel and battery (if applicable) have been run through the pole to the traffic controller cabinet and are ready to be connected.

NOTE: Consult the wiring diagram(s) for the specific installation. This should be located inside the control cabinet door. Cables for flasher and activation devices and the solar panel and battery (if applicable) are typically connected to terminal blocks in the control cabinet instead of directly to the system controller.

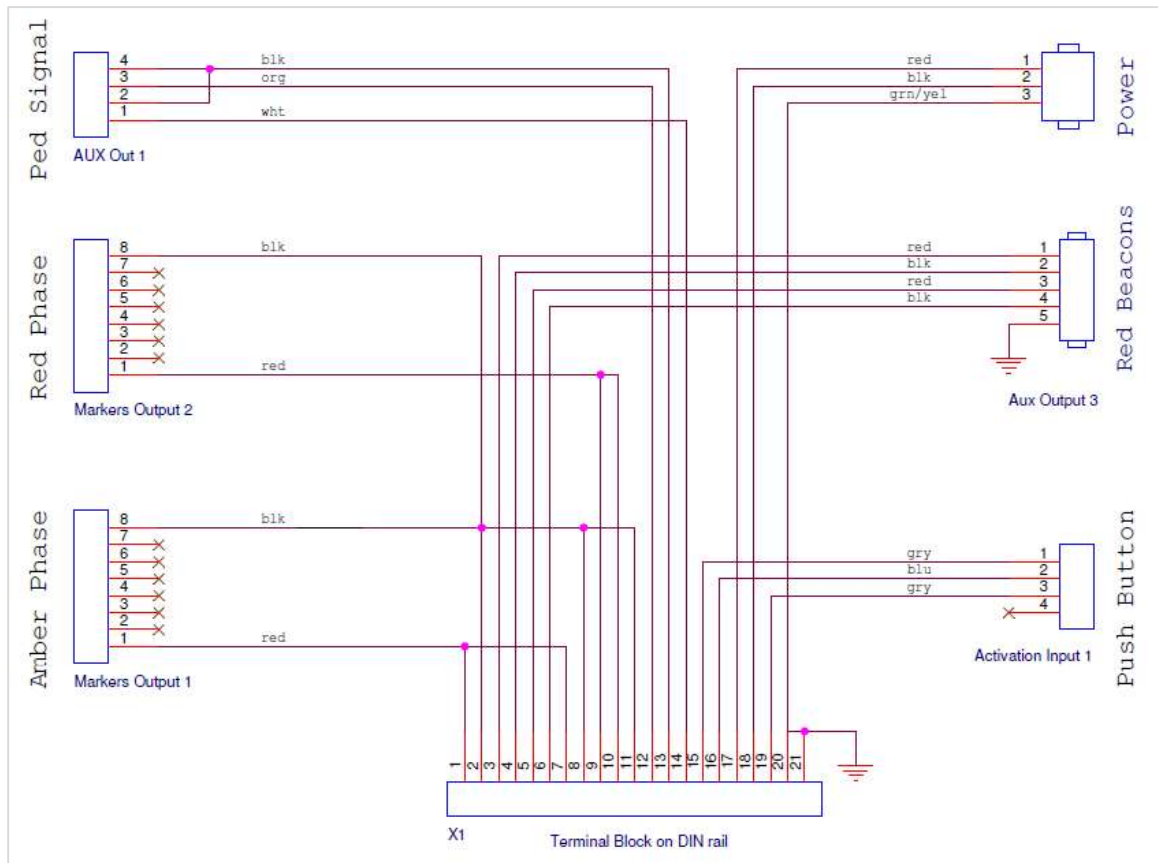
1. Ensure all breakers in the control cabinet are set to OFF.
2. Connect the activation signal input devices (e.g. pushbuttons, bollards) to the appropriate terminal blocks in the control cabinet.
3. Connect the HAWK beacons to the appropriate terminal blocks in the control cabinet.
4. Connect other flasher devices, if applicable.



CAUTION: Use caution when connecting the solar panel and the battery cables. Unless the solar panel is covered by an opaque material, there will be power at the wires. Batteries are shipped fully charged.

5. Connect solar panel cables to the appropriate terminal blocks in the control cabinet, if applicable.
6. Connect battery cables to the appropriate terminal blocks in the control cabinet, if applicable.
7. Set the breakers in the control cabinet to ON.
This enables power to the controller and all devices connected to the control cabinet.
8. Configure and test the system. Refer to section 4 *System Configuration*.

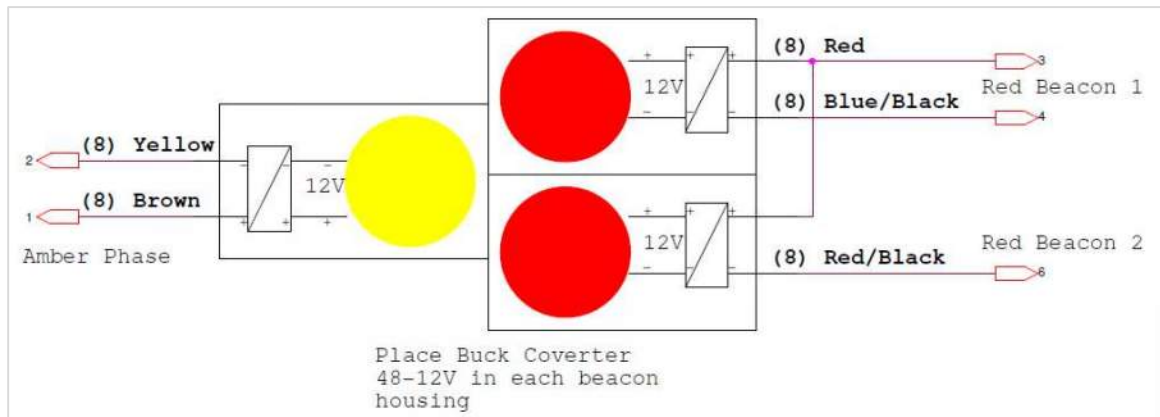
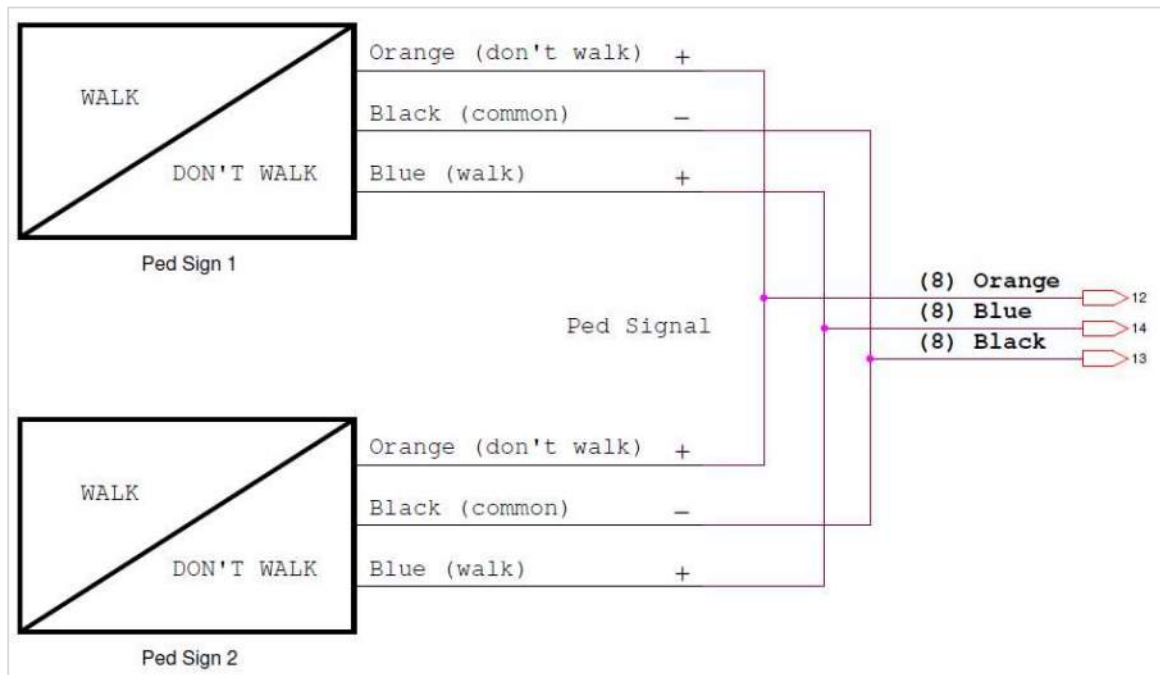
Figure 9: SAMPLE control cabinet wiring



Terminal block numbering

- | | |
|------------------------------------|-----------------------|
| 1. Amber beacon 1 (+) | 15. Push button 1a |
| 2. Amber beacon 1 (-) | 16. Push button 1b |
| 3. Red beacon 1 (+) | 17. Batt In (+) |
| 4. Red beacon 1 (-) | 18. Batt In (-) |
| 5. Red beacon 2 (+) | 19. Spare 1 |
| 6. Red beacon 2 (-) | 20. Ground |
| 7. Amber LL (+) | 21. Ground |
| 8. Amber/Red Common LL (-) | 22. Battery (+) |
| 9. Red LL (+) | 23. Battery (-) |
| 10. Sign (+) | 24. Solar (+) |
| 11. Sign (-) | 25. Solar (-) |
| 12. Ped Head (Don't Walk +) orange | 26. Breaker Load |
| 13. Ped Head (common -) black | 27. Breaker Battery |
| 14. Ped Head (Walk +) blue | 28. Breaker Panel (+) |

NOTE: All wiring diagrams shown in this manual are examples only and intended for general information. Refer to the site-specific wiring diagrams.

Figure 10: SAMPLE HAWK beacon wiring

Figure 11: SAMPLE pedestrian signal wiring


NOTE: All wiring diagrams shown in this manual are examples only and intended for general information. Refer to the site-specific wiring diagrams.

Figure 12: SAMPLE pushbutton wiring

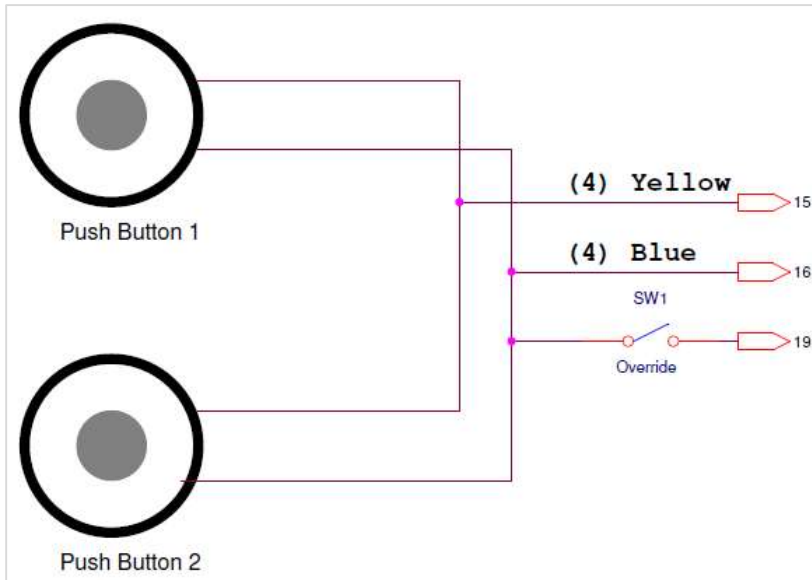
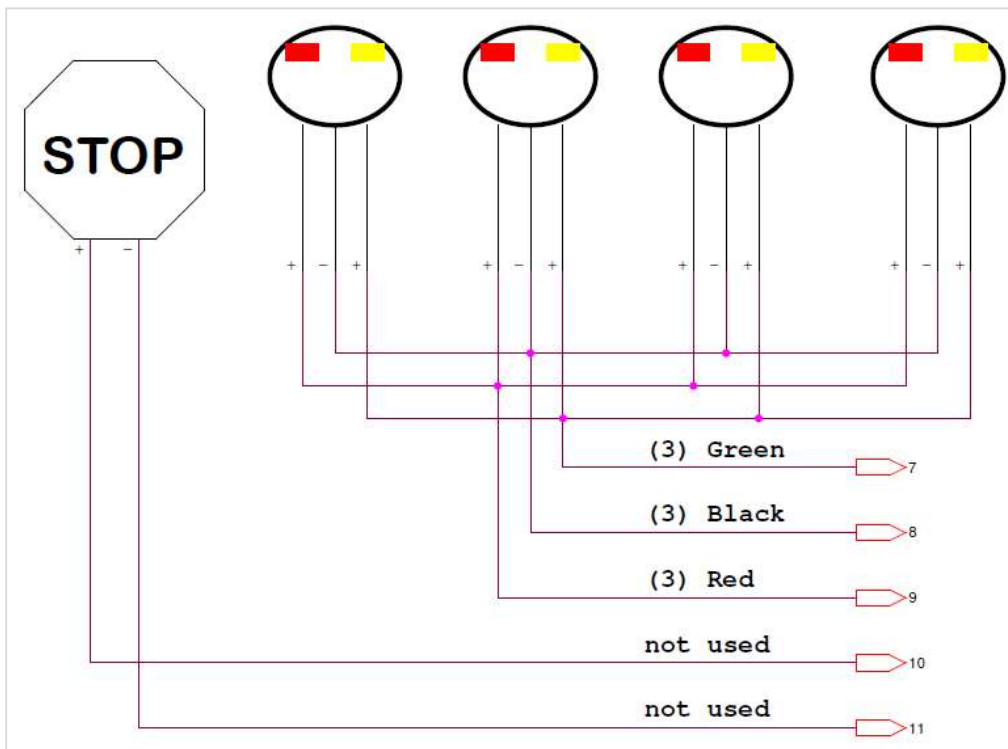


Figure 13: SAMPLE LaneLight IRWL wiring



NOTE: All wiring diagrams shown in this manual are examples only and intended for general information. Refer to the site-specific wiring diagrams.

4 SYSTEM CONFIGURATION

The HAWK can be configured using either of the following methods:

- **LCD screen and Menu button** on the front of the controller chassis (4.1.3 LCD Menu Configuration Procedure on page 20)
- **Configuration Utility** program (4.2.2 Configuration Utility Procedure on page 22)

4.1 LCD MENU

4.1.1 LCD Interface Overview

When the HAWK controller powers up, it automatically enters RUN mode, which displays status information for the controller on the controller's LCD screen. The LCD screen comprises eight (8) lines of text that display the following information:

Table 2: LCD screen layout, RUN mode

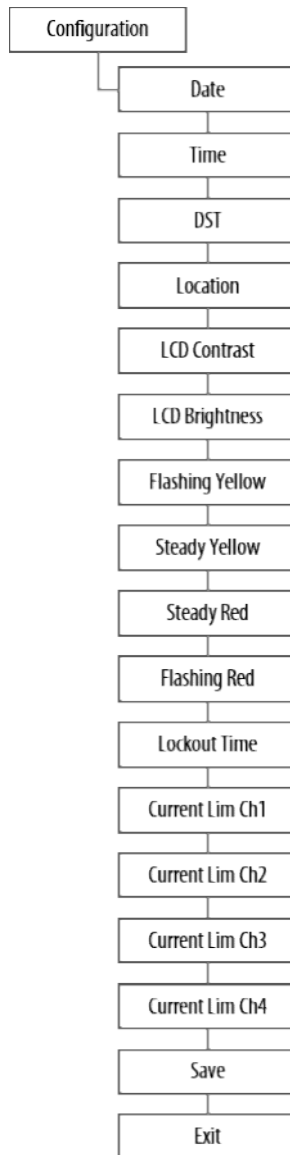
Line	Information	Example
1	Input voltage and date stamp (MM/DD/YYYY)	Vin:13.5V 01/30/2018
2	Total output current and time stamp (HH:MM:SS)	Iout:1.2A 15:22:45
3	Controller status (Idle, Activated, Triggered, Error, Lockout, Override)	Status: Idle
4	Controller mode (Run, Configuration, Diagnostic)	Mode: Run
5	Selected parameter (Configuration mode)	
6	Selected parameter value (Configuration mode)	
7	Event log entry	Max Cur Ch1 4.6A
8	Event log time stamp (MM/DD/YYYY) (HH:MM:SS)	01/30/2018 18:44:15

The LCD screen, in conjunction with the Menu pushbutton/dial, also allows users to access the controller's Configuration and Diagnostic menus.

- See section 4.1.2 *Parameter Descriptions and Options* on page 18 and section 4.1.3 *LCD Menu Configuration Procedure* on page 20 for more information regarding Configuration parameters and procedures using the LCD screen.
- See section 6.3 *Diagnostic Menu – LCD Screen* on page 28 for Diagnostic functions accessible via the LCD screen.

4.1.2 Parameter Descriptions and Options

Figure 14: Configuration menu – LCD



After powering up, the HAWK controller automatically enters Run mode and uses the parameters stored in non-volatile memory.

In **Configuration** mode, the parameters shown here can be viewed or changed/set. *Figure 14* shows the order in which the parameters will appear when configuring the controller via the LCD menu. The table on the following page describes the format and options for each parameter.

Refer to section 4.1.3 *LCD Menu Configuration Procedure* on page 20 for details.

Parameter	Description/Format/Options
Date	MM/DD/YYYY
Time	HH:MM:SS
DST (Daylight Savings Time)	<ul style="list-style-type: none"> No DST: RTC does not use Daylight Savings Time EPA 2005: Engages Daylight Saving Time from the first Sunday in April until the last Sunday in October EPS 2007: Engages Daylight Saving Time from the second Sunday in March until the first Sunday in November
Location	Text field that allows a user to create a Location label for the controller
LCD Contrast	<ul style="list-style-type: none"> Range: 0 – 100 Sets the contrast for the controller's LCD screen
LCD Brightness	<ul style="list-style-type: none"> Range: 0 – 100 Sets the brightness for the controller's LCD screen

Parameter	Description/Format/Options
Flashing Yellow	<ul style="list-style-type: none"> Range: 1 – 60 seconds Sets the 'flashing' time for the yellow beacon(s)
Steady Yellow	<ul style="list-style-type: none"> Range: 1 – 60 seconds Sets the 'steady on' time for the yellow beacon(s)
Steady Red	<ul style="list-style-type: none"> Range: 1 – 60 seconds Sets the 'steady on' time for the red beacons
Flashing Red	<ul style="list-style-type: none"> Range: 1 – 60 seconds Sets the 'flashing' time for the red beacons
Lockout Time	<ul style="list-style-type: none"> Range: 1-60 seconds Sets the time for the controller lockout and store calls from activation devices (i.e. pushbuttons)
Current Lim Ch1 (Current Limit)	<p>Range: 0.5 – 8.0 Amps</p> <ul style="list-style-type: none"> Sets the value in Amps to trip the electronic overload protection circuit for the Markers Output 1 port If an overcurrent condition exists for more than 500ms, the supply voltage to the markers is cut and a message is shown on the status line of the display The circuit is reset each time the system is triggered and trips again as long as the fault condition exists The number and color of IRWLs and the operating voltage are required to calculate this value <p>Quick Calculation Method:</p> <ul style="list-style-type: none"> Verify all LaneLight markers, external flashers and activation devices are functional. Use the Diagnostic mode to set All Markers to ON (illuminate without flashing). Read the amperage shown on the LCD display. Use the Diagnostic mode to set All Markers to OFF. Amperage value x 1.5 = Current Limit
Current Lim Ch2	Same as Current Lim Ch1 for the Markers Output 2 port
Current Lim Ch3	Same as Current Lim Ch1 for the Auxiliary Out 1 port
Current Lim Ch4	Same as Current Lim Ch1 for the Auxiliary Out 1 port
Save Settings?	<ul style="list-style-type: none"> Prompts the user to save the settings to non-volatile memory OK appears on the LCD screen when parameters have been saved User must save settings or previous/default settings will be applied
Exit	Exits the active menu

4.1.3 LCD Menu Configuration Procedure

Setting parameters on the HAWK controller's LCD screen involves both **turning** and **pressing** the Menu integrated rotary dial/pushbutton. For simplicity, the Menu integrated rotary dial/pushbutton will be referred to as 'the Menu dial' in the following procedure. The Menu dial 'clicks' as it is turned; it may take more than one 'click' to observe a change on the LCD screen.

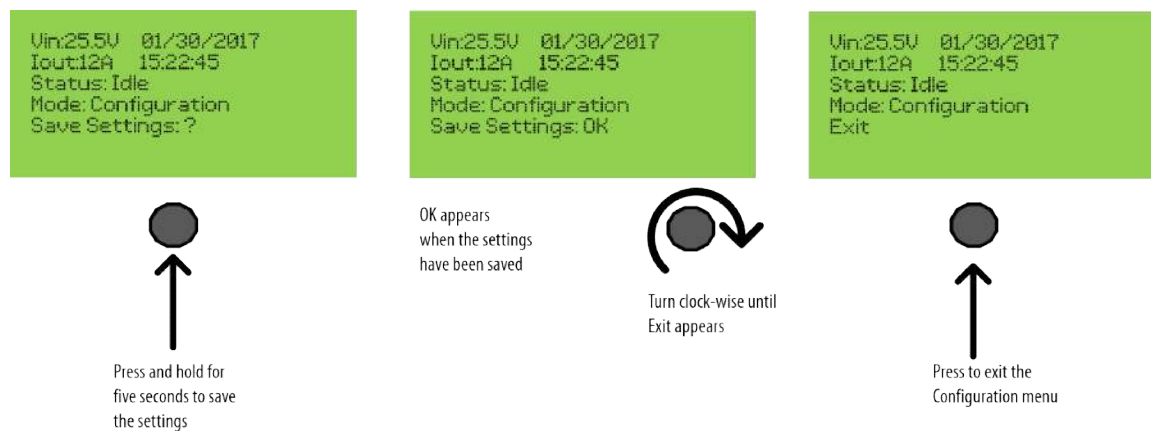
- An underline on the LCD indicates that turning the Menu dial now will change the selected parameter.
 - **Turn** the Menu dial to **change** the selected parameter/value (when underlined) or **advance** to the next parameter in the active menu.
 - Clockwise: **Increases** a value or moves to the **next** parameter in the active menu.
 - Counter-clockwise: **Decreases** a value or moves to the **previous** parameter in the active menu.
 - **Press** the Menu dial to **select** or **set** the displayed parameter/value.
1. For efficiency, determine how the parameters will be set before beginning this procedure. Refer to section 4.1.2 *Parameter Descriptions and Options* on page 18 for information regarding parameter options/values.
 2. **Press** the Menu dial to activate the LCD backlight if it is not already visible.
 3. **Turn** the Menu dial until the **Mode** field on the LCD displays **Configuration**.
 4. **Press** the Menu dial to select the Configuration mode.
The first parameter in the Configuration menu is **Date**.
 - a. To skip the Date parameter (or any parameter), **turn** the Menu dial clockwise.
The **Time** parameter will appear.
 - b. To change the Date parameter, **press** the Menu dial.
The first date field (Month) is now underlined.
 - i. **Turn** the Menu dial to change the Month field.
 - ii. **Press** the Menu dial to advance to the next Date field (Day).
 - iii. If required, change the Day and Year field values.
 - iv. When finished, **press and hold** the Menu dial until the underline disappears.
 - v. Turn the Menu dial clockwise to advance to the next parameter (Time).
 5. Use the Menu dial to navigate/change the rest of the menu options.
 - **Turn** the Menu dial to change a value (if it is underlined) or to advance to the next parameter/value.
 - **Press** the Menu dial to select or set a parameter/value.When all parameters have been set/viewed, **Save Settings:?** Will appear on the LCD screen.
 6. To save the parameter settings, **press and hold** the Menu dial for five seconds.
OK appears on the LCD screen when the Menu dial is released. This indicates the parameter values have been saved into non-volatile memory. If OK does not appear, the settings have not been saved; previous settings will be used.
 7. Turn the Menu dial until **Exit** appears.
 8. Press the Menu dial to exit the Configuration menu.
If no further action is taken, the controller will dim the LCD backlight and return to the default **Run** mode.

The following figure shows how to use the LCD and Menu dial to set the Date parameter values:

Figure 15: Setting parameters via LCD and Menu dial


Continue to use the Menu dial to select and change parameters as required (press = select; turn = change)

At the end of the Configuration menu, Save Settings: ? will appear.



4.2 CONFIGURATION UTILITY PROGRAM

The HAWK configuration utility program is a custom program designed to work with the HAWK controller. A simple, graphical, tab-based user interface allows the user to view, change and save parameters. The utility program also allows users to access the Diagnostic tools available for the HAWK controller. See section 6.4 *Configuration Utility Program* on page 29 for more information.

This method of setting parameters requires the following tools/equipment:

- Laptop with the configuration utility program (software sent via email or USB drive)
- Serial to USB converter/connection cord

4.2.1 Configuration Utility Installation

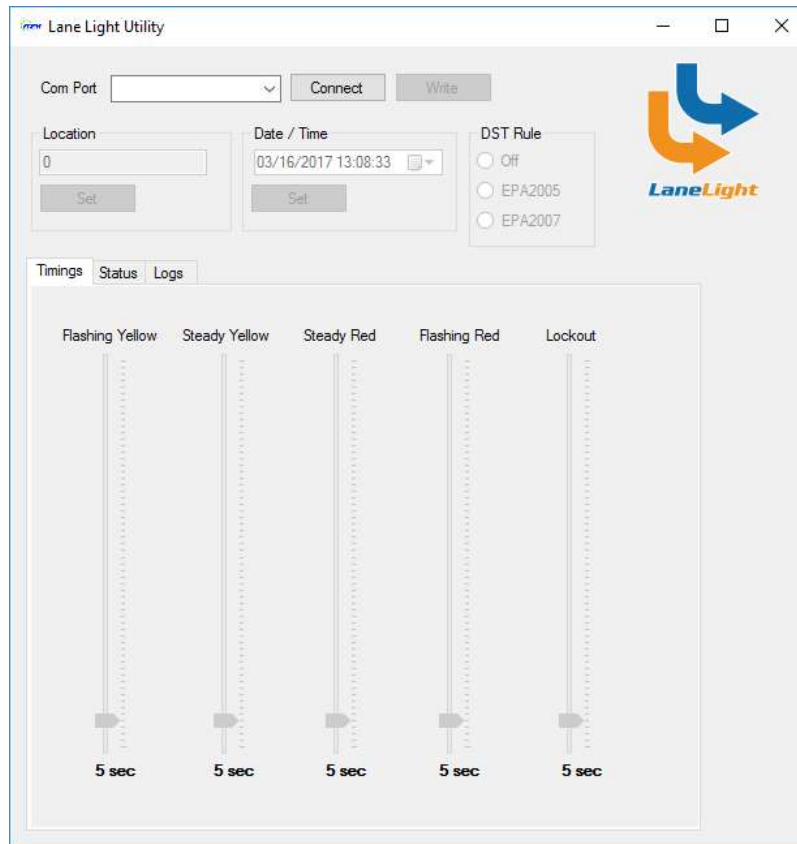
1. Download the configuration utility.zip file.
2. Open the .zip file and double-click on the setup.exe file.
This will initiate the installation process.
3. Follow the on-screen Windows prompts to install the configuration utility program.

4.2.2 Configuration Utility Procedure

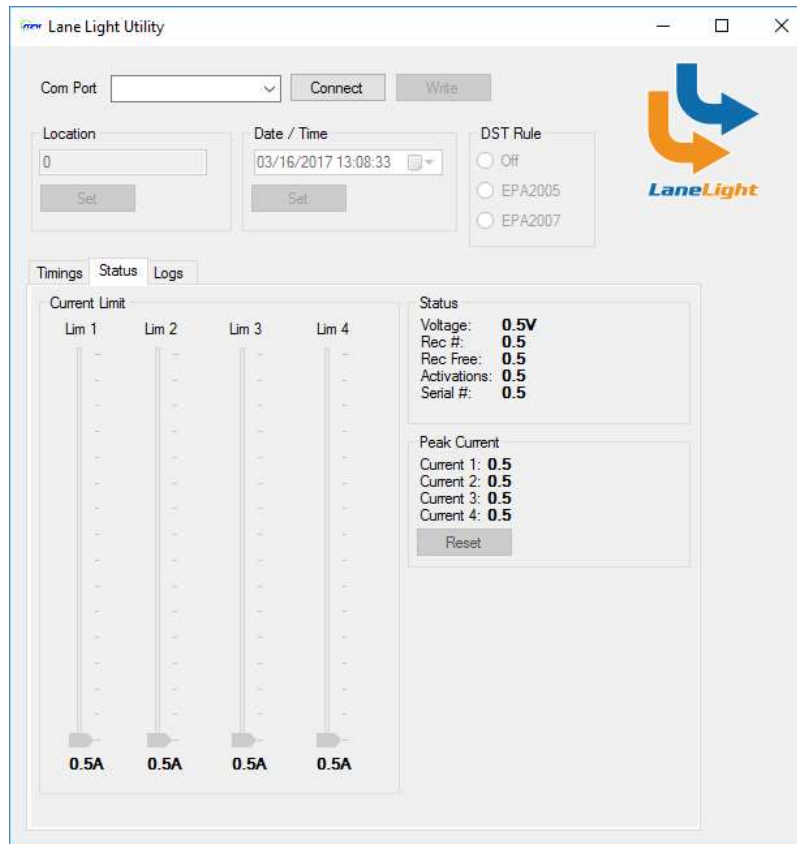
This procedure assumes that the user has a laptop with the configuration utility software installed.

For information about the parameters, see section 4.1.2 *Parameter Descriptions and Options* on page 18.

1. Power up the laptop.
2. Press the Menu dial on the controller to verify that the controller has power.
The LCD screen on the controller will illuminate if power is present.
3. Connect the laptop to the GPRS Modem port on the controller with a serial to USB adapter and connection cord.
4. Launch the configuration utility program.
The program opens to the Timings tab, but settings are greyed and not editable.
5. In the Port drop-down box, select the required port.
If the port for the controller is not known, note the port names listed in drop-down box. Disconnect the laptop and note which port name disappears from the list. This is the port for the controller. Reconnect the laptop to the controller.
6. Click the Connect button.
It may take several seconds for the connection to engage.
When the connection is successful, the parameter fields become editable and the Connect button label will change to Disconnect.
7. Set the parameters as required on each applicable tab.
Refer to the following pages for parameter descriptions and details.
NOTE: A mouse or touchpad can be used to move the cursor to a section within a tab. The mouse or arrow keys can be used to change/select values within a section. Arrow keys are useful for settings that use a slider.
(Procedure continues throughout the following pages.)

Figure 16: Configuration utility - Timings tab


UI Section	Parameter	Details
Com Port	Varies	Drop down list allows the user to select the port to access the controller
Connect/Disconnect	Button	Opens or closes the connection between the utility program and the controller
Write	Button	Writes the current configuration data from the utility to the controller memory
Location	Text Field	Allows users to enter a text description for the controller's location
	Set Button	Writes the location value to memory
Date / Time	Date	Sets the date in the following format: MM/DD/YYYY
	Time	Sets the time in the following format: HH:MM
	NOTE: To set the internal Real-Time-Clock (RTC) the controller must go through a power-cycle (On > Off > On) before any other parameter changes are made. Set the Date and Time values, then power down the controller and power it up again before setting the rest of the parameters.	
DST Rule	Off	Disables Daylight Saving Time
	EPA 2005	Engages Daylight Saving Time from the first Sunday in April until the last Sunday in October
	EPA 2007	Engages Daylight Saving Time from the second Sunday in March until the first Sunday in November
Flashing Yellow	Slider	<ul style="list-style-type: none"> Range: 0 – 60 seconds Sets the 'flashing' time for the yellow beacon(s)
Steady Yellow	Slider	<ul style="list-style-type: none"> Range: 0 – 60 seconds Sets the 'steady on' time for the yellow beacon(s)
Steady Red	Slider	<ul style="list-style-type: none"> Range: 0 – 60 seconds Sets the 'steady on' time for the red beacons
Flashing Red	Slider	<ul style="list-style-type: none"> Range: 0 – 60 seconds Sets the 'flashing' time for the red beacons
Lockout	Slider	Sets the time for the controller lockout and store calls from activation devices (i.e. pushbuttons)

Figure 17: Configuration utility – Status tab


UI Section	Parameter	Details
Current Limit	Lim 1	<ul style="list-style-type: none"> Range: 0.15– 8.0 Amps Sets the value in Amps to trip the electronic overload protection circuit for the Markers Output 1 port If an overcurrent condition exists for more than 500ms, the supply voltage to the markers is cut and a message is shown on the status line of the display The circuit is reset each time the system is triggered and trips again as long as the fault condition exists The number and color of IRWLs and the operating voltage are required to calculate this value
	Lim 2	Same as Lim 1 for the Markers Output 2 port
	Lim 3	Same as Current Lim Ch1 for the Auxiliary Out 1 port
	Lim 4	Same as Current Lim Ch1 for the Auxiliary Out 1 port
Status	Display only	Shows status information for the controller
Peak Current	Display only	Shows the peak current information for all four current channels
	Reset Button	Clears and resets the Peak Current counter

8. When all parameters have been set as required, click the Write button at the top of the Utility window.
This will write the new parameter settings to the controller's memory.
9. When finished setting and saving parameters, click the Disconnect button (optional).
10. Click the Exit button or the X in the upper right-hand corner of the Utility window to close the program.

5 MAINTENANCE

5.1 ACTIVITIES AND SCHEDULES

This section describes the recommended maintenance activities and schedules.

Table 3: Maintenance activities and schedules

Interval	Maintenance Activity
4-5 years of operation	Replace the battery (see section 5.2.1 <i>Replace the Controller Battery</i>)
As available	Update controller firmware

5.2 MAINTENANCE PROCEDURES

5.2.1 Replace the Controller Battery



WARNING: Disable power to the controller before performing this procedure.

CAUTION: Record the current operating parameters **BEFORE** replacing the battery. Replacing the battery erases the stored parameter memory.

- CAREFULLY** open the controller chassis.
- Remove the old battery.
Dispose of the battery according to local environmental and disposal regulations.
- Install the new battery.
Lithium cell battery (3V, CR2025 or similar)
- Replace the controller chassis.
- Reset the parameters. Refer to the following sections for details:
 - Section 4.1 *LCD Menu* on page 17
 - Section 4.2 *Configuration Utility Program* on page 22

6 TROUBLESHOOTING

This section describes possible issues and recommended actions/solutions.

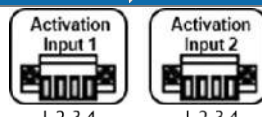
6.1 GENERAL TROUBLESHOOTING

Table 4: General troubleshooting matrix

Symptom/Problem	Actions/Solutions
General	<ul style="list-style-type: none"> View the system controller status information. The most common status types are Idle, Activated, Timer, and Error. Ensure the system is receiving the correct voltage and that there is no unusual current draw.
Constant flasher activation	<ul style="list-style-type: none"> Check the activation device circuit at the controller. Disconnect the activation device and observe if the flashers are still active or not. Check the timer. If the controller is counting down from 99 then time mode is activated. Deactivate the timer mode for activation devices within the Configuration menu for the system controller.
No flasher activation	<ul style="list-style-type: none"> Check for power to the system. Check the power circuit for the flasher devices. Check the activation device connections. Use the controller's Diagnostic mode to test marker activation; see section 6.3 <i>Diagnostic Menu – LCD Screen</i> on page 28 or section 6.4 <i>Configuration Utility Program</i> on page 29
Error message appears at the controller	<ul style="list-style-type: none"> Max Current error means there is a short circuit in the system. Check the connections on each flasher device. Check for crushed wires. Check for water in the LaneLight junction boxes (if installed) Check for improperly crimped wires. It might be necessary to disconnect flasher devices one at a time until the source of the problem is located.

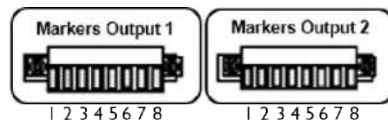
6.2 INPUT/OUTPUT PORT DESCRIPTIONS

Table 5: Activation Input ports

Layout	Pin	Description
	1	Channel 1 activation (+)
	2	Channel 1 activation (–)
	3	Channel 2 activation (+)
	4	Channel 2 activation (–)

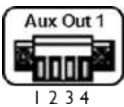
Examples: Pushbuttons, bollards

Table 6: Markers Output ports

Layout	Pin	Wire Color	Description
 <p>*Pins 6 and 8 are connected internally via jumper</p>	1	RED	+Output voltage
	2	GREEN	Synchronization signal (3-wire configurations)
	3		
	4		
	5		
	6*	BLACK	GROUND/DC return (–)*
	7	N/A	DO NOT USE
	8*	BLACK	DC return (–)*

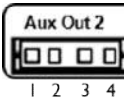
Example: LaneLight In-Road Warning Lights

Table 7: Aux Out 1

Layout	Pin	Description
	1	Power 1 +
	2	Power 1 –
	3	Power 2 +
	4	Power 2 –

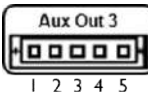
Optional high side output DC, current monitored port for additional flasher devices

Table 8: Aux Out 2

Layout	Pin	Description
	1	Common
	2	NO
	3	Common
	4	NO

Optional AC relay, 120VAC, 1A max, NO, 1 Form A for devices such as pedestrian heads or countdown heads

Table 9: Aux Out 3

Layout	Pin	Description
	1	+DC (constant voltage)
	2	Switched to ground
	3	+DC (constant voltage)
	4	Switched to ground
	5	Ground

Optional low side switch output, 2A max for additional output devices

NOTE: Voltage at the output ports is 0.7 – 1.0 V below the supply voltage.

Table 10: Power

Layout	Pin	Wire Color	Description
	+	RED	Power + 12 to 48 VDC
	–	BLACK	Power – 12 to 48 VDC
	GND	GREEN	Ground/earth

6.3 DIAGNOSTIC MENU – LCD SCREEN

The HAWK controller has a Diagnostic mode that allows users to troubleshoot several functions on site.

Figure 18: Diagnostic menu – LCD

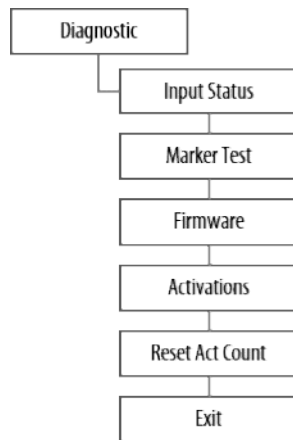


Figure 18 shows the order in which diagnostic functions appear in the LCD Diagnostic menu.

To access the Diagnostic menu via the LCD screen on the controller, turn the Menu dial on the front of the controller clockwise until **Mode: Diagnostic** appears on the LCD screen, then press the Menu dial.

Navigating menus on the controller's LCD screen involves both **turning** and **pressing** the Menu integrated rotary dial/pushbutton. For simplicity, the Menu integrated rotary dial/pushbutton will be referred to as 'the Menu dial'. The Menu dial 'clicks' as it is turned; it may take more than one 'click' to observe a change on the LCD screen.

- An underline on the LCD indicates that turning the Menu dial now will change the selected parameter.
- **Turn** the Menu dial to **change** the selected parameter/value (when underlined) or **advance** to the next parameter in the active menu.
 - Clockwise: **Increases** a value or moves to the **next** parameter in the active menu.
 - Counter-clockwise: **Decreases** a value or moves to the **previous** parameter in the active menu.

Press the Menu dial to **select** or **set** the displayed parameter/value.

The following table describes the details of each diagnostic function.

Menu Item	Description/Formats/Options																																								
Input Status	<ul style="list-style-type: none">Displays the logic states (0 or 1) of all inputs in real-time, e.g. 00000000This test helps to debug and find wiring errors and similar problems on the input signalsBit position assignments are as follows:																																								
	<table><tr><td>Bit</td><td>Position 8</td><td>Position 7</td><td>Position 6</td><td>Position 5</td><td>Position 4</td><td>Position 3</td><td>Position 2</td><td>Position 1</td></tr><tr><td>Function</td><td colspan="2">Activation Input 1</td><td colspan="2">Push Buttons</td><td colspan="4">N/A</td></tr><tr><td rowspan="2">Circuit</td><td rowspan="2">2</td><td rowspan="2">1</td><td rowspan="2">2</td><td rowspan="2">1</td><td colspan="2">N/A</td><td colspan="2">N/A</td></tr><tr><td>N/A</td><td>N/A</td><td>N/A</td><td>Entry</td></tr><tr><td>Connector</td><td>J10, Pin 3</td><td>J10, Pin 1</td><td>J9, Pin 3</td><td>J9, Pin 1</td><td>N/A</td><td>N/A</td><td>N/A</td><td>J5, Pin 2</td></tr></table>	Bit	Position 8	Position 7	Position 6	Position 5	Position 4	Position 3	Position 2	Position 1	Function	Activation Input 1		Push Buttons		N/A				Circuit	2	1	2	1	N/A		N/A		N/A	N/A	N/A	Entry	Connector	J10, Pin 3	J10, Pin 1	J9, Pin 3	J9, Pin 1	N/A	N/A	N/A	J5, Pin 2
	Bit	Position 8	Position 7	Position 6	Position 5	Position 4	Position 3	Position 2	Position 1																																
	Function	Activation Input 1		Push Buttons		N/A																																			
	Circuit	2	1	2	1	N/A		N/A																																	
						N/A	N/A	N/A	Entry																																
Connector	J10, Pin 3	J10, Pin 1	J9, Pin 3	J9, Pin 1	N/A	N/A	N/A	J5, Pin 2																																	
Marker Test	<ul style="list-style-type: none">Toggle setting: On/OffSwitches on all flasher units in the systemAllows users to check the wiring of the markers and locate non-functional units after installationMarkers are turned off after the user exits from this option to the main menu																																								
	Firmware	Displays the firmware version																																							
	Activations	Displays the number of recorded activations since the last activation counter reset																																							
	Reset Act Counter	Resets the Activations counter																																							
	Exit	Exits the Diagnostic menu																																							

6.4 CONFIGURATION UTILITY PROGRAM

The configuration utility program has a Logs tab that allows users to view activity logs for the controller. The utility also shows controller status information on the Status tab. The user must have a laptop with the configuration utility program installed and be able to connect to the controller via a Serial to USB converter/connection cable.

1. Power up the laptop.
2. Press the Menu dial and verify that the controller has power. The LCD screen will illuminate if there is power.
3. Connect the laptop to the controller with the Serial to USB converter and connection cord.
4. Launch the configuration utility program.
The program opens to the Timings tab, but settings are greyed and not editable.
5. In the Port drop-down box, select the required port.
If the port for the controller is not known, note the port names listed in drop-down box. Disconnect the laptop and note which port name disappears from the list. This is the port for the controller. Reconnect the laptop to the controller.
6. Click the Connect button.
It may take several seconds for the connection to engage.
When the connection is successful, the parameter fields become editable and the Connect button label will change to Disconnect.
7. Click the Status tab.
Status information for the controller appears on this tab.
8. Click the Logs tab.
The log information may provide information useful for troubleshooting any issues with the system.
9. When finished, click the Disconnect button (optional).
10. Click the Exit button or the X in the upper right-hand corner of the Utility window to close the program.

7 SPECIFICATIONS

Table 11: HAWK controller specifications

Specification	Details
Dimensions (WxHxD)	6.3 x 10.9 x 2.4 in. [160 x 276 x 61.3 mm]
Mounting	4 x 1/4 in. bolts
Weight	1 lb. [0.49 kg]
Material	Anodized aluminum housing
Operating Voltage	12 VDC Output voltage is 0.7 – 1.0 V below supply voltage
Power Consumption	4.5 W nominal (active), x1.8 W nominal (sleep)
Maximum Current	8A per channel
Surge Protection	Complies with test procedures applied according to A615-7.2 (Input-Output Terminals Pulse Test) and A615-7.3 (Non-Destruct Transient Immunity)
Environment	Operating Temperature: -30°F to 185°F [-30°C to +85°C] Storage Temperature: -50°F to 200°F [-45.5°C to + 93.3°C] Operating Relative Humidity: 0% to 95% non-condensing
Standards Compliance	FDOT Section A615 “Environmental Requirements” which are based on specific requirements in NEMA TS 2 (Intertek Report No. 3152884CRT-001, August 11, 2008)
Microprocessor	Type: Rabbit R3000 Clock speed: 55.5 MHz Code/data space: 1 MB
Input Circuits	Activation Input: 2 circuits, 2-wire, contact closure, open circuit voltage 15V Input Impedance: 2.5kΩ
Output Circuits	Markers Output: 2 circuits with 8 open-collector drivers for standard MLK-150 LaneLight markers Aux Out 1: 2 x high side output DC, current monitored Aux Out 2: 2 x AC relay, 120VAC, 1A max, NO, 1 Form A Aux Out 3: 2 x low side switch output, 2A max

8 TECHNICAL SUPPORT

8.1 PROOF OF WARRANTY

LaneLight requires a physical copy, scanned copy, photo or fax of your warranty report to be submitted before technical support can be provided.

Fax: 250-381-4830

Email: info@lanelight.com

Attempt the instructions provided in the Troubleshooting section of the product manual before contacting LaneLight.

8.2 SERVICE TICKETS

The simplest way to contact LaneLight for support is by creating a service ticket online:

1. Access the LaneLight online ticket system.
<https://ticket.lanelight.com/>
2. Create a user name.
3. Provide the project number.
This is usually located on a label on the inside of the main battery box.
Example: 0001.012.0123 City, State/Province
4. Submit a copy of your warranty report.
5. Provide a brief description of the problem, steps taken to solve the problem, and pictures of related equipment.

8.3 REPLACEMENT UNITS

Contact LaneLight for replacement units.

1-866-466-4836

8.4 TECHNICAL SUPPORT

LaneLight can provide technical support via phone to a technician who is working on site, however, you must have a qualified representative present at the site location with a multimeter and appropriate tools. A LaneLight representative may guide you through a series of diagnostic steps to understand the problem and assist you in solving the issue.

Contact LaneLight to discuss details and requirements regarding technical support.

1-866-466-4836

Thank you for choosing LaneLight

Solar Luminaire

Project: SGT John Pinney Pool

Type: BFL-TM-GY-00-HT-GY-T4-WW

Quantity: 1

The BFL Series solar LED street light is a great fit for residential and collector street lighting as well as parking lot lighting applications. The self-contained, unobtrusive solar engine design integrates its solar power, battery and adaptive control capabilities into a compact and simple form. This, combined with an efficient LED fixture, makes the BFL Series an excellent fit where high performance, full cutoff and cost-effective lighting is required.

- With the latest solar, LED and lithium battery technology, the BFL series offers significant advantages:
- Cost-effective design ships fully assembled and installs in minutes
- Low installation cost and minimal site impact with no trenching or cabling
- Wireless control & communication with your light
- Minimal ongoing costs with no electrical bills
- Operates entirely independent from the grid and is immune to power outages
- A sustainable choice without recurring carbon emissions

All of our solar powered lights are enabled by our innovative Solar Lighting Controller (SLC). The controller in each light is “self-learning” and allows the lights to predictively adapt to their surroundings, providing an unsurpassed level of lighting performance and reliability.



TECHNICAL SPECIFICATIONS

- Solar Module:**
- High-efficiency monocrystalline cells
 - Inconspicuously integrated into the low profile solar engine
 - Used for day/night detection (no photocell required)

- Solar Lighting Controller (SLC):**
- High-efficiency, maximum power point tracking (MPPT)
 - Microcontroller based technology
 - Multiyear data logging
 - Integrated into solar engine housing
 - Designed to adaptively manage lighting performance based on environmental conditions and lighting requirements

- Battery:**
- High-performance lithium (LiFePO4)
 - Exceptional 10+ year lifecycle
 - High temperature tolerance
 - Conotained within solar engine housing
 - Designed for easy battery changes

- Mechanical:**
- Solar engine housing formed from marine-grade, corrosion resistant, aluminum alloy
 - Internal top of pole mount structure
 - Toolless access
 - Architectural grade, durable, TGIC powder coat

- LEDs and Optics:**
- 100,000 hour L70 lifetime LED
 - Extra Warm White (2700K), Warm White (3000K), Neutral White (4000K), and Amber (595nm) LEDs available
 - High-efficiency type 2S, 2M, 3S, 3M, 4, 5 optics
 - Full cutoff optics and Dark-Sky approved at 3000K
 - Typical lumen output of 6400 lumens
 - Integrated weatherproof, high-efficiency, dimmable LED driver

- Factory Set Lighting Profiles:**
- Real-time based lighting profiles allow you to comply with the Model Lighting Ordinance, dimming after curfew, or during periods of low pedestrian conflict
 - 11 standard duration based lighting profiles available
 - Lighting profiles are field configurable with app
 - Visit our website for all options

- Wireless Controls:**
- Easy-to-use interface via iOS smartphone app
 - Configure and control lighting profiles
 - Adjust dusk and dawn thresholds

- Pole Options:**
- Various pole height and mast arm length options available
 - Pre-drilled for seamless installation

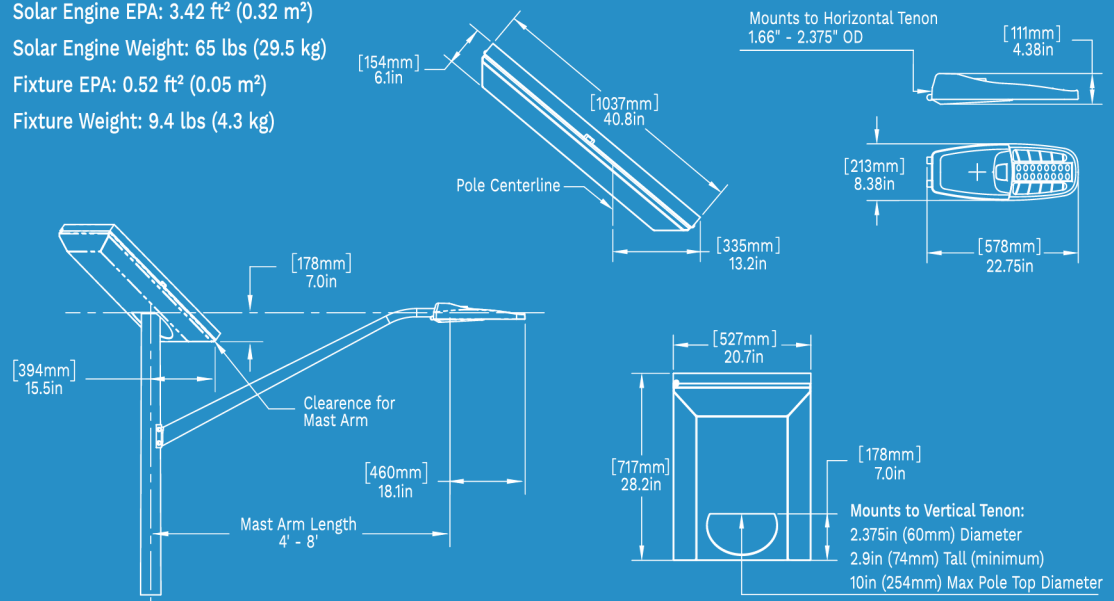
SOLAR LED STREET & AREA LIGHT

Solar Engine EPA: 3.42 ft² (0.32 m²)

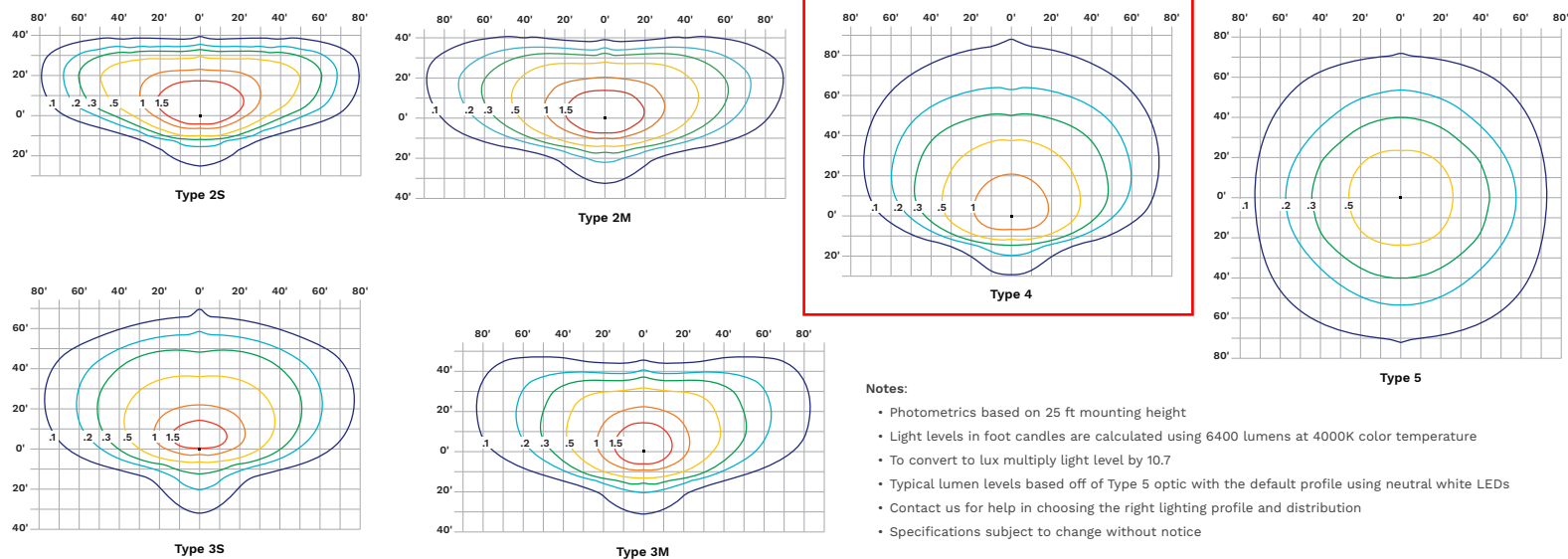
Solar Engine Weight: 65 lbs (29.5 kg)

Fixture EPA: 0.52 ft² (0.05 m²)

Fixture Weight: 9.4 lbs (4.3 kg)



PHOTOMETRICS (IES files available on our website)

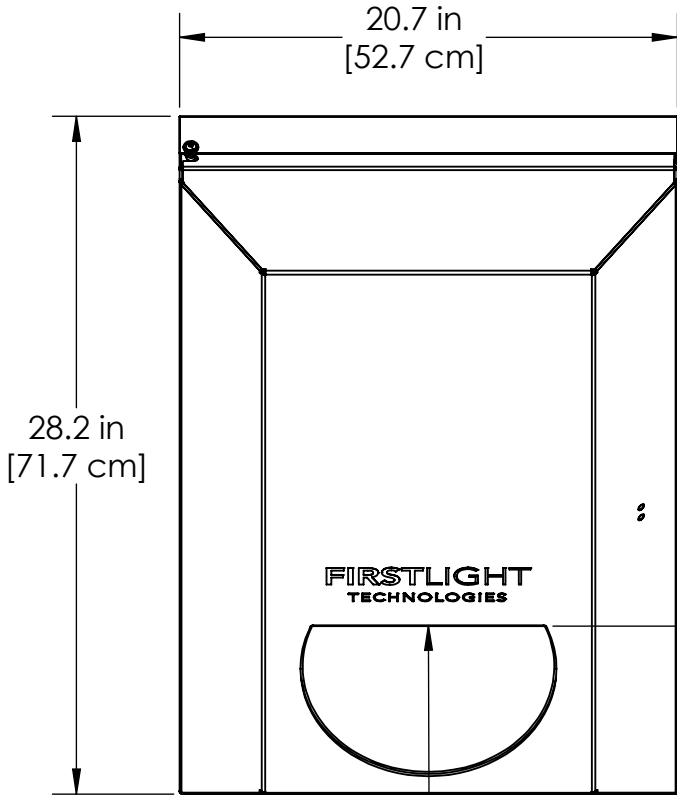
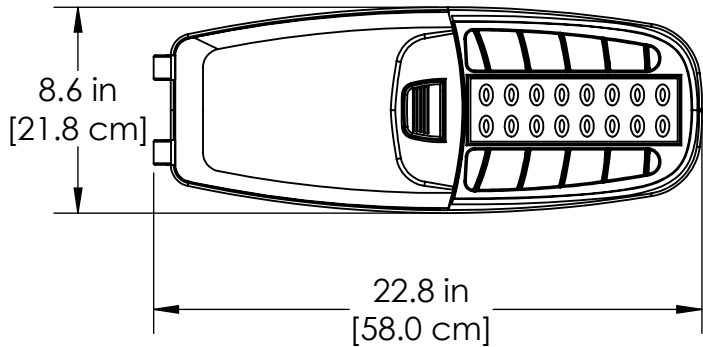
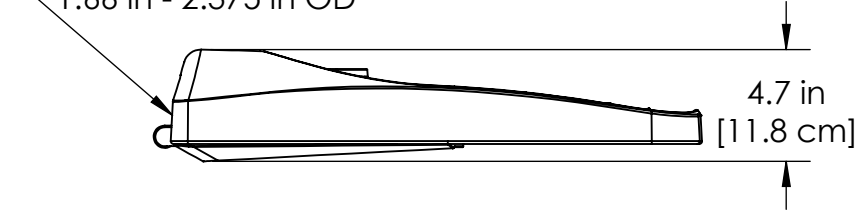


ORDER MATRIX

Solar Engine				Fixture				
Series	Mounting	Finish	Lighting Profiles (Contact us or visit our website for more options)	Mounting	Finish	Distribution	LED Colors	Options
BFL	TM - 2.375 Inch Tenon Mount	BK - Black	TM2200B0600 - On at dusk > dim to 50% at 10:00pm > brighten to 100% at 6:00am > off at dawn (Default)	HT - Horizontal Tenon	BK - Black	T2S - Type 2S	XW - 2700K	BLS - Backlight Shield
		BZ - Bronze	00 - Dusk to dawn		BZ - Bronze	T2M - Type 2M	WW - 3000K	
		GY - Gray	02 - On at dusk > dim to 30% after 6 hours > off at dawn		GY - Gray	T3S - Type 3S	NW - 4000K	
		WH - White	09 - On at dusk > dim to 30% after 3 hours > brighten to 100% 1 hour before dawn > off at dawn		WH - White	T3M - Type 3M		
			TX0000X0000 - T=Real-time based lighting profile. X=Choose O for off, L for Low (30%) or M for Medium (50%) or B for Bright. 0000=choose event time between 00:00 and 23:59. Second event optional.			T4 - Type 4		
						T5 - Type 5		

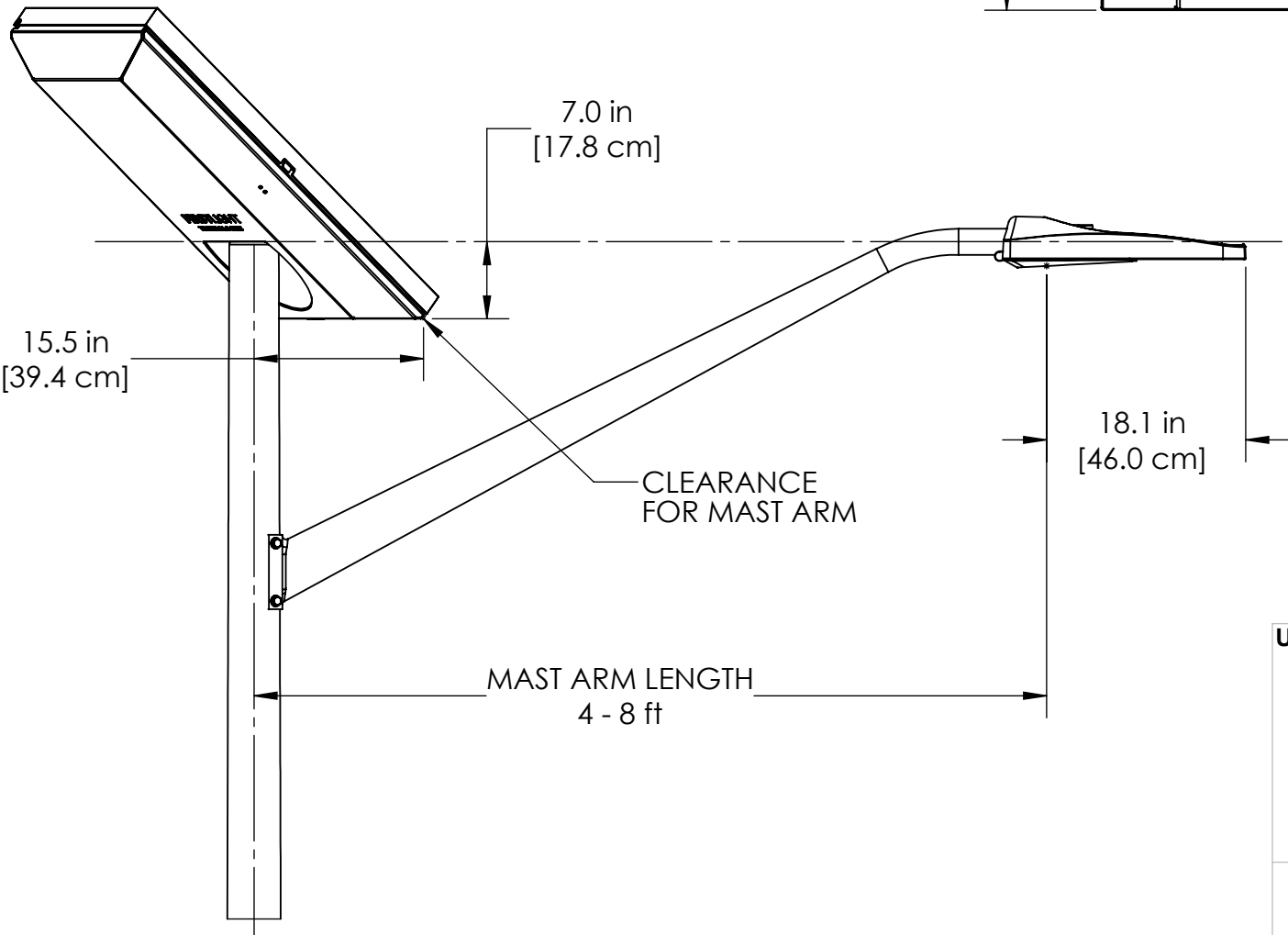
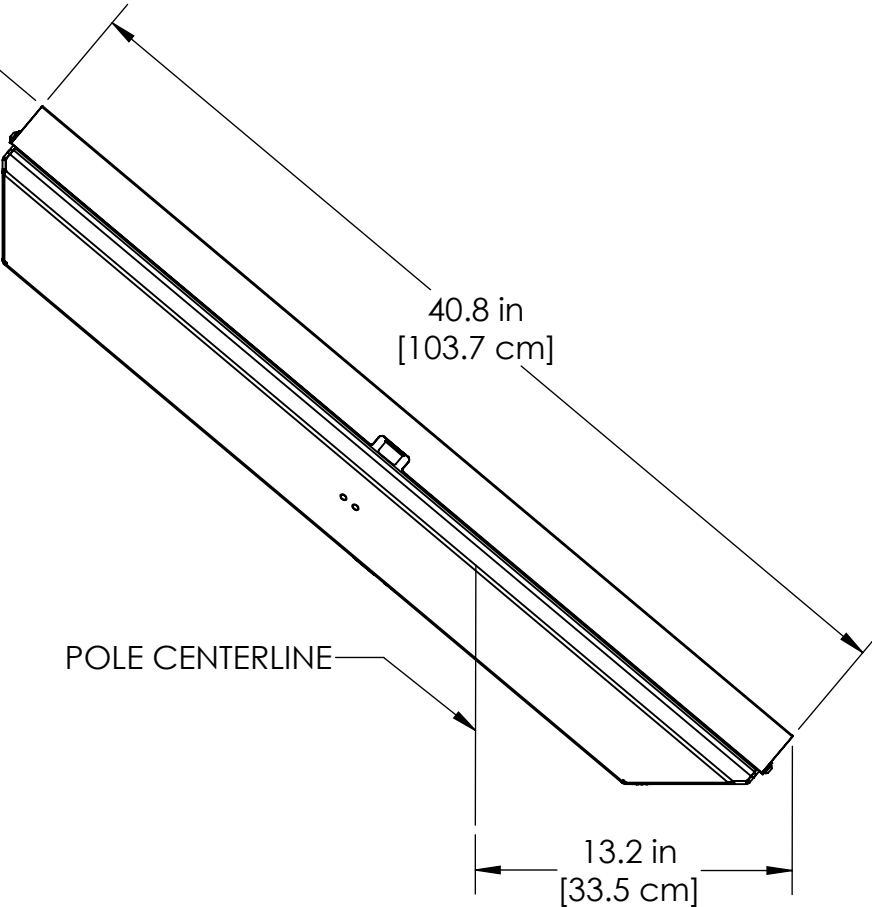
REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	INITIAL RELEASE	14/12/2022	B JOHNSTON

MOUNTS TO HORIZONTAL TENON
1.66 in - 2.375 in OD



6.1 in
[15.4 cm]

MOUNTS TO VERTICAL TENON
2.375 in [60 mm] DIAMETER
2.9 in [74 mm] MINIMUM HEIGHT
10 in [254 mm] MAXIMUM POLE TOP DIAMETER



Solar Engine EPA: 3.42 ft² (0.32 m²)
Solar Engine Weight: 65 lbs (29.5 kg)
Fixture EPA: 0.52 ft² (0.05 m²)
Fixture Weight: 9.4 lbs (4.3 kg)

UNLESS OTHERWISE SPECIFIED
DO NOT SCALE DRAWING

INTERPRET DIMENSIONS AND TOLERANCES
PER ASME Y14.100-2000
AND ASME Y14.5-2009
TOLERANCES APPLY AS SHOWN BELOW

DECIMALS	SURF FINISH	ANGLES
.X ± .05	250	±1°
.XX ± .01		
.XXX ± .005		

INCHES

THIRD ANGLE PROJECTION

CHANGES SHALL BE INCORPORATED
ELECTRONICALLY BY THE DESIGN AUTHORITY

PROPRIETARY

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REPRODUCED STORED IN A RETRIEVAL SYSTEM,
OR TRANSMITTED IN ANY FORM, WITHOUT THE
WRITTEN PERMISSION OF
First Light Technologies Ltd

ORIGINALLY DRAWN BY	DATE
S Park	14/12/2022
LAST MODIFIED BY	DATE
S Park	14/12/2022

FIRSTLIGHT
TECHNOLOGIES

TITLE	REV
BFL Line Drawing	A

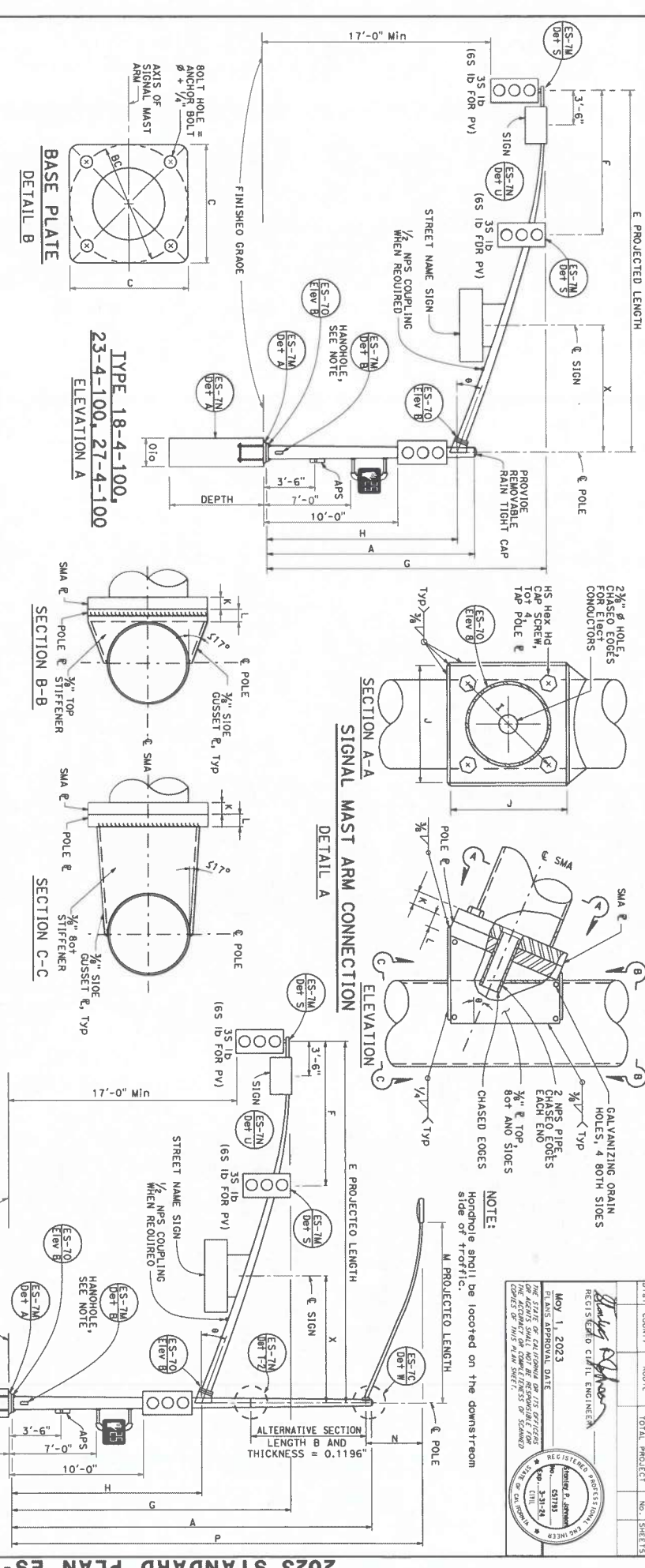
SIZE	DRAWING NO
B	73-0026

SCALE	SIMILAR TO	SHEET
1:8		1 OF 1

Applicable 2023 Caltrans Standard Plans

DATE	COUNTRY	ROUTE	POST MILES	SHEET TOTAL
			TOTAL PROJECT	NO. SHEETS
MAY 1, 2023 REGISTERED PROFESSIONAL ENGINEER REGISTERED PROFESSIONAL LAND SURVEYOR REGISTERED PROFESSIONAL CIVIL ENGINEER REGISTERED PROFESSIONAL ELECTRICAL ENGINEER REGISTERED PROFESSIONAL MECHANICAL ENGINEER REGISTERED PROFESSIONAL CHEMICAL ENGINEER REGISTERED PROFESSIONAL AERONAUTICAL ENGINEER REGISTERED PROFESSIONAL NUCLEAR ENGINEER REGISTERED PROFESSIONAL METALLURGICAL ENGINEER REGISTERED PROFESSIONAL INDUSTRIAL ENGINEER REGISTERED PROFESSIONAL AGRICULTURAL ENGINEER REGISTERED PROFESSIONAL MINING ENGINEER REGISTERED PROFESSIONAL PETROLEUM ENGINEER REGISTERED PROFESSIONAL MARINE ENGINEER REGISTERED PROFESSIONAL AEROSPACE ENGINEER REGISTERED PROFESSIONAL ENVIRONMENTAL ENGINEER REGISTERED PROFESSIONAL SAFETY ENGINEER REGISTERED PROFESSIONAL QUALITY ENGINEER REGISTERED PROFESSIONAL PROJECT ENGINEER REGISTERED PROFESSIONAL CONSTRUCTION ENGINEER REGISTERED PROFESSIONAL TRANSPORTATION ENGINEER REGISTERED PROFESSIONAL WATER RESOURCES ENGINEER REGISTERED PROFESSIONAL COASTAL ENGINEER REGISTERED PROFESSIONAL OCEANOGRAPHY ENGINEER REGISTERED PROFESSIONAL POLAR ENGINEER REGISTERED PROFESSIONAL SPACE ENGINEER REGISTERED PROFESSIONAL AERONAUTICAL ENGINEER REGISTERED PROFESSIONAL AEROSPACE ENGINEER REGISTERED PROFESSIONAL ENVIRONMENTAL ENGINEER REGISTERED PROFESSIONAL SAFETY ENGINEER REGISTERED PROFESSIONAL QUALITY ENGINEER REGISTERED PROFESSIONAL PROJECT ENGINEER REGISTERED PROFESSIONAL CONSTRUCTION ENGINEER REGISTERED PROFESSIONAL TRANSPORTATION ENGINEER REGISTERED PROFESSIONAL WATER RESOURCES ENGINEER REGISTERED PROFESSIONAL COASTAL ENGINEER REGISTERED PROFESSIONAL OCEANOGRAPHY ENGINEER REGISTERED PROFESSIONAL POLAR ENGINEER REGISTERED PROFESSIONAL SPACE ENGINEER				

NOTE: Handhole shall be located on the downstream side of traffic.



2023 STANDARD PLAN ES-7F

TYPE 19-4-100, 19A-4-100, 24-4-100, 24A-4-100, 26-4-100, 26A-4-100
ELEVATION B

SIGNAL MAST ARM DATA									
E	F	G	H	I	J	K	L	M	N
PROJECTED LENGTH	MIN. MOUNTING HEIGHT	MIN. AT POLE	THICKNESS	HS CAP RISE	PIE SIZE	MAST ARM THICKNESS	POLE THICKNESS	PROJ. LENGTH	MIN. MOUNTING HEIGHT
18'-4-100	17'-0"	22'-8"	7 3/4"	15'-0"	1'-3"	1 1/4"	1 1/2"	6'-0"	2'-0"
19'-4-100	17'-0"	22'-8"	7 3/4"	15'-0"	1'-3"	1 1/4"	1 1/2"	6'-0"	2'-0"
20'-4-100	17'-0"	22'-8"	7 3/4"	15'-0"	1'-3"	1 1/4"	1 1/2"	6'-0"	2'-0"
21'-4-100	17'-0"	22'-8"	7 3/4"	15'-0"	1'-3"	1 1/4"	1 1/2"	6'-0"	2'-0"
22'-4-100	17'-0"	22'-8"	7 3/4"	15'-0"	1'-3"	1 1/4"	1 1/2"	6'-0"	2'-0"
23'-4-100	17'-0"	22'-8"	7 3/4"	15'-0"	1'-3"	1 1/4"	1 1/2"	6'-0"	2'-0"
24'-4-100	17'-0"	22'-8"	7 3/4"	15'-0"	1'-3"	1 1/4"	1 1/2"	6'-0"	2'-0"
25'-4-100	17'-0"	22'-8"	7 3/4"	15'-0"	1'-3"	1 1/4"	1 1/2"	6'-0"	2'-0"
26'-4-100	17'-0"	22'-8"	7 3/4"	15'-0"	1'-3"	1 1/4"	1 1/2"	6'-0"	2'-0"
27'-4-100	17'-0"	22'-8"	7 3/4"	15'-0"	1'-3"	1 1/4"	1 1/2"	6'-0"	2'-0"

LUMINAIRE MAST ARM DATA									
P	Q	R	S	T	U	V	W	X	Y
PROJECTED LENGTH	MIN. MOUNTING HEIGHT	MIN. AT POLE	THICKNESS	HS CAP RISE	PIE SIZE	MAST ARM THICKNESS	POLE THICKNESS	PROJ. LENGTH	MIN. MOUNTING HEIGHT
30'-0"	35'-0"	35'-0"	30'-0"	35'-0"	35'-0"	30'-0"	35'-0"	30'-0"	35'-0"
31'-6"	36'-6"	36'-6"	31'-6"	36'-6"	36'-6"	31'-6"	36'-6"	31'-6"	36'-6"
32'-0"	37'-0"	37'-0"	32'-0"	37'-0"	37'-0"	32'-0"	37'-0"	32'-0"	37'-0"
32'-9"	37'-9"	37'-9"	32'-9"	37'-9"	37'-9"	32'-9"	37'-9"	32'-9"	37'-9"
33'-9"	38'-9"	38'-9"	33'-9"	38'-9"	38'-9"	33'-9"	38'-9"	33'-9"	38'-9"
34'-3"	39'-3"	39'-3"	34'-3"	39'-3"	39'-3"	34'-3"	39'-3"	34'-3"	39'-3"

POLE DATA									
TYPE	LOAD CASE	WIND VELOCITY (mph)	A HEIGHT	MIN. OD	THICKNESS	ALTERNATIVE SECTION B LENGTH	TOP	C	THICKNESS
18-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
19-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
20-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
21-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
22-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
23-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
24-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
25-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
26-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
27-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"

BASE PLATE DATA									
TYPE	LOAD CASE	WIND VELOCITY (mph)	A HEIGHT	MIN. OD	THICKNESS	ALTERNATIVE SECTION B LENGTH	TOP	C	THICKNESS
18-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
19-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
20-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
21-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
22-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
23-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
24-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
25-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
26-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"
27-4-100	1	17-0"	13 3/4"	11 1/4"	0.2391"	10'-0"	13 3/4"	11 1/4"	1'-11"

ELECTRICAL SYSTEMS
(SIGNAL AND LIGHTING STANDARD,
CASE 4 SIGNAL MAST ARM LOADING,
WIND VELOCITY = 100 MPH AND
SIGNAL MAST ARM LENGTHS 25' TO 45')
NO SCALE

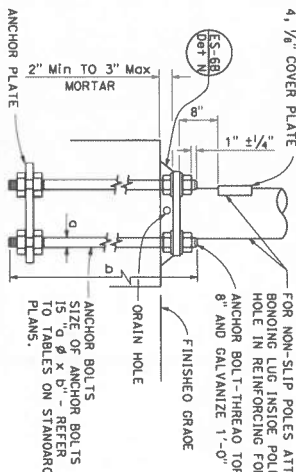
ES-7F

4" x 6 1/2" ROUNDED RECTANGLE HANOHOLE REINFORCED WITH RING WELDED TO OUTSIDE OF POLE.
SEE NOTE 4, 1/8" COVER PLATE

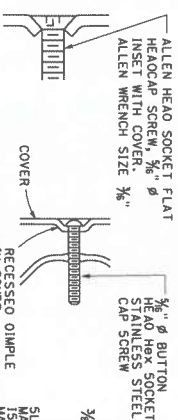
-FOR NON-SLIP POLES ATTACH
BONING LUG INSIDE POLE OR TAP
HOLE IN REINFORCING FOR BONING BOLT

IDENTIFICATION NUMBER

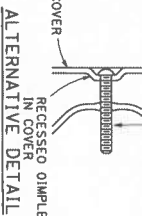
1. Attach a stomped metal tag with pole's identification number above the handlehole.
1/4" high number, minimum.
2. Attach a stomped metal tag with most arm's identification number to the bottom of the signal most arm near the pole plate.
1/4" high number, minimum.



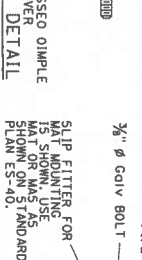
HANDHOLE AND ANCHORAGE



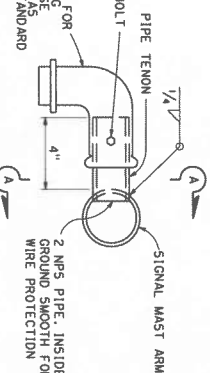
DETAIL A



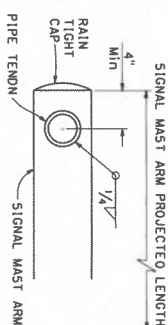
ALTERNATIVE DE



DETAIL B-2



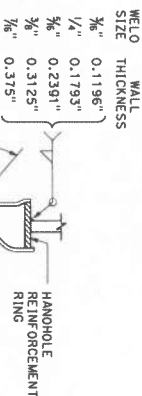
SIDE TENON
DETAIL S-1



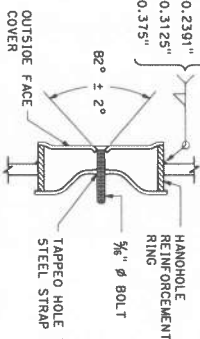
SECTION A-A

PIPE TENONS

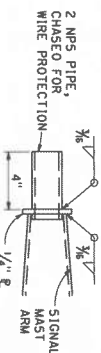
DETAILS



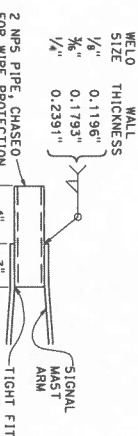
DETAIL B-2



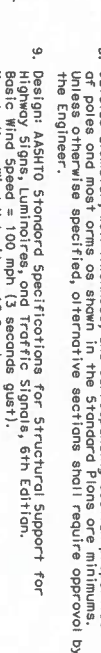
TAMPER RESISTANT HANDHOLE COVER



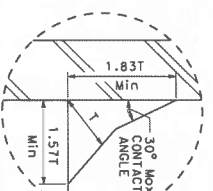
TIP TENON
DETAIL TL



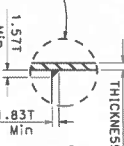
TIP TENON
DETAIL TS

 $f_y = 50,000 \text{ psi (unreinforced)}$

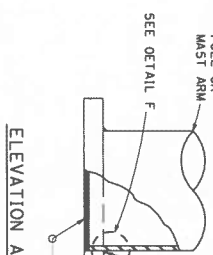
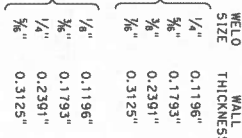
10. Materials (Structural steel):
 $f_y = 55,000$ psi (topped steel tube and anchor bolts)
 $f_y = 50,000$ psi (unless otherwise noted)
11. Materials (Reinforced concrete):
 $f'_c = 3,625$ psi
 $f_y = 60,000$ psi



DETAIL F



Fatigue resistant weld
at socket type connection
see Elevation A for inner weld

ELEVATION A

**ELECTRICAL SYSTEMS
(SIGNAL AND LIGHTING STANDARD,
DETAIL No. 1)**

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
ELECTRICAL SYSTEMS
AND LIGHTING
DETAIL No. 1)
NO SCALE

NO SCALE

ES-7M

[Return to Table of Contents](#)

DATE	COUNTRY	ROUTE	POST DATE	SHEET TOTAL
			TOTAL PROJECT	NO. SHEETS

Edward A. Johnson

REGIS. CARD C.M.I. ENGINEER

May 1, 1923

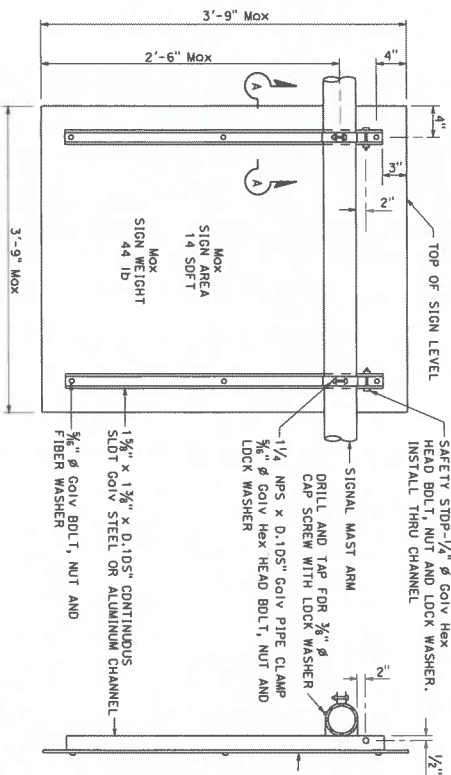
PLANS APPROVAL DATE

THE STATE OF CALIFORNIA, BY ITS DISTRICT CLERK, COUNTY OF LOS ANGELES, DO HEREBY CERTIFY THAT THE ABOVE DESCRIBED MAPS OR THIS IS A TRUE AND CORRECT COPY OF THE SAME.

REGISTERED PROFESSIONAL ENGINEER

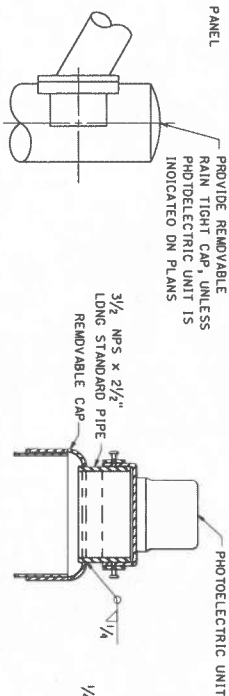
EDWARD A. JOHNSON
No. 5173-24
Exp. 5-1-24

STATE OF CALIFORNIA



REAR VIEW

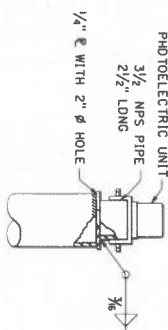
SIDE VIEW



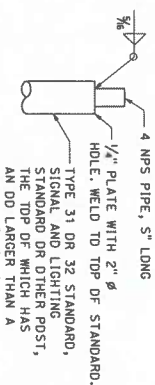
STANDARD TOP
DETAIL B-1

MOUNTING ADAPTER FOR
PHOTOELECTRIC UNIT
DETAIL B-2

POLE TOP DETAILS
DETAIL B



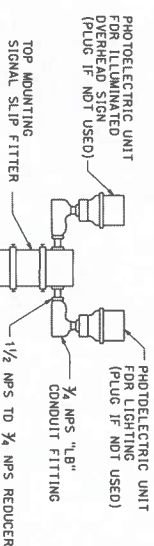
ALTERNATIVE
MOUNTING ADAPTER
DETAIL B-3



DETAIL C-1

CIDR REINFORCING AND INSPECTION PIPE SCHEDULE			
CIDR DIAMETER	VERTICAL BARS	SPIRAL	INSPECTION PIPE
2 ft	B-85	#4 AT 6	2
2.5 ft	10-86		4 *
3 ft	12-87	#5 AT 6	4
3.5 ft	14-88		4
4 ft	18-89	2-#4 AT 7	5
4.5 ft	18-89	2-#5 AT 7	5
5 ft	22-810	2-#5 AT 7	6
6 ft	26-811	2-#6 AT 7	7

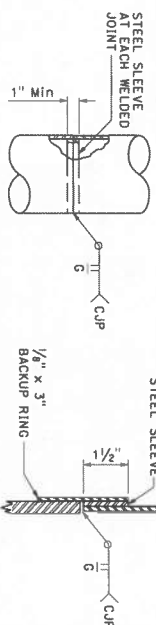
* FOR SLIP BASE VERSIONS WITH 3 ANCHDR BOLTS
USE 3 INSPECTION PIPES.



DETAIL C-1



DETAIL C-2

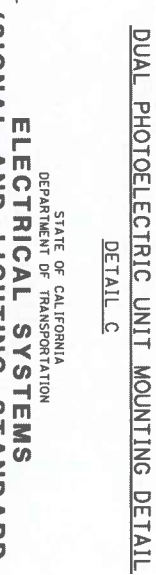
DETAIL C

FOR UNIFORM PIPE THICKNESS

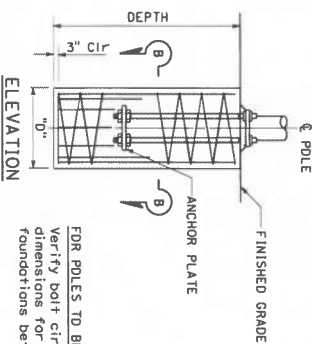
AT PIPE THICKNESS CHANGE
DETAIL T-2

POLE SPLICES

DETAIL T



DUAL PHOTOELECTRIC UNIT MOUNTING DETAIL



CAST-IN-DRILLED-HOLE PILE FOUNDATION, REINFORCED PILE

DETAIL A

FDR POLES TO BE INSTALLED ON EXISTING FOUNDATION:
Verify bolt circles, anchor bolt sizes and dependent dimensions for poles to be installed on existing foundations before fabricating the poles.

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
**TELEPHONICAL SYSTEMS
ILLUSTRATING STANDARD,
MAIL No. 2)**
NO SCALE

[Return to Table of Contents](#)

Dist	COUNTRY	ROUTE	POST MILES	SHEET TOTAL
			TOTAL PROJECT	NO. SHEETS

Edward A. Johnson

REGISTRAR C.E.M.T. ENGINEER

May 1, 1923

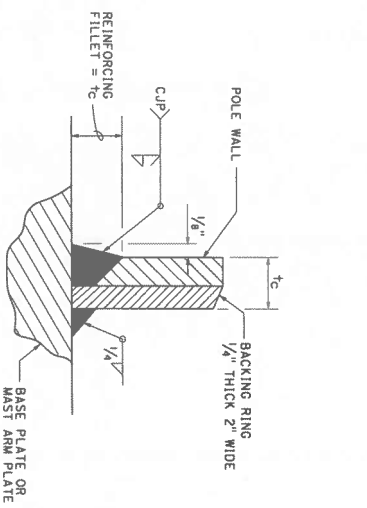
PLANS APPROVAL DATE

ONE STATE OF CALIFORNIA OR ITS OFFICERS
 HAVE REVIEWED THESE PLANS AND
 THE ACCURACY OF CONTAINMENTS OF SAME
 COPIES OF THIS DATA SHEET.

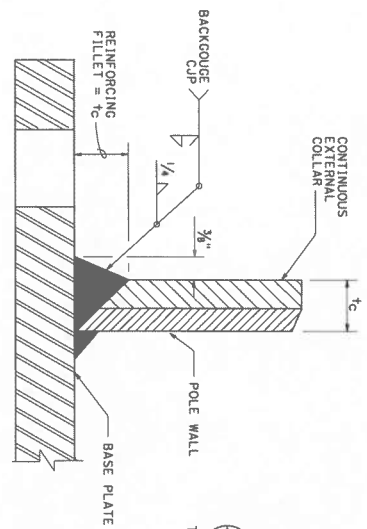
REGISTERED PROFESSIONAL ENGINEER
 Edward A. Johnson
 No. 37124
 CIVIL
 STATE OF CALIFORNIA

Dist	COUNTY	ROUTE	POST MILES	SHEET TOTAL
			TOTAL PROJECT	No. SHEETS

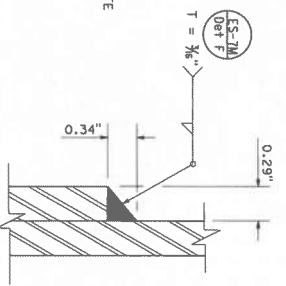
REGISTERED PROFESSIONAL ENGINEER Kevin P. Adams No. 51793 Exp. 3-31-24 CIVIL STATE OF CALIFORNIA		MAY 1, 2023 RE: SIGN APPROVAL DATE FOR ALL SIGNAGE AND ITS ERECTION OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OF THE DIMENSIONS OR SCALING OF THIS PLAN AND SHEET.
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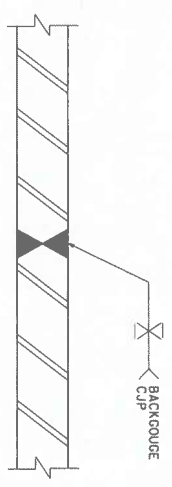
DETAIL B



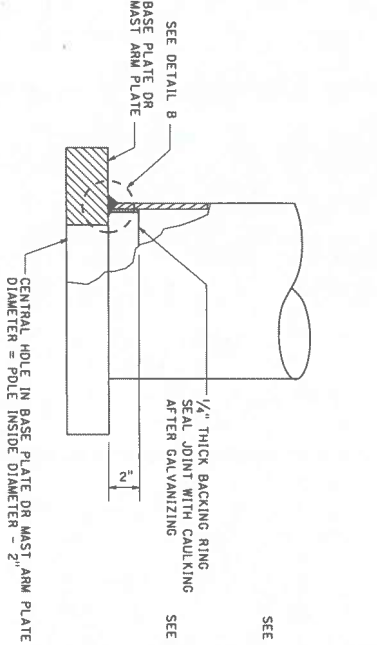
DETAIL C1



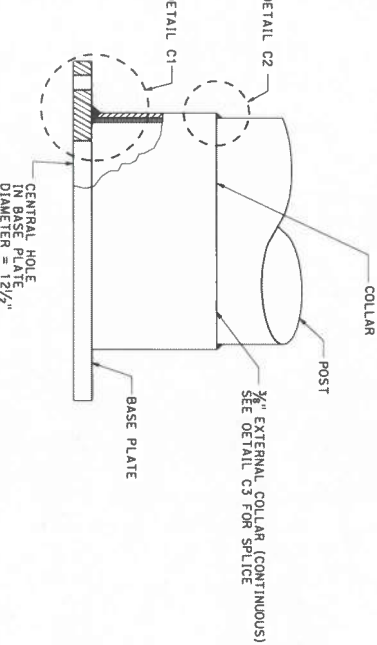
DETAIL C2



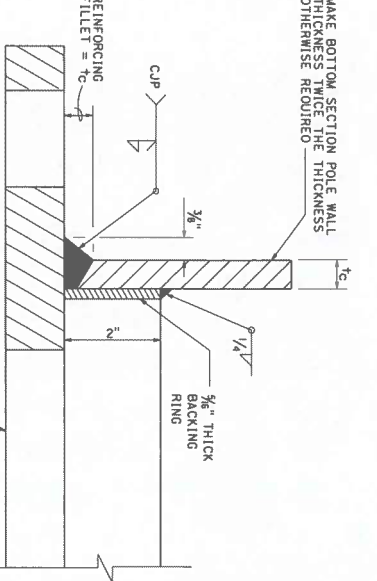
DETAIL C3



ELEVATION B



ELEVATION C



DETAIL C4

STATE OF CALIFORNIA
 DEPARTMENT OF TRANSPORTATION
ELECTRICAL SYSTEMS
(SIGNAL AND LIGHTING STANDARD,
DETAIL NO. 3)
 NO SCALE

ES-70

Return to Table of Contents

SOILS ENGINEERING, INC.



**GEOTECHNICAL INVESTIGATION
FOR
SGT. JOHN PINNEY MEMORIAL POOL REPLACEMENT
205 S. WARNER STREET
RIDGECREST, CA 93555**

Prepared for:

**City of Ridgecrest
100 W. California Ave
Ridgecrest, CA 93555**

By:

**SOILS ENGINEERING, INC.
SEI File 23-19224
November 7, 2023**

A handwritten signature in blue ink that reads 'On Man Lau'.

**On Man Lau, P.E., G.E.
Engineering Manager**



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TABLE OF CONTENTS

INTRODUCTION3

SITE INFORMATION

A. PROJECT DESCRIPTION4
B. GEOLOGIC SETTING4
C. SUBSURFACE CONDITIONS5
D. GROUNDWATER5
E. SEISMIC DESIGN VALUES5
F. SOIL FERTILITY AND HORTICULTURAL SUITABILITY ANALYSIS6

EARTHWORK RECOMMENDATIONS

A. COMPACTION, OPTIMUM MOISTURE.....7
B. STRIPPING.....7
C. GROUND SURFACE PREPARATION.....7
D. ENGINEERED FILL9
E. IMPORTED FILL9
F. DRAINAGE.....10
G. PERCOLATION TEST RESULTS.....10

FOUNDATION RECOMMENDATIONS10

MODULUS OF SUBGRADE REACTION12

LATERAL EARTH PRESSURES12

SLABS-ON-GROUND13

PAVEMENT RECOMMENDATIONS14

SOIL CORROSIVITY15

LIMITATIONS, OBSERVATIONS AND TESTING15

REVIEW OF EARTHWORK OPERATIONS16

APPENDIX A, "GUIDE SPECIFICATIONS FOR EARTHWORK.....17

APPENDIX B, "FIELD INVESTIGATION"23

APPENDIX C, "SOILS TEST DATA"24

APPENDIX D, "SEISMIC DESIGN DATA"25

APPENDIX E, "SOIL FERTILITY AND HORTICULTURAL SUITABILITY ANALYSIS"26

GEOTECHNICAL INVESTIGATION
FOR
SGT. JOHN PINNEY MEMORIAL POOL REPLACEMENT
205 S. WARNER STREET
RIDGECREST, CA 93555

SOILS ENGINEERING, INC.
SEI File No. 23-19224
November 7, 2023

INTRODUCTION

At your request, Soils Engineering, Inc. has prepared this Geotechnical Investigation for the subject site. This report includes recommendations for the site preparation and grading and for foundation design.

Appendix A, "Guide Specifications for Earthwork," is providing as supplement to Section I, "Earthwork," in the recommendations of the report.

Appendix B, "Field Investigation," contains a boring location map, Figure 1, and Logs of Test Borings, Figures 2 through 13 and Perc Table results.

Appendix C, "Soils Test Data," contains tabulations of laboratory test data.

Appendix D, "Seismic Design Data," contains information provided by EQFAULT, and the USGS.

Appendix E, "Soil Fertility and Horticultural Suitability Analysis"

We hope this provides the information you require. If you have any questions regarding the contents of our report, or if we can be of further assistance, please contact us.

Respectfully submitted,
SOILS ENGINEERING, INC.

SITE INFORMATION

A. PROJECT DESCRIPTION

The proposed Sgt. John Pinney Memorial Pool Project is located at 205 S. Warner Street, Ridgecrest, CA (site). The proposed improvements include the construction of a new pool, office buildings, and parking areas. The proposed buildings will be constructed with a combination of concrete, masonry, wood and/or metal framing and parking & drive aisles will be constructed of aggregate base and hot mix asphalt. It appears the site is bordered by S Warner Street to the east, a dirt track to the east, open field to the south, and an outdoor recreational area to the north.

The surface of the site appears to be relatively flat.

B. GEOLOGIC SETTING

According to the California Department of Conservation's Geologic Atlas of California, Trona Sheet, and the 2010 Geologic Map of California, the project site is situated on Pleistocene-Holocene marine and nonmarine (continental) sedimentary rocks (Q). Based on the California Department of Conservation's Geological Survey maps, the site is not located in an Alquist-Priolo (earthquake fault) Special Study Zone. Nearby active earthquake faults include the following:

Owl Lake	3.7 miles/ 6.0 kilometers
So. Sierra Nevada.....	7.0 miles/ 11.2 kilometers
Garlock (East)	11.5 miles/ 18.5 kilometers
Blackwater.....	18.9 miles/ 30.4 kilometers
Tank Canyon.....	20.4 miles/ 32.8 kilometers
Lenwood-Lockhart-Old Woman Sprgs	28.1 miles/ 45.2 kilometers
Gravel Hills-Harper Lake	28.1 miles/ 45.2 kilometers
Garlock (West)	30.6 miles/ 49.3 kilometers
Panamint Valley	32.4 miles/ 52.1 kilometers
Helendale-S. Lockhardt.....	39.8 miles/ 64.1 kilometers
Owens Valley	43.1 miles/ 69.4 kilometers
White Wolf.....	44.7 miles/ 71.9 kilometers
Owl Lake	44.8 miles/ 72.1 kilometers

Major fault systems and their distances from the site are given in the EQFault Summary attached in Appendix D. The largest estimated peak site acceleration, based on deterministic methods, is 0.4679-g from a magnitude 7.3 earthquake on the So. Sierra Nevada fault located approximately 3.7 miles from the site.

C. SUBSURFACE CONDITIONS

Subsurface soils encountered in our field investigation consisted of loose silty sand and clayey sand underlain with medium to dense silty sand and sand to maximum explored depth of 51 feet. These soils are classified as SM, CL and SP, respectively in the unified Soil Classification System (USCS).

The on-site soil is considered to have low Expansion Potential. Expansive soils are defined in the 2022 California Building Code (CBC), Section 1803A.5.3. Soils are considered to be expansive when the EI result is greater than 20, per ASTM D4829, Expansion Index of Soils. Design of foundations for structures shall be designed in accordance with the 2022 CBC, Sections 1808A.6.1, & 1808A.6.2.

Detailed descriptions of the various soils encountered during our field investigation are shown on Figures 2 through 13 in Appendix B, "Field Investigation." A "Key to Symbols" legend describing the symbols in the boring logs is also attached.

D. GROUNDWATER

No groundwater was encountered in the soil boring to maximum explored depth of 51 feet. According to the California Department of Water Resources' Water Data Library (WDL), the historical high groundwater in the vicinity is approximately 126.5 feet below ground surface at state well 27S40E04A001M, observed on September 18, 1969, located approximately 0.1 miles northeast of the Site.

E. SEISMIC DESIGN VALUES

The seismic design values tabulated below are based on the 2022 California Building Code (CBC). The Site Class for the proposed project was determined using standard penetration test data obtained at the site and documented in the attached Logs of Borings. The site is not in an Alquist-Priolo (earthquake fault) Special Study Zone.

SEISMIC DESIGN CRITERIA		VALUE	SOURCE
Risk Category		II	2022 CBC Table 1604.5 or 1604A.5
Site Class		D	2022 CBC § 1613.2.2 or 1613A.2.2; ASCE 7-16 Table. 20.3-1; Site Specific Soils Report
Mapped MCE _R Spectral Response Acceleration, short period	S_s	1.421g	SEAOC-OSHPD software; 2022 CBC Figure 1613.2.1(1)
Mapped MCE _R Spectral Response Acceleration, at 1-sec. Period	S₁	0.477g	SEAOC-OSHPD software; 2022 CBC Figure 1613.2.1(2)
Site Coefficient	F_a	1	SEAOC- OSHPD software; 2022 CBC Table 1613.2.3(1) or 1613A.2.3(1)
Site Coefficient	F_v[*]	1.823[*]	2022 CBC Table 1613.2.3(2) or 1613A.2.3(2)
Adjusted MCE _R Spectral Response Acceleration, short period, F _a · S _s	S_{MS}	1.421g	SEAOC- OSHPD software; 2022 CBC § 1613.2.3 or 1613A.2.3

GEOTECHNICAL INVESTIGATION
Sgt. John Pinney Memorial Pool Replacement
205 S. Warner Street, Ridgecrest, CA 93555

SEI File No. 23-19224
November 7, 2023
Page 6

SEISMIC DESIGN CRITERIA		VALUE	SOURCE
Adjusted MCE_R Spectral Response Acceleration, 1-sec. period, $F_v * S_{1^*}$ * 1.5	S_{M1}^*	1.304g*	2022 CBC § 1613.2.3 or 1613A.2.3, ASCE 7-16, Supplement 3, § 11.4.8
Design Spectral Response Acceleration, short period, $2/3 * S_{MS}$	S_{DS}	0.948g	SEAOC- OSHPD software; 2022 CBC § 1613.2.4 or 1613A.2.4
Design Spectral Response Acceleration, 1-sec. period, $2/3 * S_{MI}$	S_{D1}^*	0.870g*	2022 CBC § 1613.2.4 or 1613A.2.4
Peak Ground Acceleration for Max. Considered Earthquake (MCE_G)	PGA	0.627g	SEAOC- OSHPD software; ASCE 7-16 Fig 22-9
Site Coefficient, $F_{PGA} = 1.1$, $F_{PGA} * PGA$	PGA_M	0.69g	SEAOC- OSHPD software; ASCE 7-16 § 11.8.3.2
Seismic Design Category, short period		D	2022 CBC § 1613.2.5
Seismic Design Category, 1second period *		D*	2022 CBC § 1613.2.5
<p><i>* The project Structural Engineer shall confirm that a ground motion hazard analysis is not required in accordance with ASCE 7-16 § 11.4.8-Exception 2. The values tabulated above for S_{M1}, S_{D1}, and the Seismic Design Category/1-second period are based on the site coefficient, F_v, interpolated from 2022 CBC Table 1613.2.3(2) or 1613A.2.3(2). The use of that table is predicated on the above referenced Exception 2 being applicable for the site and the structure(s). The project Structural Engineer or designer shall confirm that the above referenced Exception 2 is applicable. Where the above referenced Exception 2 does not apply, the values for F_v, S_{M1}, S_{D1}, and for the Seismic Design Category/1-second period may not be applicable for the site and structure(s).</i></p>			
<p>MCE_R = Maximum Considered Earthquake (risk targeted) MCE_G = Maximum Considered Earthquake (geometric mean)</p>			

F. SOIL FERTILITY AND HORTICULTURAL SUITABILITY ANALYSIS

Soil fertility and horticultural suitability analysis were performed. SEI obtained soil sample at Borings B-1 and B-4 at 0 to 5 feet. The soil samples were sent to Dellavalle Laboratory Inc. for analysis. The results are presented in Appendix E.

EARTHWORK RECOMMENDATIONS

"Earthwork Specifications," in Appendix A are provided for general guidance in preparing site grading plans. In addition, the following specific recommendations are provided and supersede the latter wherever discrepancies may exist:

A. COMPACTION AND OPTIMUM MOISTURE

Unless otherwise specified herein, the terms, "Compaction," or "Compacted," wherever used or implied within this report should be interpreted as compaction to 90 percent of the maximum density obtainable by ASTM Test Method D1557. The term, "Optimum Moisture," wherever used or implied within this report, should be interpreted as that obtained by the above-described test method.

B. STRIPPING

Prior to soil compaction, existing ground surfaces should be stripped of surface vegetation. A stripping depth of one inch should be adequate. In no instances should stripped material be used in engineered fill or blended with and compacted in original ground.

C. GROUND SURFACE PREPARATION

Proposed Structure and Pool Deck Areas:

Ground surfaces in the proposed structure areas should be compacted in accordance with the following procedures:

1. Excavate earth material in the proposed structure area to a minimum depth of two (2) feet below existing grade or two (2) feet below bottom of foundations, whichever is deeper.
2. The upper 12 inches of the pool deck subgrade soil must be compacted to a minimum of 90 percent of ASTM D1557.
3. The bottom of the excavation shall be reviewed by the geotechnical engineer or his representative prior to any backfill operations.
4. Moisten soils to near the optimum moisture or to a moisture consistent with effective compaction and soil stability. Compact moistened soils to a minimum of 90 percent of the maximum density obtained by ASTM Test Method D1557.
5. Over-excavation laterally should be performed at least five (5) feet beyond the outside edges of exterior footings.

Review of Excavation Bottoms:

Prior to placement of backfill, excavation bottoms shall be reviewed for indications of loose-fill, discoloration, or loose, compressible, native materials. Where these are encountered, they should be excavated and removed, or excavated and compacted as directed by the geotechnical engineer. Excavation of native soils shall continue in vertical increments of one foot until relative compaction tests taken at the bottom of the working surface (excavation bottom) equal or exceed 80 percent relative compaction. Fill placement in excavations shall not proceed until the geotechnical engineer or his representative on the site has reviewed, tested as described above and accepted materials exposed at the bottom of the excavation.

Utility Lines:

Backfill for utility lines traversing areas proposed for facilities, pavements, concrete slabs-on-grade, or areas to receive engineered fill for future construction should be compacted in accordance with the same requirements for adjacent and/or overlying fill materials.

Compaction should include haunch area, spring line and from top of pipe to finished subgrade. The haunch area up to one foot above the top of the pipe should be backfilled with "cohesionless" material.

Cohesionless native materials may be used for trench and pipe or conduit backfill. The term "cohesionless," as used herein, is defined as material which, when dry, will flow readily in the haunch areas of the pipe trench.

Pipe backfill materials should not contain rocks larger than two inches in maximum dimension. Where adjacent native materials exposed on the trench bottoms contain protruding rock fragments larger than two inches in maximum dimension, conduits and pipelines should be laid on a bedding consisting of clean, cohesionless sand (SP), in the Unified Soils Classification System.

Compaction Requirements – where not otherwise specified in our plans or in these recommendations, the following compaction requirements are applicable to all electrical, gas or water conduits:

TABLE A			
COMPACTION DEPTH			
Area	Haunch to 1 ft. Above Top Of Pipe	1 ft. Above Top of Pipe to 2'6" Below Finished Grade	2'6" Below Finished Grade to Finished Subgrade
Structural	90%	90%	90%
Pavements	90%	90%	90%
Non-Structural	90%	90%	90%

D. ENGINEERED FILL

Earth materials obtained on site are acceptable for use as engineered fill provided that all grasses, weeds, cobbles less than 2 inches and other deleterious debris are first removed. On-site, non-expansive soils with expansion index of less than 20 must be used.

Engineered fill materials should be placed in thin layers (less than ten inches uncompacted thickness), brought to near the optimum moisture content or to a moisture content commensurate with effective compaction and soil stability, and compacted to a minimum of 90 percent of the maximum density obtainable by ASTM Test Method D1557, "Placing, Spreading and Compacting Fill Materials," in Appendix A.

E. IMPORTED FILL

The table shown below provides general guidelines for acceptance of import engineered fill. Materials of equal or better quality than on-site material could be reviewed by the Geotechnical Engineer on a case-by-case basis. No soil materials shall be imported onto the project site without prior approval by the Geotechnical Engineer. Any deviation from the specifications given below shall be approved by the Geotechnical Engineer prior to import operations.

MAXIMUM PERCENT PASSING #200 SIEVE	40
MAXIMUM PERCENT RETAINED 3" SIEVE	0
MAXIMUM PERCENT RETAINED 1½" SIEVE <i>FOR BUILDING AREAS</i>	15
MAXIMUM PERCENT RETAINED ¾" SIEVE <i>FOR LANDSCAPE AREAS</i>	5
MAXIMUM LIQUID LIMIT	40
MAXIMUM PLASTICITY INDEX	14
MINIMUM R-VALUE FOR PAVEMENT AREAS	50
MAXIMUM EXPANSION INDEX	20

Furthermore, the soils proposed for import shall be generally homogenous and shall not contain cemented or clayey and/or silty lumps larger than one inch. When such lumps are present, they shall not represent more than ten percent (10%) of the material by dry weight.

Where a proposed import source contains obviously variable soils, such as clay and/or silt layers, the soils which do not meet the above requirements shall be segregated and not used for this project or the various layers shall be thoroughly mixed prior to acceptance testing by the Geotechnical Engineer. The contractor shall provide sufficient advance notice, prior to import operations, to allow testing and evaluation of the proposed import materials. Because of the time needed to perform the above tests, the contractor shall provide a means by which the Geotechnical Engineer or others can verify that the soil(s) which was sampled and tested is the same soil(s) which is being imported to the project.

F. DRAINAGE

Finished ground grades adjacent to the proposed structures should be sloped to provide positive free drainage away from the foundations. No areas should be constructed that would allow drainage generated on the site, or water impinging upon the site from outside sources, to pond near footings and slabs or behind curbs.

Where ground surfaces adjacent to subsurface walls are to be landscaped, walls should be waterproofed. Installation of gravel-filled drains to route subsurface drainage away from walls will reduce the thickness of damp-proofing resulting in a considerable savings.

G. PERCOLATION TEST RESULTS

Three percolation tests were performed at depths of 4 to 5 feet. The locations are presented in Figure 1, Boring Location Map. The percolation rates ranged from 2 to 24 minutes per inch. For design, a percolation rate of 24 minutes per inch should be used. A safety factor of 3 should be applied to the percolation rate.

FOUNDATIONS RECOMMENDATIONS

Spread Footings – The proposed foundation could be supported on continuous spread footings in accordance with the following Table B:

TABLE B			
FOUNDATION DESIGN CRITERIA			
Footing Type	Minimum Width (ft.)	Minimum Depth Below Lowest Adjacent Subgrade (ft.)	Maximum Allowable Soil Bearing Pressure (lbs./sq.ft.)
Continuous	1	1	2500
Isolated	1	1	3000

Bearing pressures given are for the minimum widths and depths shown above.

Bearing pressures given above are for dead and sustained (loads acting most of the time) live loads; they may be increased by one-third for wind and/or seismic loading conditions. The proposed foundations shall be reinforced in accordance with the structural engineer's recommendations.

Settlement:

Provided maximum allowable soil bearing pressures given above are not exceeded, total settlement should not exceed one inch. A major portion two-thirds to one-half of total settlement should occur before the end of construction. Differential settlements should occur before the end of construction. Differential settlements should, accordingly, be less than one-half of an inch for a horizontal span of twenty feet.

Cast-In-Drilled (CIDH) Piles – As general guidance structures may be supported on straight-shafted drilled piers combined with grade beams. Casing may be needed to stabilize the shaft for the proposed piers. Pier design criteria are given below:

1. Friction Values: We recommend a friction value or skin friction (fs) of 300 psf. This value is for dead load plus live loads and can be increased by 1/3 for the total of all loads, including wind or seismic forces. Uplift pressure may be taken as three fourths (3/4) of the downward capacity.
The top one foot (1.0') of the below-grade portion of the pier shall be excluded when determining the pier frictional resistance. In the event that steel casing is required to drill the piers and the casing is to remain in place, the friction values above shall be reduced by one third.
2. Minimum Penetration: The piers should extend a minimum of Six (6) feet below adjacent subgrade or per the structural engineer's recommendations. Minor deviations from the recommended caisson depths may be necessary upon field review of the drilled caissons.
3. Minimum Diameter: The recommended minimum diameter for friction piers is 24 inches.
4. Concrete Placement: All concrete should be placed in one continuous operation. Vibration to consolidate concrete should be provided. When a casing is used to stabilize the shaft, an adequate height of concrete should be maintained above the bottom of the casing while it is gradually withdrawn. Concrete should be placed as quickly as possible following review, by the Geotechnical Engineer or his representative, of the completed excavation and cleaning.

Uncased excavations should not be permitted to remain open overnight. Adequate devices should be used to guide the fall of concrete in the pier and prevent it from striking the shaft walls, entraining soil or promoting sloughing during placement.

5. Construction Review and Observations: The Geotechnical Engineer should provide continuous review of pier drilling and concrete placement. The Geotechnical Engineering should also retain the option of reviewing individual piers and requesting minor depth variations when warranted by changes in soil conditions from those assumed during the preparation of this Geotechnical Investigation Report.

MODULUS OF SUBGRADE REACTION

Modulus of subgrade reaction for use in design of foundations is based on ranges of values for soil types provided by Foundation Analysis and Design by Joseph E Bowles.¹ Equation 1 should be used for footings on sandy soils.

Foundations on clay soils should employ Equation 2. Equation 3 is for rectangular footings having dimensions $w = b$ (width) and $l = mb$ (length) the variable "m" being the ratio of the length to the width of the foundation. K_{s1} is the modulus of subgrade reaction from the source referenced above based on a 1 foot x 1 foot square plate. For general guidance K_{s1} of 150 kcf may be used for the subsurface soils.

$$\text{Equation (1)} \quad k_{sf} = K_{s1} \times \left(\frac{B+1}{2B} \right)^2$$

$$\text{Equation (2)} \quad k_{sf} = K_{s1} \times B$$

$$\text{Equation (3)} \quad k_{sf} = K_{s1} \times \frac{m+5}{1.5 \times m}$$

Values given above should be used for guidance. Local values may be higher or lower and should be based on results of in-situ plate bearing tests performed in accordance with ASTM Test Method D1194.

LATERAL EARTH PRESSURES

Lateral earth pressures and friction coefficients for determining the passive lateral resistance of foundations against lateral movement and the active lateral forces against retaining walls and subsurface walls, expressed as equivalent fluid pressures, are given below in Table C. Lateral earth pressures were computed assuming that backfill materials are essentially free draining and level; and that no surcharge loads or sloping backfills are present within a distance from the wall equal to or less than the height (H)* of the wall.

(H)* = the height of backfill above the lowest adjacent ground surface.

TABLE C LATERAL EARTH PRESSURES		
Case	Lateral Earth Pressures Drained	Lateral Earth Pressures Saturated
Active	35 P.C.F.	80 P.C.F.
Passive	400 P.C.F.	230 P.C.F.
At-Rest	50 P.C.F.	87 P.C.F.

Active Case: Active lateral earth pressures should be used when computing forces against free standing retaining walls, unrestrained at the tops. Active pressures should not be used where tilting outward of the walls is greater than .002H would not be desirable.

¹ Bowles, Joseph E; FOUNDATION ANALYSIS AND DESIGN; McGraw-Hill Book Company (1977); Table 9-1 pg 269

Passive Case: Passive lateral earth pressures should be used when computing the lateral resistance provided by undisturbed or compacted native soils against the movement of footing. When computing passive resistance, the upper one foot of embedment depth should be discounted.

At-Rest Case: At-rest pressures should be used for subsurface walls restrained at their tops by floor diaphragms or tie-backs and for retaining walls where tilting outward greater than .002 H would not be desirable.

Frictional Resistance: A friction coefficient of **0.45** may be used when computing the frictional resistance to sliding of footings, grade beams, and slabs-on-grade. Frictional resistance and passive lateral soil resistance may be combined without reduction.

SLABS-ON-GROUND

Slabs-on-grade can be adequately supported by compacted native soils or by compacted import materials of equal or superior quality.

We recommend that moisture protection be provided for interior concrete slabs-on-ground that will receive moisture-sensitive floor coverings, or where moisture-sensitive equipment, products, or environments may be present. For exceptions to slab moisture protection, refer to the 2019 California Building Code, Section 1907.1. The project designer should provide specific details regarding construction of the concrete slab-on-ground, including the moisture barrier or vapor retarder/barrier, capillary break (if included), and blotter material (if included). The American Concrete Institute recommends a minimum moisture vapor retarder of 10 mil thick polyethylene. The vapor retarder should be protected from damage. Punctures and tears should be repaired prior to concrete placement.

It has been common local practice to use a sandy material as a blotter layer between the moisture barrier and the concrete to absorb some of the bleed water and to potentially reduce slab curling. However, a blotter layer may act as a moisture reservoir and all apparent advantages of its use are then negated. Therefore, it should not be incorporated into the section design for moisture-sensitive slabs if it cannot be kept dry prior to concrete placement or if water may migrate into the layer after slab construction (eg. wet curing, rainfall). If the slab-on-ground section is to include a blotter layer between the moisture barrier and the concrete, it is our recommendation that the blotter material consist of crusher fines (rock dust) or sand with angular, interlocking grains. The material should be easily compacted and should be screened so that 100% of the material is finer than ¼". Do not use blotter material which may be potentially reactive with the alkalis in the concrete or which has high sulfate content. At the time of concrete placement, the blotter material should be dry to damp, compact, and smooth. For slabs which are to be water-cured, a blotter layer should not be used. For further consideration, refer to the American Concrete Institute *Manual of Concrete Practice 302.1R and 360*.

Slab thicknesses, reinforcing, and the concrete characteristics should be in accordance with the project designer's recommendations. The 2022 California Building Code, Section 1907.1 requires that the slab thickness be not less than 3½". Pressurized water lines should not be placed beneath slabs.

Porosity is directly related to the amount of extra water added to the concrete mix of the slab when it was created. The extra water creates permanent space in the slab. Once it is evacuated, that space remains moist and easily passes vapor through it. Creating a slab with the lowest possible permeability starts with keeping a low water/cement ratio.

PAVEMENT RECOMMENDATIONS

R-value test results ranged from 17, 26, and 71. The laboratory test reports are provided as Figures D-1, D-2, D-3.

Based on the R-value of 26, the following HMA pavement section as follows:

TI of 5	2.5 inches of AC and 8.0 inches of AB
TI of 6	3.5 inches of AC and 9.0 inches of AB
TI of 7	4.5 inches of AC and 10.0 inches of AB
TI of 8	5.0 inches of AC and 12.0 inches of AB

Hot Mix Asphalt (HMA) design should meet the requirements of the 2010 or newer, State of California, Standard Specifications Manual (SSM), Section 39 and Aggregate Base should meet the Class 2 requirements of the SSM, Section 26.

These recommendations are valid only if the pavement is properly drained and shoulder areas are graded to prevent water ponding at pavement edges. All construction should be subject to adequate tests and observations to verify conformance with these recommendations.

Ground surfaces to receive pavement should be moisture conditioned as needed and compacted. For areas which are cut to grade and for the existing grade in fill areas, scarify the top one foot (1.0') of soil, moisture condition it to approximately optimum moisture (as determined in accordance with ASTM D1557), and compact it. As an alternative to scarifying one foot of the soil, the contractor may choose to excavate that material, moisture condition it, and replace it in uniform lifts with applicable compaction. Engineered fill in pavement areas should be placed, spread, moisture conditioned, and compacted in accordance with the recommendations of the geotechnical investigation or as described herein. Compaction for pavement areas should extend at least two feet beyond the edges of the pavement(s). The uppermost one foot (1.0') of pavement subgrade (cut or fill) should be compacted to not less than ninety-five percent (95%) of the laboratory maximum density (as determined in accordance with ASTM D1557). Engineered fill below the uppermost one foot of pavement subgrade should be compacted to not less than ninety percent (90%) of the laboratory maximum density (as determined in accordance with ASTM D1557).

SOIL CORROSIVITY

Soluble Sulfates (SO₄)

The highest Sulfate (SO₄) concentration ranged from 2.9 through 25 ppm.

Based on Table 19.3.1.1 "Exposure categories and classes" of ACI 318-14 "Building Code Requirements for Structural Concrete" the soil exposure is classified as S0. Per Table 19.3.2.1 "Requirement for Concrete by Exposure Class" of the same reference, no type restriction applies to cement type of mix design.

Chlorides (Cl)

The highest Chloride (Cl) concentration ranged from 1.9 through 30 ppm. Generally, chloride concentrations greater than 500 ppm are considered to be corrosive to foundation elements. (Ref: Caltrans Corrosion Guidelines / Version 1.0)

pH

The soil pH result ranged from 8.50 through 8.94. Generally, a pH level less than 5.5 are considered to be corrosive to foundation elements. (Ref: Caltrans Corrosion Guidelines / Version 1.0)

LIMITATIONS, OBSERVATION AND TESTING

Conclusions and recommendations in this report are given for the Sgt. John Pinney Memorial Pool Replacement project located at 205 S. Warner Street, Ridgecrest, CA 93555 and are based on the following:

- a. The information retrieved from twelve (12) exploratory borings drilled at the subject site to a maximum depth of 51 feet below the existing ground surface.
- b. Our laboratory testing program results.
- c. Our engineering analysis based on the information defined in this report.
- d. Our experience in the Kern County area.

Variations in soil type, strength and consistency may exist between specific boring locations. These variations may not become evident until after the start of construction. If such variations appear, a re-evaluation of the soils test data and recommendations may be necessary. Unless a Geotechnical Engineer of this firm is afforded the opportunity to review plans and specifications, we accept no responsibility for compliance with design concepts or interpretations made by others with regard to foundation support, fill selection, fill placement or other recommendations presented in this report. Changes in conditions of the subject property can occur with time because of natural processes or the works of man on the subject site or on adjacent properties. Changes in applicable engineering and construction standards can also occur as the result of legislation or from the broadening of knowledge. Accordingly, the finding of this report may be invalidated, wholly or in part, by changes beyond our control. Therefore, this report is subject to review and should not be relied upon without review after a period of two years or after any modifications to the site.

REVIEW OF EARTHWORK OPERATIONS

Review of earthwork operations relating to site clearing, ground stabilization, placement and compaction of fill materials, and finished grading is critical to the structural integrity of building foundation and floor systems.

While the preliminary Geotechnical investigation and report provide guidelines which are used by the design team, i.e., architects, grading engineers, structural engineers, landscape engineers, etc., in completing their respective tasks, review of plans and site review and testing during earthwork operations are vital adjuncts to the completion of the Geotechnical engineer's tasks.

The most prevalent cause of failure of a structure foundation system is lack of adequate review and testing during the earthwork phase of the project. Projects rarely reach completion without some alteration being required such as may result from a change in subsurface conditions, an amendment in the size and scope of the project, a revision of the grading plans or a variation in structural details. Occasionally, even minor changes can significantly affect the performance of foundations. The most prevalent secondary cause for foundation failure is inadequate implementation of Geotechnical recommendations during the formulation of foundation designs and grading plans. The error in a foundation design or an omission of a key element from a grading plan occurs most often as a result of inadequate communication between the various project consultants and -- when a change in consultants occurs -- improper transfer of authority and responsibility². It is imperative, therefore, that any revisions to the project scope, any change in structural detail, or change in consultant, be brought to the attention of Soils Engineering, Inc. to allow for timely review and revision of recommendations and for an orderly transfer of responsibility and approval.

It is the responsibility of the owner or his representative to ensure that a representative of our firm is present at all times during earthwork operations relating to site preparation and grading, so that relative compaction tests can be performed, earthwork operations can be observed and compliance with the recommendations provided herein can be established. This engineering report has been prepared within the limits prescribed to us by the client or his representative, in accordance with the generally accepted principles and practices of Geotechnical engineering. No other warranty, expressed or implied, is included or intended in this report.

Respectfully submitted,
SOILS ENGINEERING, INC.

² If the civil engineer, the soils engineer, the engineering geologist or the testing agency of record is changed during the course of the work, the work shall be stopped until the replacement has agreed to accept the responsibility within the area of his technical competence for approval upon completion of the work.

APPENDIX A

GENERAL GUIDE SPECIFICATIONS FOR EARTHWORK

1. GENERAL

1.1 Scope

These specifications and plans include all earthwork pertaining to site rough grading including, but not limited to furnishing all labor and equipment necessary for clearing and grubbing; stripping; preparation of ground surfaces to receive fill; excavation; placement and compaction of structural and non-structural fill; disposal of excess materials and products of clearing, grubbing, and stripping; and any other work necessary to bring ground elevations to the lines and grades shown on the project plans.

1.2 Performance:

It shall be the responsibility of the contractor to complete all earthwork in accordance with project plans and specifications. No variance from plans and specifications shall be permitted without written approval of the Engineer-of-Record, hereinafter referred to as the "engineer" or his designated representative, hereinafter referred to as the "soils engineer." Earthwork shall not be considered complete until the "engineer" has issued a written statement confirming substantial compliance of earthwork operations to these specifications and to the project plans.

The contractor shall assume sole responsibility for job site conditions during the course of earthwork operations on the project, including safety of all persons and preservation of all property; this requirement shall apply continuously and not be limited to normal working hours. The contractor shall defend, indemnify, and hold harmless the owners, engineer, and soils engineer from any and all liability and claims, real or alleged, arising out of performance of earthwork on this project, except from liability incurred through sole negligence of the owner, engineers, or soils engineers.

2. DEFINITIONS

2.1 Excavations:

Excavation shall be defined within the content of these specifications as earth material excavated for the purpose of constructing fill embankment; grading the site to elevations shown on project plans; or placing underground pipelines, conduits, or other subsurface utilities or minor structures.

Excavations shall be made true to the lines shown on project plans and to within plus or minus one-tenth (0.1) of a foot, of grades shown on the accepted site grading plans.

2.2 Engineered Fill:

Engineered fill shall be construed within the body of these specifications as earth materials conforming to specifications provided in the soils or geotechnical report placed to raise the grade of the site, to backfill excavations, or to construct asphaltic concrete or Portland cement concrete pavement; and upon which the soils engineer has performed sufficient tests and has made sufficient observation during placement and compaction to enable him to issue a written statement confirming substantial conformance of the work to project earthwork specifications.

2.3 On-Site Material:

On-site material is earth material obtained in excavation made on the project site.

2.4 Imported Material:

Imported materials are earth materials obtained off the site, hauled in, and placed as fill.

2.5 “Compaction” or “Compacted:”

Wherever expressed or implied within the context of these specifications shall be interpreted as compaction to ninety (90) percent of the maximum density obtainable by ASTM Test Method D1557.

2.6 Grading Plane:

The grading Plane is the surface of the basement material upon which the lowest layer of subbase, base, asphaltic or Portland cement concrete, surfacing, or other specified layer is placed.

3. SITE CONDITIONS

The contractor shall visit the site, prior to bid submittal, to determine existing soil and topographic conditions, and the nature of materials that may be encountered during the course of the work under this contract, and make his own interpretation of the contents of the Geotechnical Report, as they pertain to said conditions.

The contractor shall assume all liability under the contract for any loss sustained as a result of variations which may exist between specific soil boring locations or changed conditions resulting from natural or man-made circumstances occurring after the date of the Preliminary Field Investigations.

4. CLEARING AND GRUBBING

4.1 Clearing and Grubbing

Clearing and grubbing shall consist of removing all debris such as metal, broken concrete, trash, vegetation growth and other biodegradable substances, from all

areas to be graded. Existing obstructions below shall be removed in accordance with the following procedures:

- 4.1.1 Slabs and Pavements** – Shall be completely removed. Asphaltic or Portland Cement, concrete fragments may be used in engineered fills provided they are broken down to a maximum dimension of six (6.0) inches and thoroughly dispersed within a friable soil matrix. Engineered fill containing said fragments should not be placed above the elevation of the bottom of the lowest structure footing.
- 4.1.2 Foundations** – existing at the time of grading shall be removed to a depth not less than two (2.0) feet below the bottom of the lowest structure footing.
- 4.1.3 Basements, Septic Tanks** – buried concrete containers of similar construction located within areas destined to receive pavements, structures, or engineered fills should be completely removed and disposed of off the site. Basements, septic tanks, etc., situated outside structures, or structural fill areas shall be disposed of by breaking an opening in bottoms to permit drainage, and by breaking walls down to not less than two (2.0) feet below finished subgrade.
- 4.1.4 Buried Utilities** – such as sewer, water and gas lines or electrical conduits to remain in service shall be re-routed to pass no closer than four (4.0) feet to the outside edge of proposed exterior footings of structures. Lines to be abandoned shall be completely removed to a minimum depth of two (2.0) feet below finished building pad grade. Concrete lines deeper than two (2.0) feet below finished building pad grade and having diameters less than six (6.0) inches can be crushed in place.
- 4.1.5 Root Systems** – shall be completely removed to a minimum depth of two (2.0) feet below the bottom of the lowest proposed structure footing or to two (2.0) feet below finished subgrade, whichever depth is lower. Root systems deeper than the elevation indicated above shall be excavated to allow no roots larger than two (2.0) inches in diameter.
- 4.1.6 Cavities** – resulting from clearing and grubbing or cavities existing on the site as a result of man-made or natural activity shall be backfilled with earth materials placed and compacted in accordance with Sections 5.3 and 5.4 of these specifications.
- 4.1.7 Preservation or Monuments, Construction Stakes, Property Corner Stakes**, or other temporary or permanent horizontal or vertical control reference points shall be the responsibility of the contractor. Where these markers are disturbed, they shall be replaced at the contractor's expense.

5. SITE GRADING

Site grading shall consist of excavation and placement of fills to lines and grades shown on the project plans and in accordance with project specifications and recommendations

of the Preliminary Soils Report, whichever is more stringent. The following are recommendations issued in this report.

5.1 Areas to Receive Fill:

- 5.1.1** Surfaces to receive fill shall be scarified to a depth of at least six (6.0) inches, or as recommended in this report, whichever is greater, until the surface is free from ruts, hummocks or other uneven features which would tend to prevent uniform compaction by the equipment to be used.
- 5.1.2** After the area to receive fill has been cleared and scarified, it shall be moistened and compacted to a depth of at least six (6.0) inches in accordance with specifications for compacting fill material in paragraph 5.4, below.

5.2 Excavation:

- 5.2.1** Excavations shall be cut to elevations plus or minus 0.1 foot of the grades shown on the accepted plans.
- 5.2.2** When excavated materials are to be used in engineered fill, the excavation shall be made in a manner to produce as much mixing of the excavated materials as practicable.
- 5.2.3** When excavations are to backfilled, and where surfaces exposed by excavation are to support structures or concrete floor slabs, the exposed surfaces shall be scarified, moistened and compacted, as stated above for areas to receive fill. Over excavation below specified depths will not eliminate the requirement for exposed surface compaction.

5.3 Fill Materials:

- 5.3.1** Materials obtained from on-site excavations will be considered satisfactory for construction of on-site engineered fills unless otherwise stated in the Soils Report or Foundation Investigation. If unexpected pockets of poor or weak materials are encountered in excavations, and they cannot be upgraded by mixing with other materials or by other means, they may be rejected by the soils engineer for use in engineered fill.

Rocks larger than 12 inches in size in any dimension shall not be allowed in the proposed building area. If a large amount of rocks greater than 12 inches in size in any dimension is encountered a rock disposal area shall be located on the grading plan. Rocks shall be mixed with well graded soils to assure that the voids in these areas will fill properly.

- 5.3.2** When imported fill materials are necessary to bring the site up to planned grades, no material shall be imported prior to its approval and acceptance by the soils engineer.

- 5.3.3** The soils engineer shall be given notice of the proposed source of imported materials with adequate time allowance for his testing of the proposed materials. The time required for testing will vary with different types of materials, job conditions, and ultimate function of filled areas. Under best conditions the time requirement will not be less than 48 hours.

5.4 Placing, Spreading, and Compacting Fill Material:

- 5.4.1** The fill materials shall be placed in layers which, when compacted, shall not exceed six (6.0) inches in thickness. Each layer shall be spread evenly and shall be thoroughly mixed during the spreading to insure uniformity of material in each layer. Increased thickness of layers may be approved by the soils engineer when conditions warrant.
- 5.4.2** All fills shall be placed in level layers; layers shall be continuous over the area of any structural unit, and all portions of the fill shall be brought up simultaneously within the area of any structural unit. When imported material is used, it must be placed so that its thickness is as uniform as possible within the area of any structural unit.
- 5.4.3** When materials are to be excavated and replaced in a compacted condition, segmented, or leap-frogging of cut-fill operation within the area of any structural unit will not be permitted unless the method is specifically described by the soils engineer.
- 5.4.4** When the moisture content of fill material is below the lower limit specified by the Soils Engineer, water shall be added until the moisture content is as specified; and when it is above the upper limit specified, the material shall be aerated by blading or other satisfactory methods until the moisture content is as specified.
- 5.4.5** After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted to not less than ninety (90) percent of maximum density in accordance with ASTM Density Test Method D1557. Compaction shall be by equipment of such design that it will be able to compact the fill to specified density. When the soils engineer specifies a specific type of compaction equipment to be used, such equipment shall be used as specified.
- 5.4.6** Compaction of each layer shall be continuous over its entire area and the equipment shall make sufficient trips to insure that the desired density has been obtained.
- 5.4.7** Field density tests shall be made by the soils engineer. The compaction of each layer of fill shall be subject to testing. Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density tests shall be taken in the compacted material below the disturbed surface. When tests indicate the density of any layer of fill or portion thereof is below the required ninety (90) percent density, the particular layer or portion shall be re-worked until the required density has been obtained.

- 5.4.8** When the soils engineer specifies compaction to other standards or to percentages other than ninety (90) percent, such specification, with respect to the particular items shall supersede these specifications.
- 5.4.9** The fill operation shall be continued in six (6) inch compacted layers, as specified above, until the fill has been brought to within 0.1 foot, plus or minus of the finished slopes and grades, as shown on the accepted plans. The finished surface of fill areas shall be graded or bladed to a smooth and uniform surface and no loose material shall be left on the surface.
- 5.4.10** No fill materials shall be placed, spread, or compacted while it is frozen or thawing or during unfavorable weather conditions. When work is interrupted by weather conditions, fill operations shall not be resumed until the soils engineer indicates that moisture content and density of previously placed fill are satisfactory.

5.5 Observations and Testing:

The soils engineer shall be provided with a 48 hour advance notice, in order that he may be present at the site during all earthwork activities related to excavation, tree root removal, stripping, backfill, and compaction and filling of the site and to perform periodic compaction tests so that substantial conformance to these recommendations can be established.

APPENDIX B**FIELD INVESTIGATION**

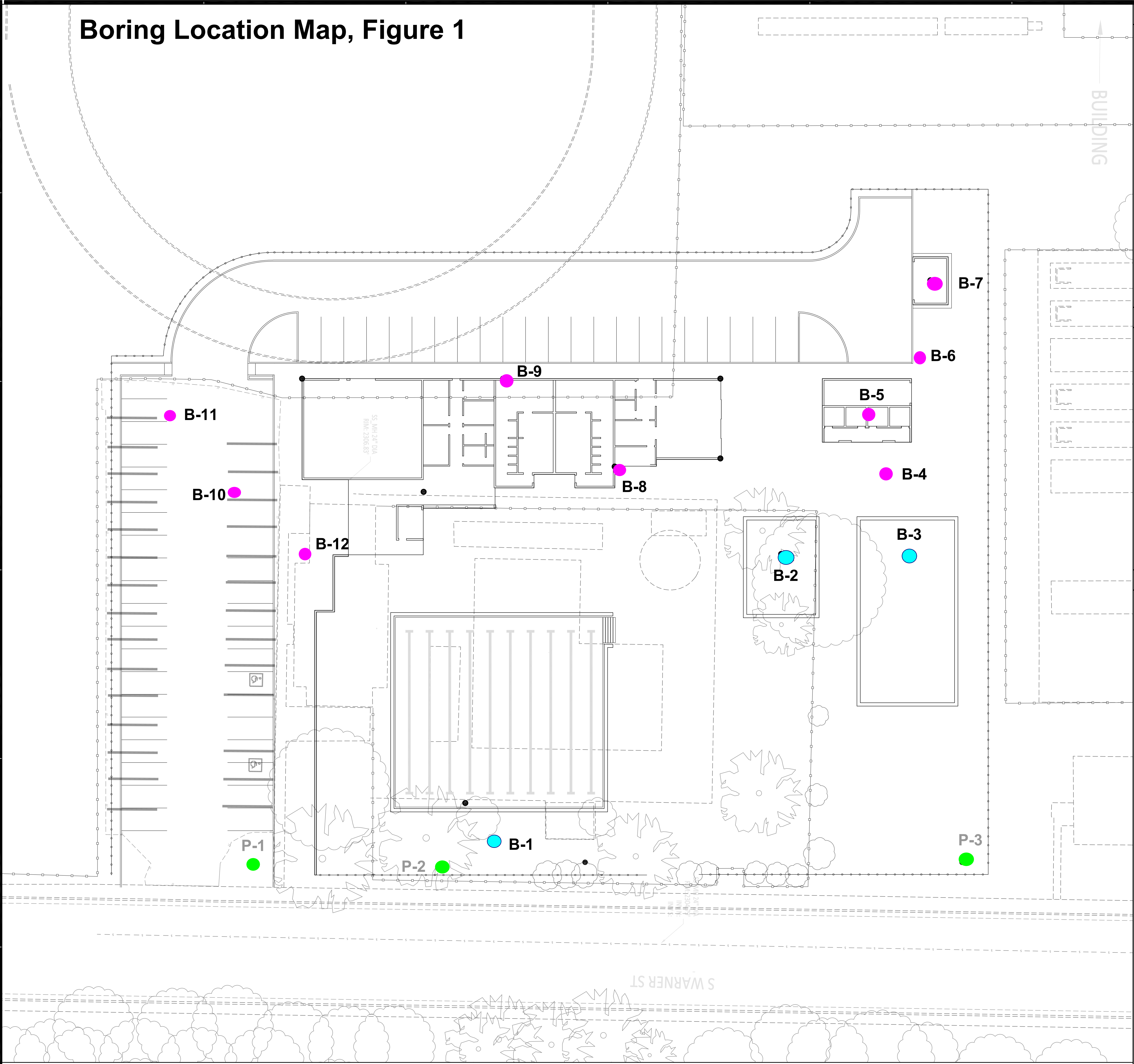
Twelve (12) test borings were drilled at the subject site and terminated at a maximum depth of 51 feet below the existing ground surface. Borings were advanced using an (4.25) inch hollow-stem auger. Test data and descriptions from these holes form the basis of the conclusions and recommendations contained in this report.

Undisturbed samples and disturbed bulk samples were obtained. Undisturbed samples were taken using either a 2-3/8" (inside diameter) split-barrel sampler or a 1-3/8" (inside diameter), 2" (outside diameter) Standard Penetration Sampler (SPT). Penetration resistance of undisturbed soils was obtained by driving the above-described sampler using a one-hundred-forty-pound hammer falling thirty inches (30"). Blow counts for each six inch (6") driven increment was recorded and are reported on the Test Borings Logs. In addition, bulk soil samples, selected as most representative of near surface soils encountered, were taken for laboratory testing.

As drilling progressed, earth materials encountered were logged and classified in accordance with the Unified Soils Classification System and presented graphically on Logs of Test Borings, Figures 2 through 13, along with the Legend. Approximate locations of test borings are shown on the Boring Location Map, Figure 1.

In addition to the borings, field percolation tests were performed at two separate locations. Tests were performed at approximately five feet below the existing ground surface and were conducted in substantial accordance with the Manual of Septic Tank Practice, Part I, of the U.S. Department of Health, Education, and Welfare, Public Health Service, and the Kern County Environmental Health Department. Percolation test results are presented on Table 1.

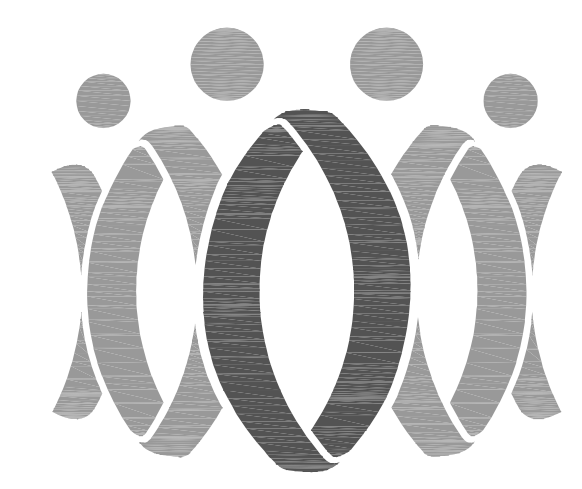
Boring Location Map, Figure 1



GENERAL NOTES

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LEGEND

- Boring Location For Structural
- Boring Location For Pools
- Boring Location For Percolation/Infiltration Tests

RECONSTRUCTION KEY NOTES

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CONSULTANT

Drawn by

Checked by

Revisions		
No.	Date	Description

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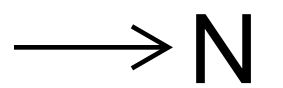
SGT. JOHN PINNEY MEMORIAL
POOL REPLACEMENT
205 S. WARNER STREET
RIDGECREST, CA 93555

PROPOSED
BORING LOCATIONS

PROPOSED BORING LOCATIONS

SCALE: 1/16" = 1'

1
A2.02

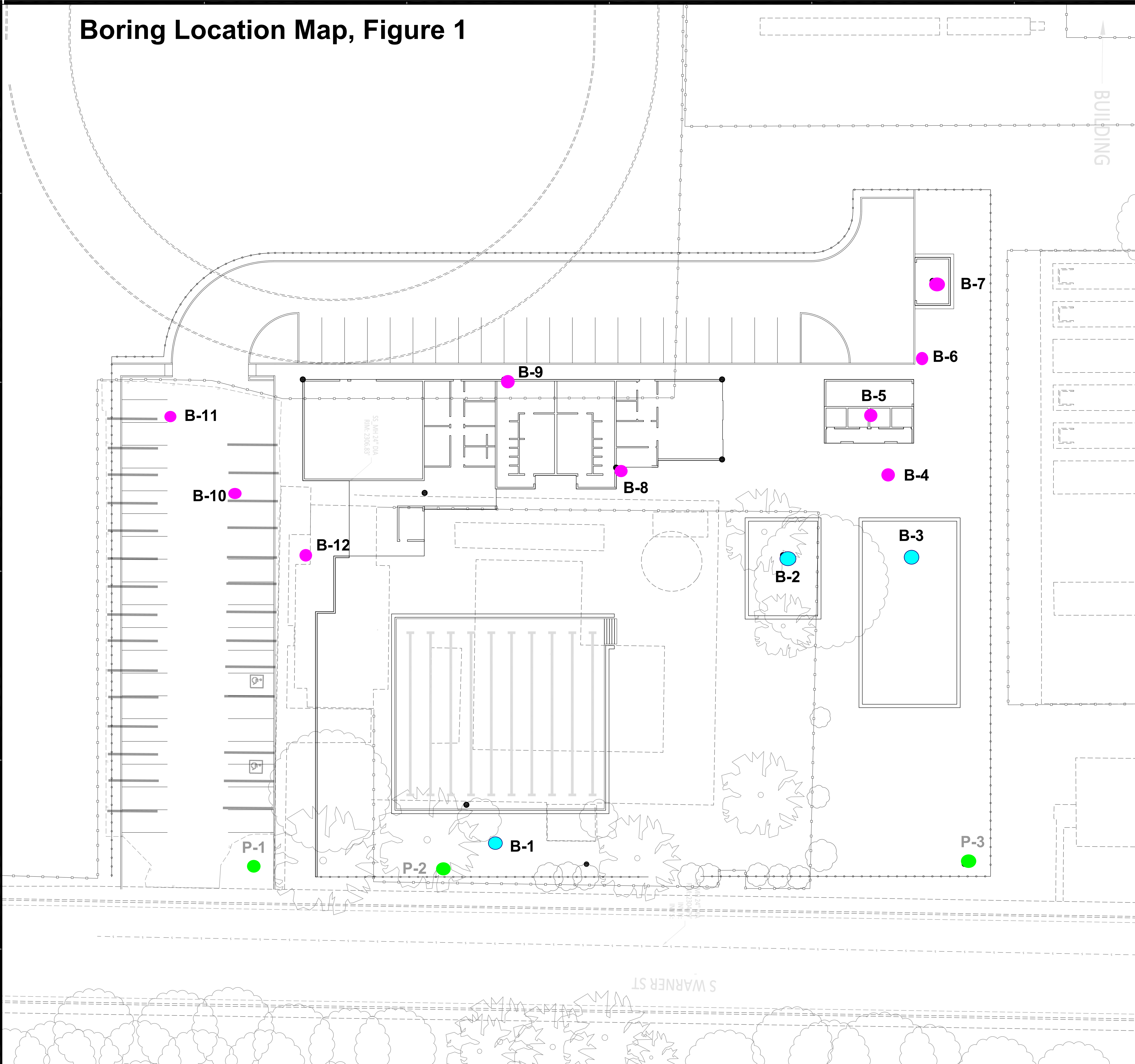


Job No.
3055.0000

Date
05-17-2023

A2.02

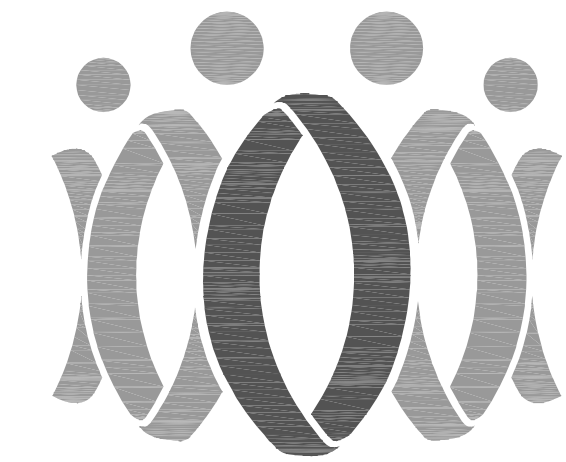
Boring Location Map, Figure 1



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Revisions		
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PROPOSED
BORING LOCATIONS

Job No.

3055.0000

Date

05-17-2023

A2.02

PROPOSED BORING LOCATIONS

SCALE: 1/16" = 1'

1

A2.02

→ N



LOG OF TEST BORING BORING B-1

Page 1 of 2

PROJECT: Sgt. John Pinney Memorial Pool Replacement

BORING DATE: 09/19/23

BORING LOCATION: See Boring Location Map, Figure 1

DRILL METHOD: 4.25" I.D. Hollow-Stem Auger

DESCRIPTION: Geotechnical Engineering Services

DEPTH TO WATER - ∇ : N/A

CAVING - \blacktriangleright : N/A

FILE NO: 19224

ELEV.:

START: 09/19/23

FINISH: 09/19/23

LOGGER: L.Winder

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Remarks	Density pcf	Moisture %
0		SM	Grass 1".			
			SILTY SAND: Yellowish brown, moist, poorly graded, cohesive, fine gravel. Loose.		117.6	8.7
3/6 4/6 8/6						
5			Medium dense.		119.1	9.0
5/6 8/6 11/6						
10		CL	SANDY CLAY: Light yellowish brown, moist, medium plasticity.		108.5	11.3
		SP- SM	POORLY GRADED SAND with low fine content: Light yellowish brown, poorly graded, fine grained, cohesive, traces of clay. Dense.			
9/6 15/6 26/6			Fine gravel, sand, fine grained, coarse strarting and 14'. Medium dense.			
12/6 12/6 13/6						5.8
15						
5/6 9/6 11/6						5.5'
20						
6/6 20/6 31/6			Very dense.			4.1'
25						
4/6 7/6 13/6			Medium dense.			6.2'
30						
35						

Figure Number 2



LOG OF TEST BORING BORING B-1

Page 2 of 2

PROJECT: *Sgt. John Pinney Memorial Pool Replacement*

BORING DATE: 09/19/23

BORING LOCATION: *See Boring Location Map, Figure 1*

DRILL METHOD: 4.25" I.D. Hollow-Stem Auger

DESCRIPTION: *Geotechnical Engineering Services*

DEPTH TO WATER -  : N/A

CAVING -  : N/A

FILE NO: 19224

ELEV.:

START: 09/19/23

FINISH: 09/19/23

LOGGER: *L. Winder*





ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Remarks	Density pcf	Moisture %
40	 9/6 12/6 14/6		Medium dense.			4.8'
45	 6/6 16/6 20/6		Dense.			3.9
50	 8/6 14/6 17/6					2.3
55	 7/6 14/6 23/6		BOTTOM.			3.4
60						
65						
70						

Figure Number 2



LOG OF TEST BORING BORING B-2

Page 1 of 1

PROJECT: Sgt. John Pinney Memorial Pool Replacement

BORING DATE: 09/19/23

BORING LOCATION: See Boring Location Map, Figure 1

DRILL METHOD: 4.25" I.D. Hollow-Stem Auger

DESCRIPTION: Geotechnical Engineering Services

DEPTH TO WATER - ∇ : N/A

CAVING - \blacktriangleright : N/A

FILE NO: 19224

ELEV.:

START: 09/19/23

FINISH: 09/19/23

LOGGER: L.Winder

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Remarks	Density pcf	Moisture %
0		SM	SILTY SAND: Yellowish brown, moist, poorly graded, cohesive.			
5	5/6 9/6 18/6	SC	CLAYEY SAND: Light reddish brown, damp, poorly graded, cohesive, fine gravel. Medium dense.		115.9	7.2
10	14/6 17/6 14/6	CL	SANDY CLAY: Light yellowish brown, dry, medium plasticity.		108.2	15.5
15	4/6 8/6 10/6	SM	SILTY SAND: Light yellowish brown, poorly graded, fine grained, damp, cohesive. Medium dense. Coarse sand.		89.8	4.8
20	12/6 40/6 39/6		Very dense. BOTTOM.		108.3	3.3
25						
30						
35						

Figure Number



LOG OF TEST BORING BORING B-3

Page 1 of 1

PROJECT: Sgt. John Pinney Memorial Pool Replacement

BORING DATE: 09/19/23

BORING LOCATION: See Boring Location Map, Figure 1

DRILL METHOD: 4.25" I.D. Hollow-Stem Auger

DESCRIPTION: Geotechnical Engineering Services

DEPTH TO WATER - ∇ : N/A

CAVING - \blacktriangleright : N/A

FILE NO: 19224

ELEV.:

START: 09/19/23

FINISH: 09/19/23

LOGGER: L.Winder

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Remarks	Density pcf	Moisture %
0		SC	CLAYEY SAND: Light yellowish brown, moist, poorly graded, cohesive.			
	19/6 26/6 35/6		Dense.		115.5	9.4
5						
	13/6 18/6 40/6				96.9	9.4
10		SM	SILTY SAND: Light brown, damp, poorly graded, fine grained, cohesive.			
	12/6 16/6 19/6		Medium.		99.8	3.9
15		SP	POORLY GRADED SAND, Light yellowish brown, damp.			
	22/6 26/6 30/6		BOTTOM.		112.5	3.2
20						
25						
30						
35						

Figure Number 4



LOG OF TEST BORING

BORING B-4

Page 1 of 1

PROJECT: *Sgt. John Pinney Memorial Pool Replacement*

BORING DATE: 09/19/23

BORING LOCATION: *See Boring Location Map, Figure 1*

DRILL METHOD: 4.25" I.D. Hollow-Stem Auger

DESCRIPTION: *Geotechnical Engineering Services*

DEPTH TO WATER -  : N/A

CAVING -  : N/A

FILE NO: 19224

ELEV.:

START: 09/19/23

FINISH: 09/19/23

LOGGER: *L. Winder*

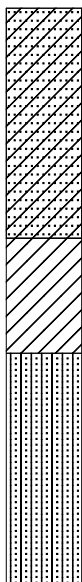
ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Remarks	Density pcf	Moisture %
0		SC	CLAYEY SAND: Yellowish brown, poorly graded, damp, cohesive.			
5		CL	SANDY CLAY: Yellowish brown, damp, medium plasticity.			
10		SM	SILTY SAND: Light brown, damp, fine grained, cohesive.			
15			BOTTOM.			
20						
25						
30						
35						

Figure Number 5



LOG OF TEST BORING BORING B-5

Page 1 of 1

PROJECT: Sgt. John Pinney Memorial Pool Replacement

BORING DATE: 09/19/23

BORING LOCATION: See Boring Location Map, Figure 1

DRILL METHOD: 4.25" I.D. Hollow-Stem Auger

DESCRIPTION: Geotechnical Engineering Services

DEPTH TO WATER - ∇ : N/A

CAVING - \blacktriangleright : N/A

FILE NO: 19224

ELEV.:

START: 09/19/23

FINISH: 09/19/23

LOGGER: L.Winder

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Remarks	Density pcf	Moisture %
0		SC	CLAYEY SAND: Light yellowish brown, damp, poorly graded, cohesive.			
	13/6 22/6 22/6		Medium dense.		108.3	12.8
5			Light reddish brown.			
	12/6 23/6 39/6		Dense.		107.5	10.6
10		SM	SILTY SAND: Light brown, damp, fine, cohesive.			
	9/6 16/6 22/6		Medium dense.		92.8	4.3
15			Very dense. BOTTOM.		112.7	4.4
	6/6 18/6 50/5					
20						
25						
30						
35						

Figure Number 6



LOG OF TEST BORING

BORING B-6

Page 1 of 1

PROJECT: Sgt. John Pinney Memorial Pool Replacement

BORING DATE: 09/20/23

BORING LOCATION: See Boring Location Map, Figure 1

DRILL METHOD: 4.25" I.D. Hollow-Stem Auger

DESCRIPTION: Geotechnical Engineering Services

DEPTH TO WATER -  : N/A

CAVING -  : N/A

FILE NO: 19224

ELEV.:

START: 09/20/23

FINISH: 09/20/23

LOGGER: L.Winder

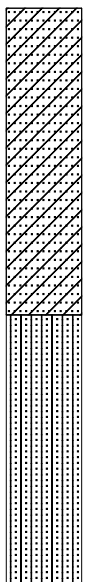
ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Remarks	Density pcf	Moisture %
0		SC	CLAYEY SAND: Yellowish brown, damp, poorly graded, cohesive. Fine sand.			
5		SM	SILTY SAND: Light brown, damp, fine, cohesive.			
10						
15			BOTTOM.			
20						
25						
30						
35						

Figure Number 7



LOG OF TEST BORING BORING B-7

Page 1 of 1

PROJECT: Sgt. John Pinney Memorial Pool Replacement

BORING DATE: 09/20/23

BORING LOCATION: See Boring Location Map, Figure 1

DRILL METHOD: 4.25" I.D. Hollow-Stem Auger

DESCRIPTION: Geotechnical Engineering Services

DEPTH TO WATER - ∇ : N/A

CAVING - \blacktriangleright : N/A

FILE NO: 19224

ELEV.:

START: 09/20/23

FINISH: 09/20/23

LOGGER: L.Winder

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Remarks	Density pcf	Moisture %
0		SC	CLAYEY SAND: Light yellowish brown, damp, poorly graded, cohesive.			
	20/6 26/6 29/6		Dense.		112.4	4.4
5			Very dense.		99.6	14.2
	17/6 37/6 45/6	SM	SILTY SAND: Light brown, damp, poorly graded, fine grained, cohesive.			
10			Medium dense.		96.9	5.0
	8/6 17/6 24/6					
15		SP	POORLY GRADED SAND: Pale brown, dry to damp, fine gravel.		106.7	3.5
	11/6 20/6 20/6		Medium dense. BOTTOM.			
20						
25						
30						
35						

Figure Number 8



LOG OF TEST BORING BORING B-8

Page 1 of 1

PROJECT: Sgt. John Pinney Memorial Pool Replacement

BORING DATE: 09/20/23

BORING LOCATION: See Boring Location Map, Figure 1

DRILL METHOD: 4.25" I.D. Hollow-Stem Auger

DESCRIPTION: Geotechnical Engineering Services

DEPTH TO WATER - ∇ : N/A

CAVING - \blacktriangleright : N/A

FILE NO: 19224

ELEV.:

START: 09/20/23

FINISH: 09/20/23

LOGGER: L.Winder

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Remarks	Density pcf	Moisture %
0		SM	SILTY SAND: Light yellowish brown, damp, poorly graded, cohesive, traces of clay.			
5	5/6 10/6 14/6	SC	CLAYEY SAND: Moist, yellowish brown, low to medium plasticity. Medium dense. Dense.		120.2	8.6
10	20/6 29/6 27/6				108.2	5.2
15	9/6 14/6 18/6	SM	SILTY SAND: Light brown, damp, damp, poorly graded, fine grained, cohesive. Medium dense.		94.4	4.9
20	29/6 23/6 32/6	SP	POORLY GRADED SAND" Light yellowish brown, damp, fine, coarse. Dense. BOTTOM.		106.0	2.4
25						
30						
35						

Figure Number 8



LOG OF TEST BORING

BORING B-9

Page 1 of 2

PROJECT: Sgt. John Pinney Memorial Pool Replacement

BORING DATE: 09/20/23

BORING LOCATION: See Boring Location Map, Figure 1

DRILL METHOD: 4.25" I.D. Hollow-Stem Auger

DESCRIPTION: Geotechnical Engineering Services

DEPTH TO WATER - ∇ : N/A

CAVING - \blacktriangleright : N/A

FILE NO: 19224

ELEV.:

START: 09/20/23

FINISH: 09/20/23

LOGGER: L.Winder

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Remarks	Density pcf	Moisture %
0		SM	SILTY SAND: Yellowish brown, moist, poorly graded, cohesive, fine gravel. Loose.		121.6	9.1
4/6 3/6 4/6						
5		SC	CLAYEY SAND: Yellowish brown, moist, medium plasticity. Medium dense.		109.5	21.6
6/6 11/6 14/6						
10		SM	SILTY SAND: Yellowish brown, damp, poorly graded, cohesive, traces of clay. Very dense.		114.9	8.6
17/6 29/6 50/6						
15		SP	POORLY GRADED SAND: Light yellowish brown, damp, fine gravel. Medium dense.			2.7
5/6 11/6 11/6						
20						3.9
7/6 8/6 10/6						
25		SM	SILTY SAND: Light yellowish brown, damp, poorly graded. Dense.			2.7
7/6 15/6 18/6						
30			Dense.			3.6
10/6 14/6 18/6						
35						

Figure Number 10



LOG OF TEST BORING BORING B-9

Page 2 of 2

PROJECT: Sgt. John Pinney Memorial Pool Replacement

BORING DATE: 09/20/23

BORING LOCATION: See Boring Location Map, Figure 1

DRILL METHOD: 4.25" I.D. Hollow-Stem Auger

DESCRIPTION: Geotechnical Engineering Services

DEPTH TO WATER - ∇ : N/A

CAVING - \blacktriangleright : N/A

FILE NO: 19224

ELEV.:

START: 09/20/23

FINISH: 09/20/23

LOGGER: L.Winder





ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Remarks	Density pcf	Moisture %
40	 11/6 15/6 20/6		Dense.			3.4
45	 5/6 11/6 14/6		Medium dense.			8.7
50	 10/6 15/6 23/6	SP	POORLY GRADED SAND: Light brown, damp, fine to medium grained, traces of silt. Dense.			4.6
55	 10/6 22/6 26/6	SM	SILTY SAND: Light yellowish brown, damp, poorly graded, fine to medium grained, traces of clay.			2.3
60			DENSE. BOTTOM.			
65						
70						

Figure Number 10



LOG OF TEST BORING

BORING B-10

Page 1 of 1

PROJECT: Sgt. John Pinney Memorial Pool Replacement

BORING DATE: 09/20/23

BORING LOCATION: See Boring Location Map, Figure 1

DRILL METHOD: 4.25" I.D. Hollow-Stem Auger

DESCRIPTION: Geotechnical Engineering Services

DEPTH TO WATER - ∇ : N/A

CAVING - \blacktriangleright : N/A

FILE NO: 19224

ELEV.:

START: 09/20/23

FINISH: 09/20/23

LOGGER: L.Winder

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Remarks	Density pcf	Moisture %
0		SM	Asphaltic concrete 2", no aggregate base. SILTY SAND: Yellowish brown, moist, poorly graded, cohesive, traces of clay.			
5		CL	SANDY CLAY: Light brown, moist, medium plasticity.			
10		SM	SILTY SAND: Light brown, damp, poorly graded, cohesive.			
15			BOTTOM.			
20						
25						
30						
35						

Figure Number 11



LOG OF TEST BORING

BORING B-11

Page 1 of 1

PROJECT: Sgt. John Pinney Memorial Pool Replacement

BORING DATE: 09/20/23

BORING LOCATION: See Boring Location Map, Figure 1

DRILL METHOD: 4.25" I.D. Hollow-Stem Auger

DESCRIPTION: Geotechnical Engineering Services

DEPTH TO WATER - ∇ : N/A

CAVING - \blacktriangleright : N/A

FILE NO: 19224

ELEV.:

START: 09/20/23

FINISH: 09/20/23

LOGGER: L.Winder

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Remarks	Density pcf	Moisture %
0		SM	Asphaltic concrete 2". No aggregate base.			
	4/6 4/6 4/6		SILTY SAND: Yellowish brown, damp, poorly graded, cohesivve, traces of clay.		120.4	5.1
5		CL	Loose.			
	10/6 23/6 34/6		SANDY CLAY: Light yellowish brown, moist, medium plasticity.		106.6	19.8
10		SM	Hard.			
	11/6 15/6 18/6		SILTY SAND: Light brown, moist, poorly graded. Medium dense.		112.5	2.8
15		SP	POORLY GRADED SAND: Light brown, damp.		111.8	3.4
	11/6 22/6 24/6		Dense. BOTTOM.			
20						
25						
30						
35						

Figure Number 12



LOG OF TEST BORING

BORING B-12

Page 1 of 1

PROJECT: Sgt. John Pinney Memorial Pool Replacement

BORING DATE: 09/20/23

BORING LOCATION: See Boring Location Map, Figure 1

DRILL METHOD: 4.25" I.D. Hollow-Stem Auger

DESCRIPTION: Geotechnical Engineering Services

DEPTH TO WATER - ∇ : N/A

CAVING - \blacktriangleright : N/A

FILE NO: 19224

ELEV.:

START: 09/20/23

FINISH: 09/20/23

LOGGER: L.Winder

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Remarks	Density pcf	Moisture %
0		SM	Asphaltic concrete 2". No aggregate base.			
10/6 40/6 50/4		SC	SILTY SAND: Yellowish brown, moist, poorly graded, cohesive, traces of clay.		131.3	6.3
30/6 50/5			CLAYEY SAND: Reddish brown, moist, poorly graded, cohesive, fine gravel.		118.7	11.0
12/6 25/6 35/6			Very dense. Yellowish brown.			
			Dense.		120.0	11.5
14/6 34/6 44/6		SM	SILTY SAND: Light brown, damp, poorly graded, fine gravel.		115.3	3.3
			Very dense. BOTTOM.			
20						
25						
30						
35						

Figure Number 13

KEY TO SYMBOLS

Symbol Description

Strata symbols



Description not given for:
"J{"



Silty sand



Low plasticity
clay



Poorly graded sand
with silt



Clayey sand



Poorly graded sand



Paving

Misc. Symbols



Boring continues

Soil Samplers



California sampler



Standard penetration test

Notes:

1. Twelve (12) exploratory borings were drilled from 09/19/2023 through 09/20/2023 using an 8-inch outside diameter hollow-stem auger.
2. No free groundwater was encountered to the maximum depth drilled of 51'.
3. Boring locations are shown on the Boring Location Map, Figure 1.
4. These logs are subject to the limitations, conclusions, and recommendations in this report.
5. Results of tests conducted on samples recovered are reported on the logs.

PERCOLATION TEST DATA LOG

SEI File No. 23-19224

SITE ADDRESS: 205 S. Warner Street, Ridgecrest, CA 93555

TEST PERFORMED BY: Soils Engineering, Inc. (SEI)

TEST DATE: September 20, 2023

HOLE #	Percolation # 1 (P-1)				Percolation # 2 (P-2)				Percolation # 3 (P-3)			
DEPTH	5 FEET				5 FEET				4 FEET			
	TIME (MIN)		WATER LEVEL DROP (IN)	PERC RATE (MIN/IN)	TIME (MIN)		WATER LEVEL DROP (IN)	PERC RATE (MIN/IN)	TIME (MIN)		WATER LEVEL DROP (IN)	PERC RATE (MIN/IN)
	INITIAL	FINAL			INITIAL	FINAL			INITIAL	FINAL		
	TEST # 1				TEST # 1				TEST # 1			
	10:00	--	8.5	--	8:47	--	7.5	--	9:05	--	7.75	--
	10:00	10:30	2.75	10.91	8:47	9:00	7.5	1.73	9:05	9:14	7.75	1.16
	TEST # 2				TEST # 2				TEST # 2			
	10:30	--	11	--	9:05	--	6.75	--	9:24	--	10.5	--
	10:30	11:00	4	7.50	9:05	9:20	6.75	2.22	9:24	9:54	8.5	3.53
	TEST # 3				TEST # 3				TEST # 3			
	11:00	--	8	--	9:22	--	8.75	--	9:56	--	11	
	11:00	11:30	1.25	20	9:22	9:39	8.75	1.94	9:56	10:26	9	3.33
	TEST # 4				TEST # 4							
	12:00	--	8.75	--	9:45	--	8	--				
	12:00	12:30	1.75	24	9:45	10:03	8	2.25				
					TEST # 5							
					10:07	--	9					
					10:07	10:28	9	2.33				
					TEST # 6							
				10:29	--	9.5	--					
				10:29	10:48	9.5	2.00					

APPENDIX C

SOIL TEST DATA

SIEVE ANALYSES (ASTM D422 and/or ASTM D1140)

Grain size distributions for samples selected as most representative of sub-soils encountered in our test borings were determined by sieve analysis. Test results are shown in Figures A-1 through A-3.

IN-SITU DENSITY & MOISTURE RELATIONSHIPS (ASTM D2216 & D2937)

Moisture & density data for undisturbed native soils was obtained by use of a 2-3/8-inch (inside diameter) split-barrel sampler. Test results are given on the Logs of Test Borings, Figures 2 through 13.

CONSOLIDATION TESTS (ASTM D2435)

Compressibility of soils was determined on saturated, undisturbed samples of native materials. Consolidation Test Diagrams, Figures B-1 through B-3 graphically express the relationship of vertical strain vs. applied vertical (normal) load for earth materials selected as most representative of the soil strata within the anticipated zone of influence of foundation loads.

DIRECT SHEAR TESTS (ASTM D3080)

One (1) quick-consolidated direct shear test was performed on undisturbed, saturated samples of native earth materials. This test provides information on soil shear strength vs. normal load and is used to determine the angle of internal friction and cohesion of earth materials under essentially drained conditions. Test results are presented in Figures C-1 through C-3.

R-VALUE TESTS (CTM-301)

R-Value tests were performed to obtain flexible pavement design data. Test results are presented on Figures D-1 through D-3.

SOIL CORROSIVITY (SO₄ / pH / Chlorides)

Tests for Soluble Sulfates (SO₄), Soluble Chlorides (Cl), and pH values were performed on three (3) composite samples taken from the upper 5 feet to determine the corrosion potential of the soils. Corrosion prevention measures and the extent to which measures should be taken (if any) should be addressed with the corrosion engineer. Soluble Sulfates and Soluble Chlorides values were determined according to EPA 300.0M. The pH values were determined according to EPA 9045C. Results of all the constituent(s) are discussed in the Soil Corrosivity section.

TABLE 1

TEST LOCATION	USCS	% < # 200	CONSOLIDATION				DIRECT SHEAR		UNCONFINED COMPRESSION		E.I.	ATTERBERG LIMITS			R-VALUE @ 300 psi		MAXIMUM DENSITY	
			C _c	C _s	S.P. (psf)	HV %	C, (ksf)	F.A.	Q _u , (psi)	C, (ksf)		LL	PL	PI	R.V.	E.P. (psi)	MDD (pcf)	O.M.
B-1 @ 0-5'	SM	20									0							
B-1 @ 6'	SM						0.25	38.8										
B-1 @ 11'	SM						0.71	36.7										
B-1 @ 16'	SP-SM	6.7																
B-1 @ 21'	SP-SM	7.5																
B-1 @ 26'	SP-SM	8.3																
B-1 @ 31'	SP-SM	5.7																
B-1 @ 36'	SP-SM	11																
B-1 @ 41'	SP-SM	9.6																
B-1 @ 46'	SP-SM	8.6																

CONSOLIDATION
Cc - Compression Index
Cs - Swell Index
S.P. (psf) - Swell Pressure
HV % - Heave Percentage / Collapase

UNCONFINED COMPRESSION
Q_u (psi) - Unconfined Compression Strength
C, (ksf) - Cohesion

DIRECT SHEAR
C (ksf) - Cohesion
F.A. - Friction Angle

E.I. - EXPANSION INDEX
ATTERBERG LIMITS
LL - Liquid Limit
PL - Plastic Limit
PI - Plasticity Index

(R)ESISTANCE VALUE
RV - R-Value @ 300 psi
EP - Expansion Press @ 300 psi

MAXIMUM DENSITY
MDD (pcf) - Max Dry Density
O.M. - Optimum Moisture

City of Ridgecrest

Geotechnical Engineering Services
Sgt. John Pinney Memorial Pool Replacement
205 S. Warner Street, Ridgecrest, CA 93555

SEI File No. 23-19224
November 6, 2023

TABLE 1

TEST LOCATION	USCS	% < # 200	CONSOLIDATION				DIRECT SHEAR		UNCONFINED COMPRESSION		E.I.	ATTERBERG LIMITS			R-VALUE @ 300 psi		MAXIMUM DENSITY	
			C _c	C _s	S.P. (psf)	HV %	C, (ksf)	F.A.	Q _u , (psi)	C, (ksf)		LL	PL	PI	R.V.	E.P. (psi)	MDD (pcf)	O.M.
B-1 @ 51'	SP-SM	8.8																
B-7 @ 0-5'	SC	27													17	0		
B-8 @ 3'	SC						0.65	33.7										
B-8 @ 6'	SC		0.07	0.01	1513	0.4												
B-9 @ 0-5'	SM	25									0							
B-9 @ 3'	SM		0.01	0	0	0												
B-9 @ 6'	SC		0.02	0.01	3612	0.4												
B-11 @ 0-5'	SM	17													71	0		
B-12 @ 0-5'	SM	28													26	0		

CONSOLIDATION
Cc - Compression Index
Cs - Swell Index
S.P. (psf) - Swell Pressure
HV % - Heave Percentage / Collapase

UNCONFINED COMPRESSION
Q_u (psi) - Unconfined Compression Strength
C, (ksf) - Cohesion

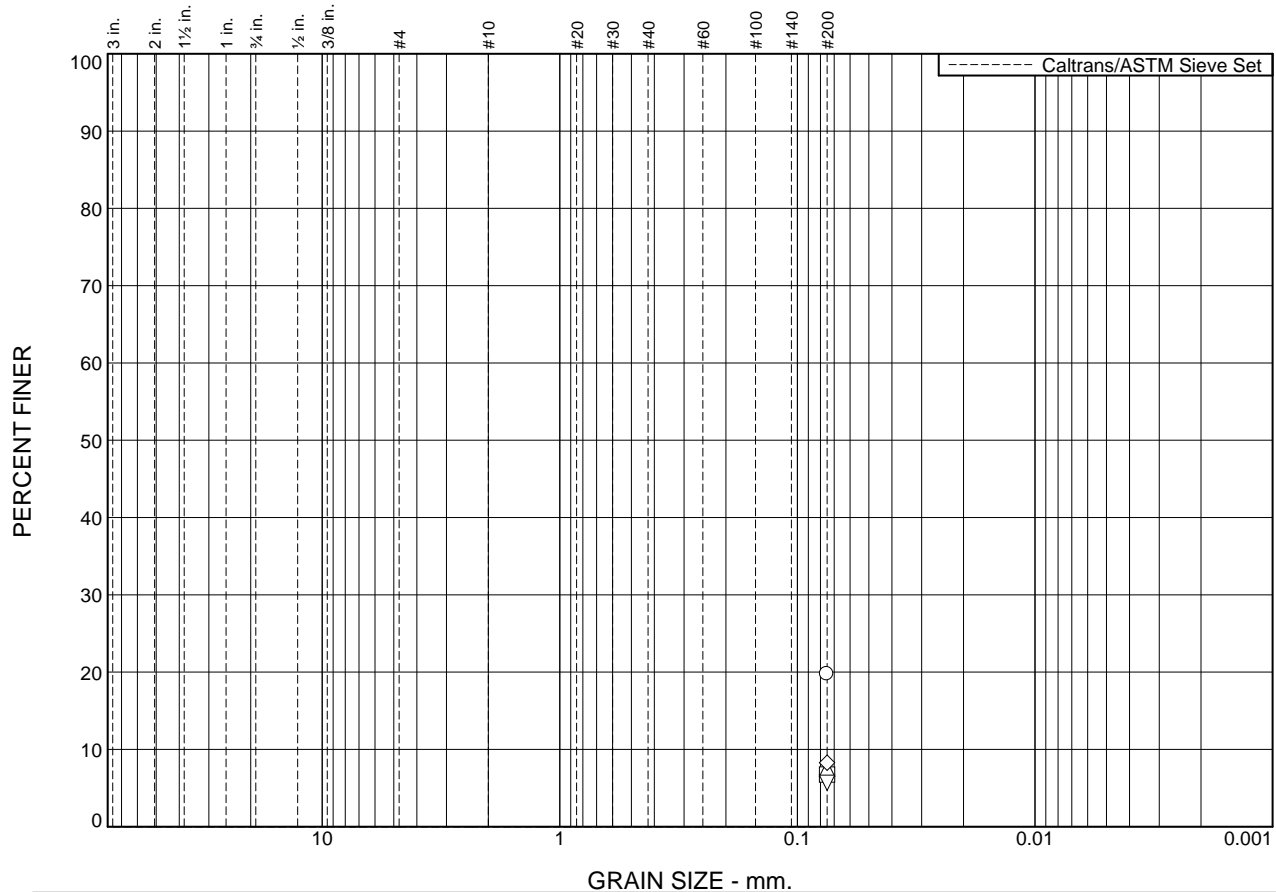
DIRECT SHEAR
C (ksf) - Cohesion
F.A. - Friction Angle

E.I. - EXPANSION INDEX
ATTERBERG LIMITS
LL - Liquid Limit
PL - Plastic Limit
PI - Plasticity Index

(R)ESISTANCE VALUE
RV - R-Value @ 300 psi
EP - Expansion Press @ 300 psi

MAXIMUM DENSITY
MDD (pcf) - Max Dry Density
O.M. - Optimum Moisture

Particle Size Distribution Report

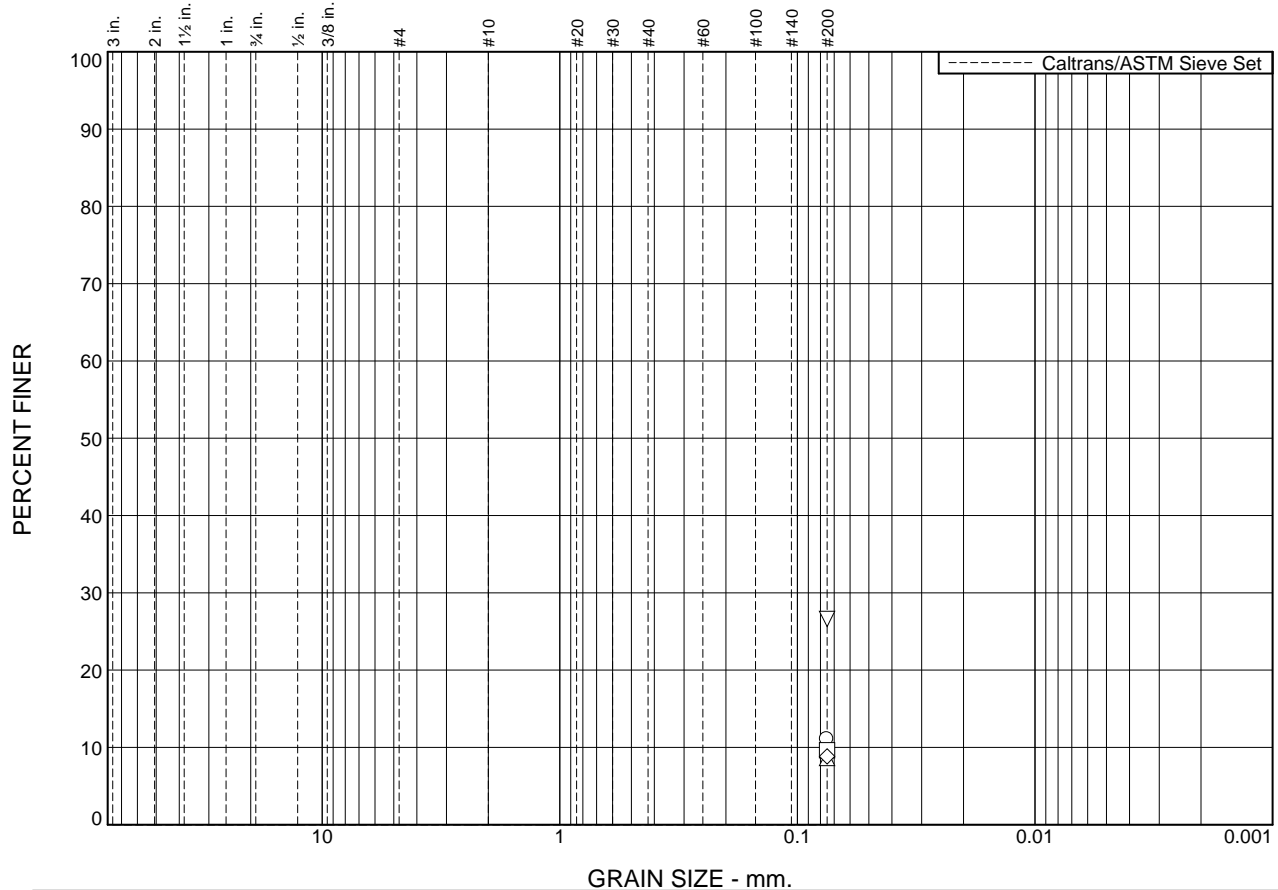


% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○						20	
□						7	
△						7	
◇						8	
▽						6	

SOIL DATA					
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○		90485	0-5'	SILTY SAND (B-1)	SM
□	B-1		16'	POORLY GRADED SAND with low fine content	SP-SM
△	B-1		21'	POORLY GRADED SAND with low fine content	SP-SM
◇	B-1		26'	POORLY GRADED SAND with low fine content	SP-SM
▽	B-1		31'	POORLY GRADED SAND with low fine content	SP-SM

SOILS ENGINEERING, INC.	Client: City of Ridgecrest
	Project: Sgt. John Pinney Memorial Pool Replacement
	Project No.: 19224
Figure A-1	

Particle Size Distribution Report

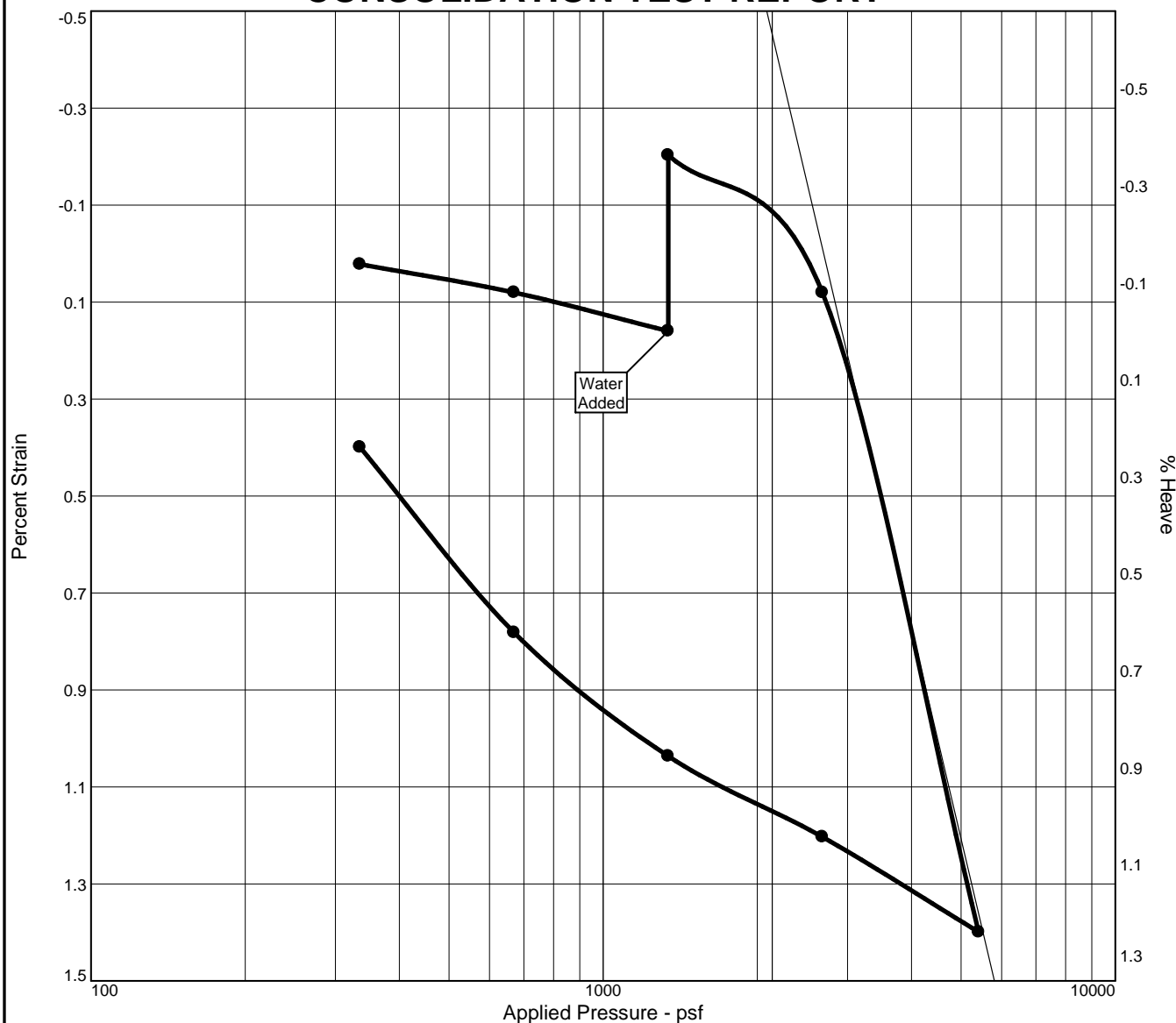


% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○						11	
□						10	
△						9	
◇						9	
▽						27	

SOIL DATA					
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	B-1		36'	POORLY GRADED SAND with low fine content	SP-SM
□	B-1		41'	POORLY GRADED SAND with low fine content	SP-SM
△	B-1		46'	POORLY GRADED SAND with low fine content	SP-SM
◇	B-1		51'	POORLY GRADED SAND with low fine content	SP-SM
▽		90556	0-5'	CLAYEY SAND (B-7)	SC

SOILS ENGINEERING, INC.	Client: City of Ridgecrest
	Project: Sgt. John Pinney Memorial Pool Replacement
	Project No.: 19224
Figure A-2	

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (psf)	P_c (psf)	C_c	C_s	Swell Press. (psf)	Heave %	e_o
Sat.	Moist.											
42.3 %	8.8 %	106.8	N/A	N/A	2.65	336	2629	0.07	0.01	1513	0.4	0.549

MATERIAL DESCRIPTION										USCS	AASHTO
CLAYEY SAND										SC	N/A

Project No. 19224		Client: City of Ridgecrest		Remarks: Test Date: 10/23/23
Project: Sgt. John Pinney Memorial Pool Replacement				
Source of Sample: B-8		Depth: 6'		
SOILS ENGINEERING, INC.				

Figure B-1

Figure B-1

Tested By: RG Checked By: AL

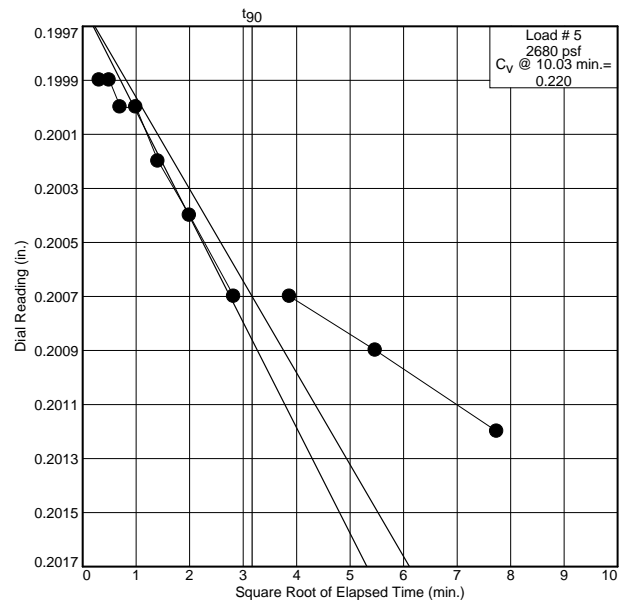
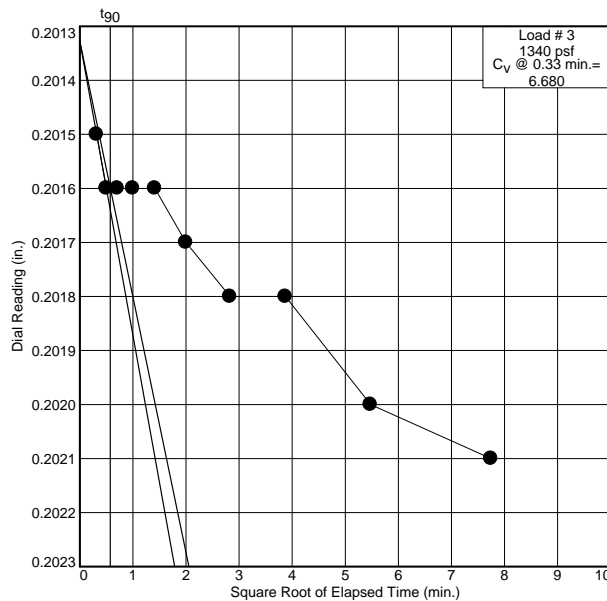
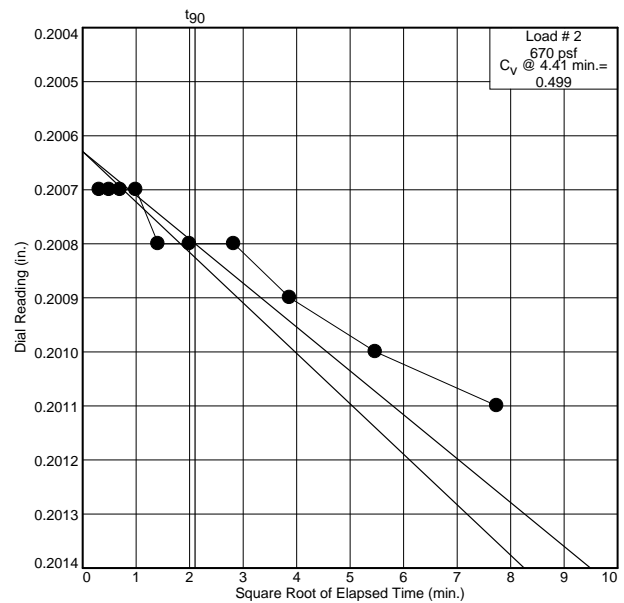
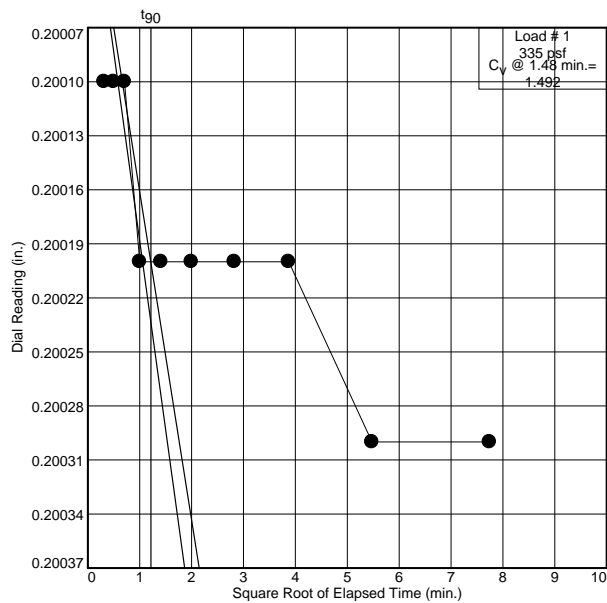
Dial Reading vs. Time

Project No.: 19224

Project: Sgt. John Pinney Memorial Pool Replacement

Source of Sample: B-8

Depth: 6'



SOILS ENGINEERING, INC.

Figure B-1

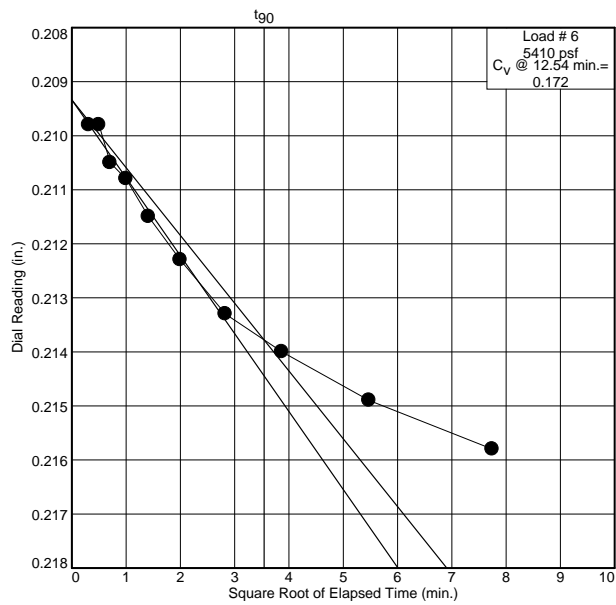
Dial Reading vs. Time

Project No.: 19224

Project: Sgt. John Pinney Memorial Pool Replacement

Source of Sample: B-8

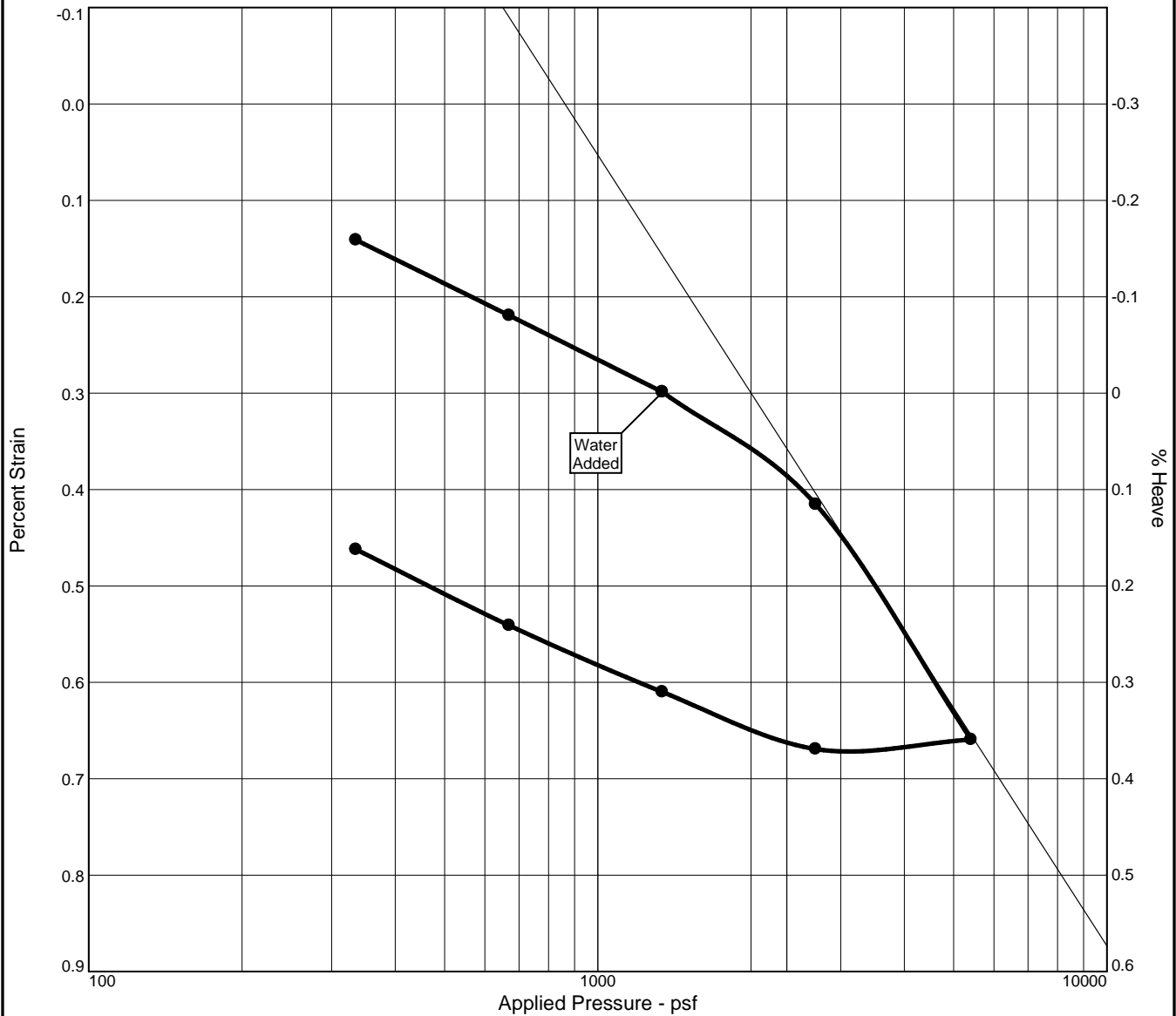
Depth: 6'



SOILS ENGINEERING, INC.

Figure B-1

CONSOLIDATION TEST REPORT



Natural Sat.	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (psf)	P _c (psf)	C _c	C _s	Swell Press. (psf)	Heave %	e _o
61.8 %	112.8	N/A	N/A	2.65	336	2620	0.01	0.00		0.0	0.466

MATERIAL DESCRIPTION	USCS	AASHTO
SILTY SAND	SM	N/A

Project No. 19224 Client: City of Ridgecrest Project: Sgt. John Pinney Memorial Pool Replacement Source of Sample: B-9 Depth: 3'	Remarks: Test Date: 10/23/23
SOILS ENGINEERING, INC.	

Figure B-2

Tested By: RG Checked By: AL

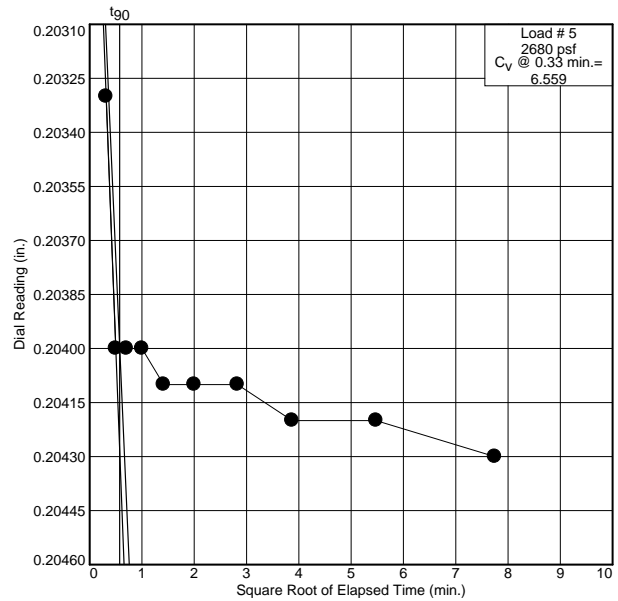
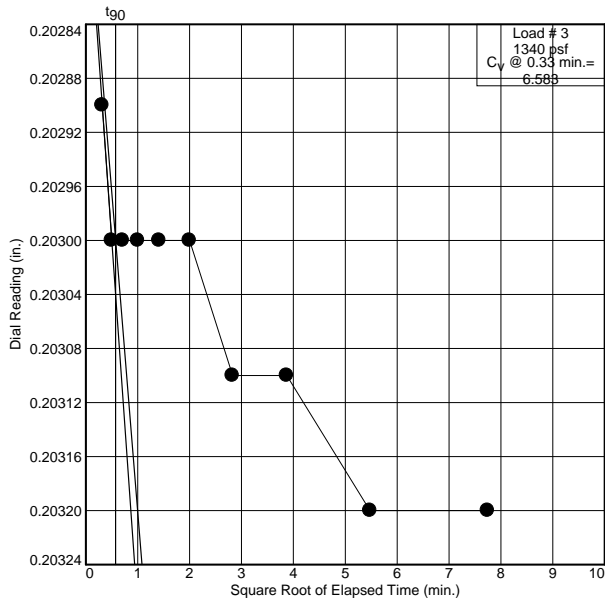
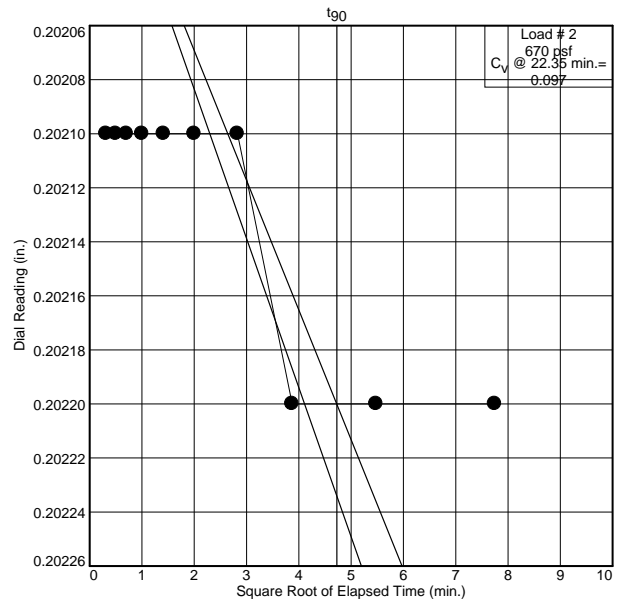
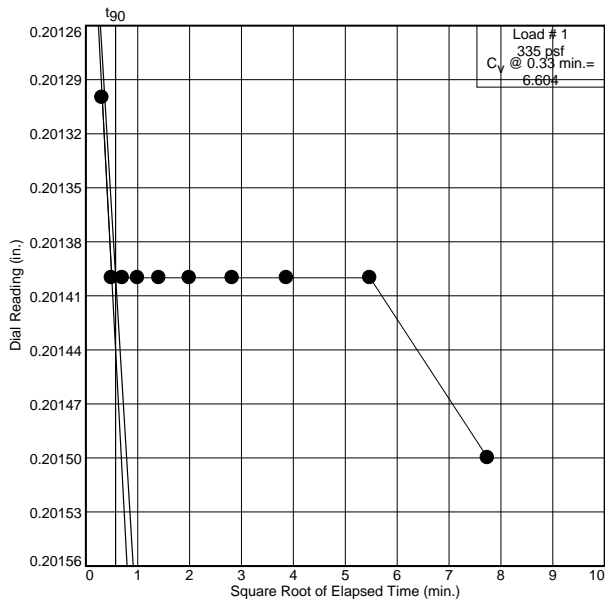
Dial Reading vs. Time

Project No.: 19224

Project: Sgt. John Pinney Memorial Pool Replacement

Source of Sample: B-9

Depth: 3'



SOILS ENGINEERING, INC.

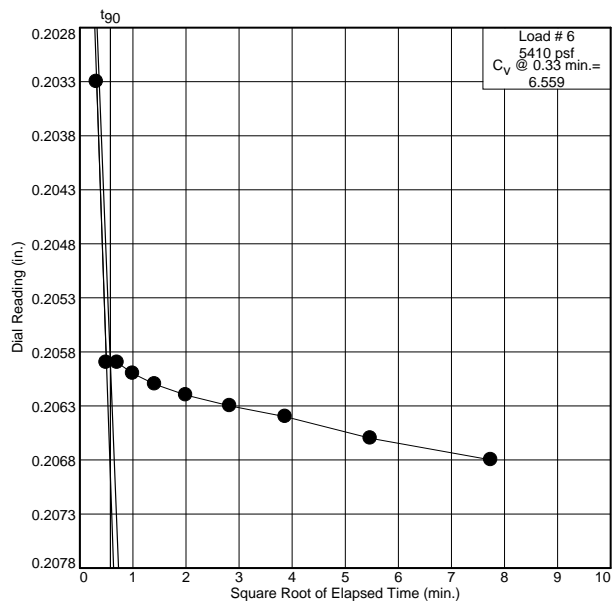
Figure B-2

Dial Reading vs. Time

Project No.: 19224

Project: Sgt. John Pinney Memorial Pool Replacement

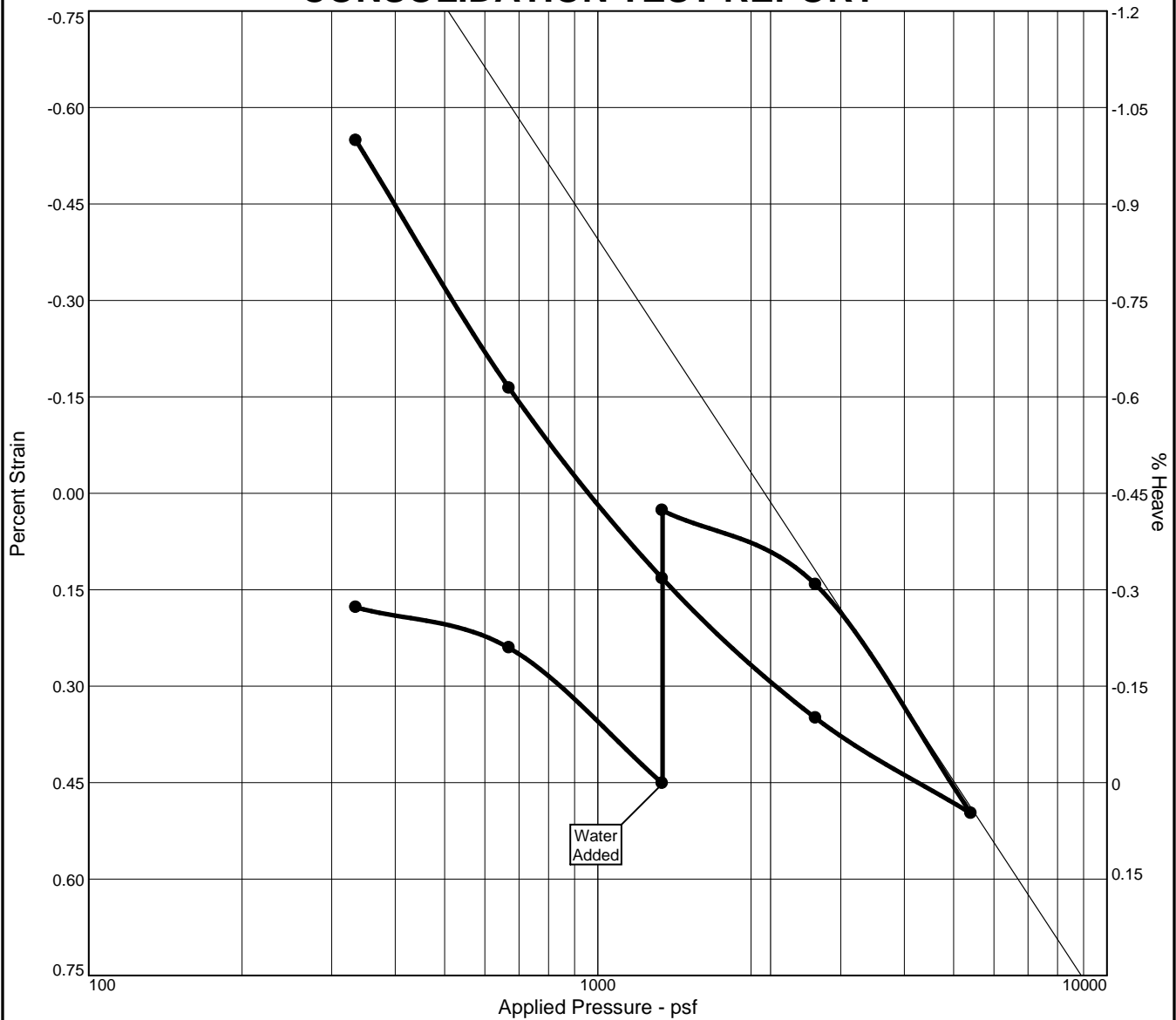
Source of Sample: B-9 Depth: 3'



SOILS ENGINEERING, INC.

Figure B-2

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (psf)	P_c (psf)	C_c	C_s	Swell Press. (psf)	Heave %	e_o
Sat.	Moist.											
76.6 %	14.4 %	110.3	N/A	N/A	2.65	336	2602	0.02	0.01	3612	0.4	0.500

MATERIAL DESCRIPTION										USCS	AASHTO
CLAYEY SAND										SC	N/A

Project No. 19224 Client: City of Ridgecrest Project: Sgt. John Pinney Memorial Pool Replacement Source of Sample: B-9 Depth: 6'	Remarks: Test Date: 10/25/23
<div>SOILS ENGINEERING, INC.</div>	

Figure B-3

Tested By: RG Checked By: AL

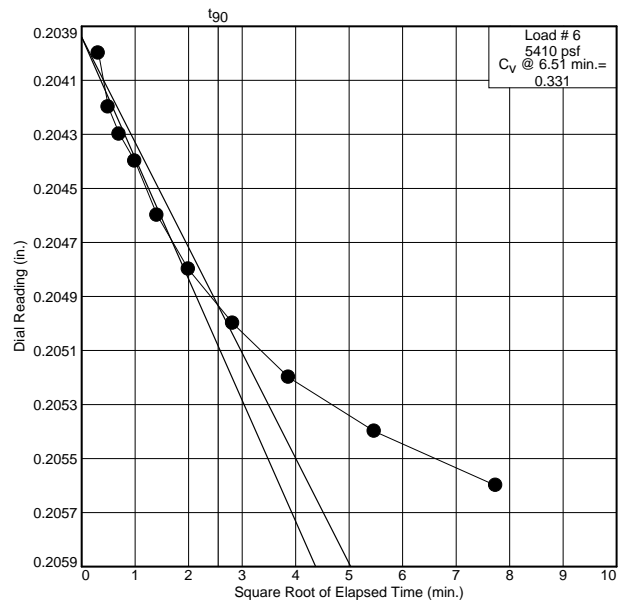
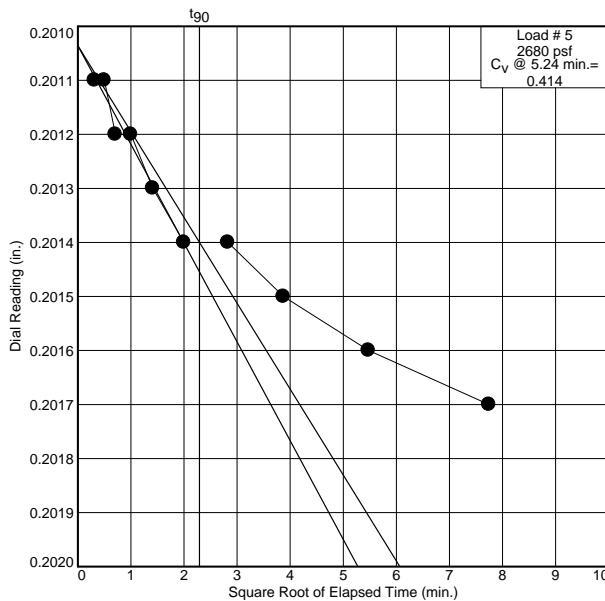
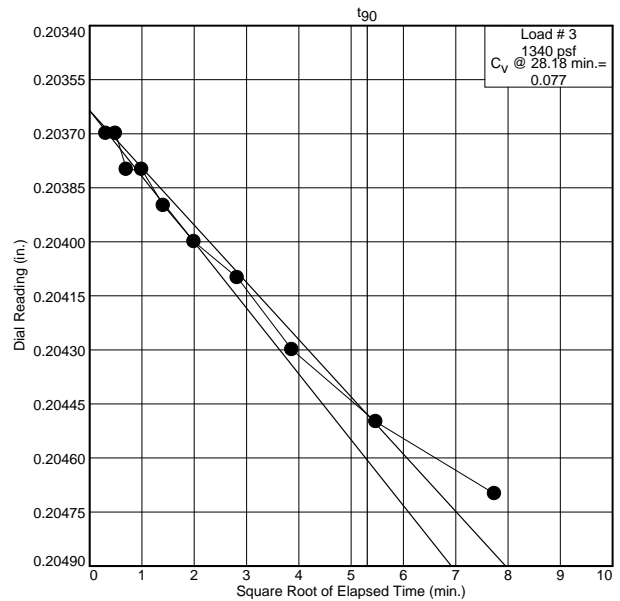
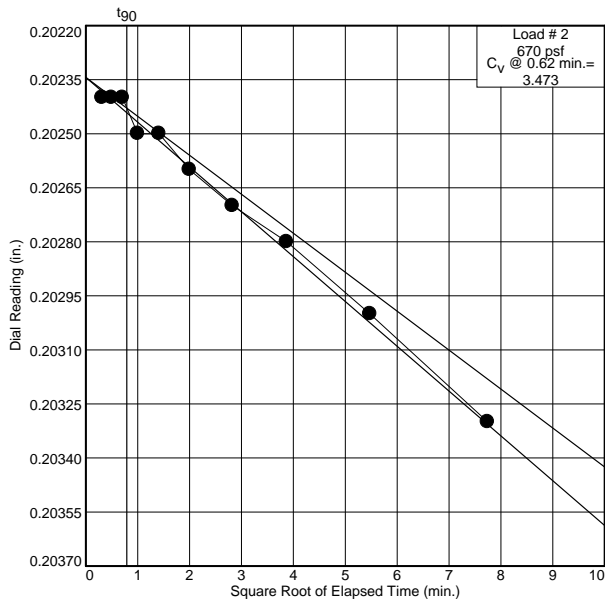
Dial Reading vs. Time

Project No.: 19224

Project: Sgt. John Pinney Memorial Pool Replacement

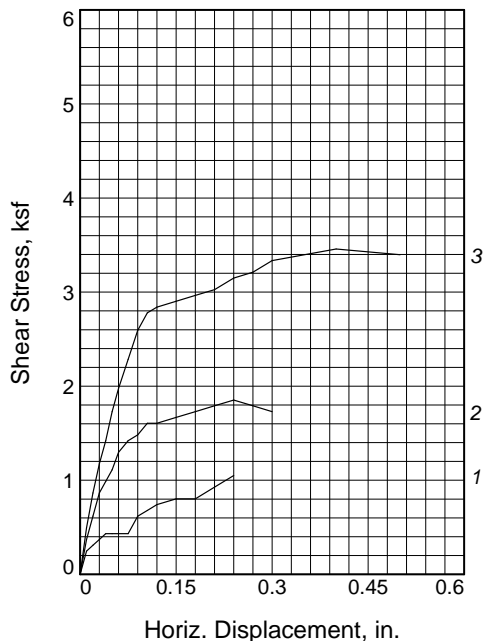
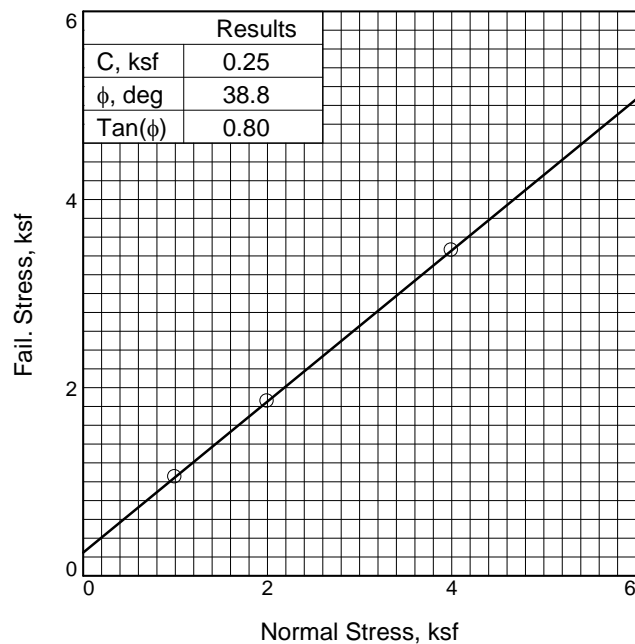
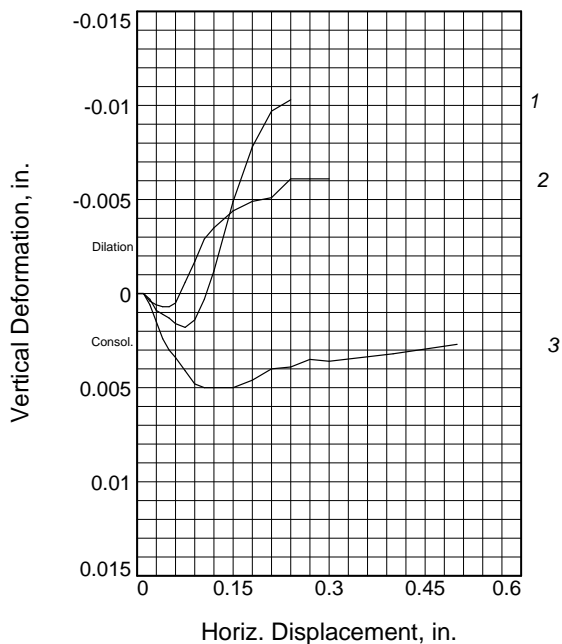
Source of Sample: B-9

Depth: 6'



SOILS ENGINEERING, INC.

Figure B-3



Sample No.		1	2	3
Initial	Water Content, %	8.4	8.8	8.5
	Dry Density, pcf	114.3	113.3	113.7
	Saturation, %	49.5	50.7	49.8
	Void Ratio	0.4476	0.4608	0.4552
	Diameter, in.	2.38	2.38	2.38
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	13.5	13.4	13.8
	Dry Density, pcf	114.3	113.3	113.7
	Saturation, %	80.2	76.9	80.6
	Void Ratio	0.4476	0.4608	0.4552
	Diameter, in.	2.38	2.38	2.38
	Height, in.	1.00	1.00	1.00
Normal Stress, ksf		1.00	2.00	4.00
Fail. Stress, ksf		1.05	1.85	3.46
Displacement, in.		0.24	0.24	0.40
Ult. Stress, ksf				
Displacement, in.				
Strain rate, in./min.		N/A	N/A	N/A

Sample Type: 2.5" X 6" TUBE

Description: SILTY SAND; brown, fine, gravel,
Medium dense.

LL= N/A

PI= N/A

Assumed Specific Gravity= 2.65

Remarks: Test Date: 10/11/23

Client: City of Ridgecrest

Project: Sgt. John Pinney Memorial Pool Replacement

Source of Sample: B-1

Depth: 6'

Proj. No.: 19224

Date Sampled: 09/19/23

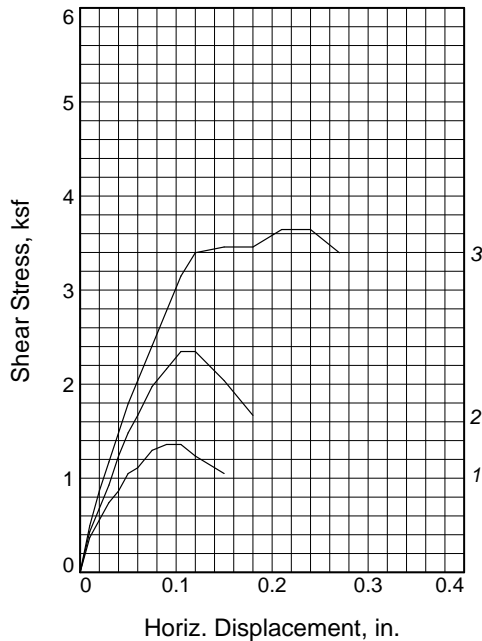
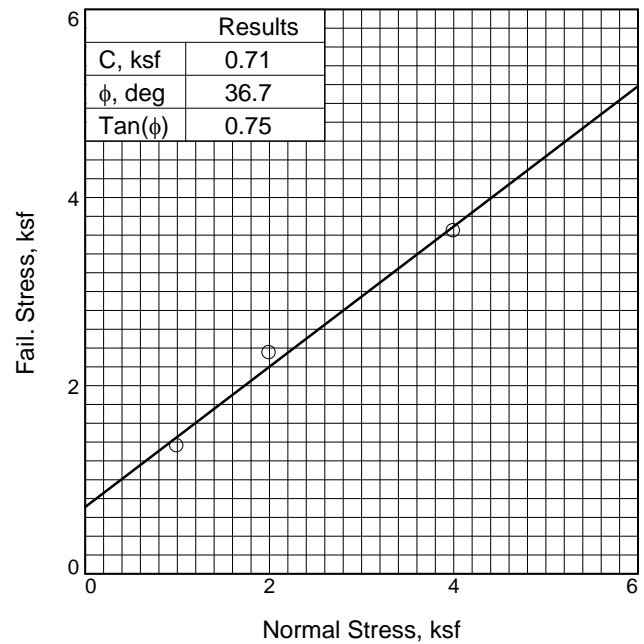
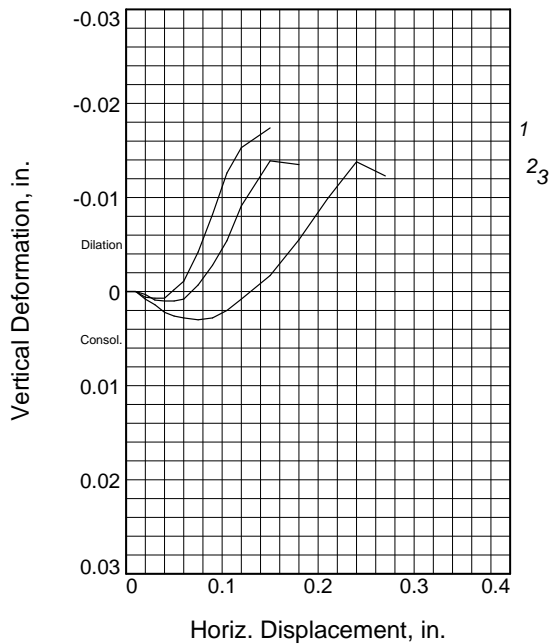
DIRECT SHEAR TEST REPORT

SOILS ENGINEERING, INC.

Figure C-1

Tested By: DH

Checked By: AL



Sample No.		1	2	3
Initial	Water Content, %	14.6	14.5	14.1
	Dry Density, pcf	98.5	97.9	98.3
	Saturation, %	56.9	55.6	54.6
	Void Ratio	0.6787	0.6905	0.6831
	Diameter, in.	2.38	2.38	2.38
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	22.9	21.6	21.2
	Dry Density, pcf	98.5	97.9	98.3
	Saturation, %	89.6	83.0	82.1
	Void Ratio	0.6787	0.6905	0.6831
	Diameter, in.	2.38	2.38	2.38
	Height, in.	1.00	1.00	1.00
Normal Stress, ksf		1.00	2.00	4.00
Fail. Stress, ksf		1.36	2.35	3.64
Displacement, in.		0.09	0.11	0.21
Ult. Stress, ksf				
Displacement, in.				
Strain rate, in./min.		N/A	N/A	N/A

Sample Type: 2.5" x 6" TUBE
Description: SILTY SAND; light brown, fine, cohesive, Dense.
LL= N/A **PI=** N/A
Assumed Specific Gravity= 2.65
Remarks: Test Date: 10/11/23

Client: City of Ridgecrest
Project: Sgt. John Pinney Memorial Pool Replacement
Source of Sample: B-1 **Depth:** 11'

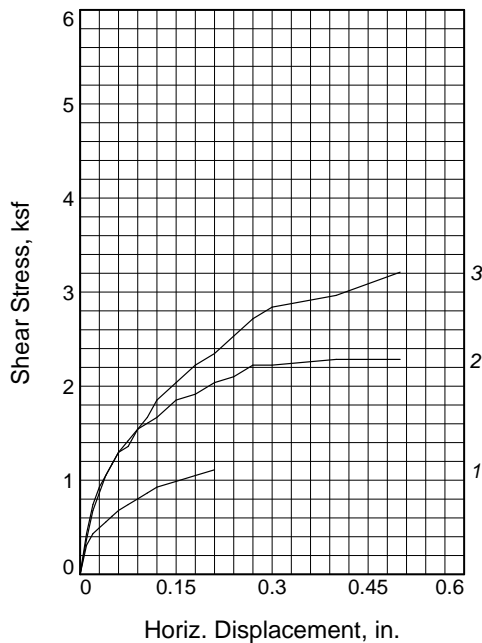
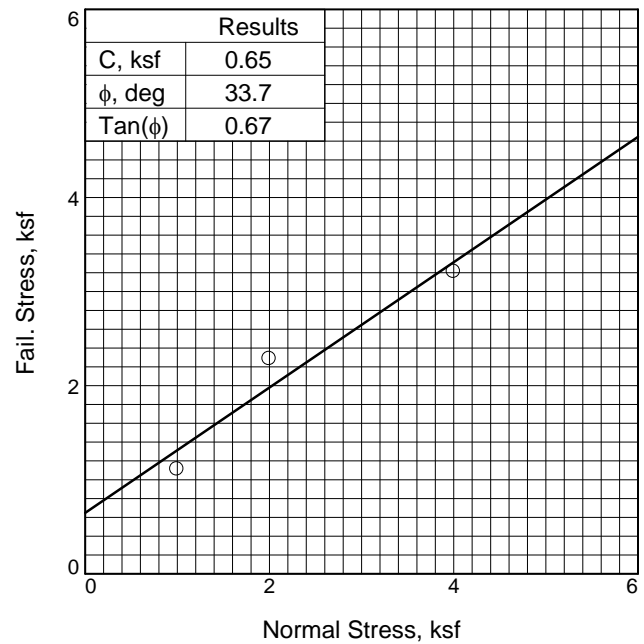
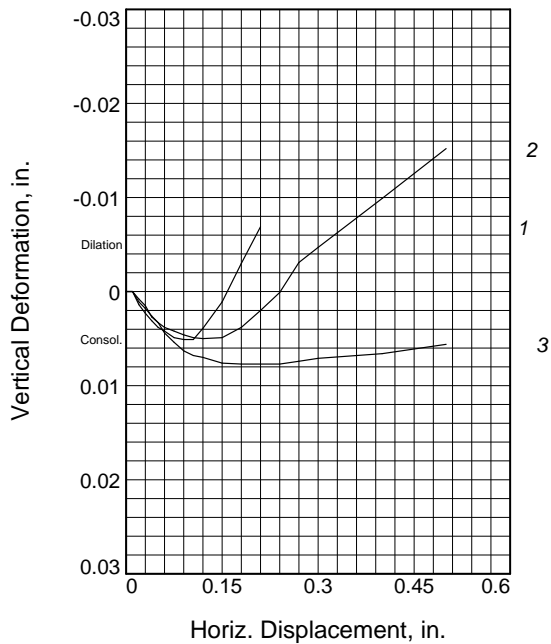
Proj. No.: 19224 **Date Sampled:** 09/19/23

DIRECT SHEAR TEST REPORT

SOILS ENGINEERING, INC.

Figure C-2

Tested By: DH **Checked By:** AL



Sample No.		1	2	3
Initial	Water Content, %	12.4	11.9	11.1
	Dry Density, pcf	107.8	108.3	109.2
	Saturation, %	61.3	59.8	57.1
	Void Ratio	0.5341	0.5281	0.5148
	Diameter, in.	2.38	2.38	2.38
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	18.6	19.6	17.2
	Dry Density, pcf	107.8	108.3	109.2
	Saturation, %	92.2	98.5	88.8
	Void Ratio	0.5341	0.5281	0.5148
	Diameter, in.	2.38	2.38	2.38
	Height, in.	1.00	1.00	1.00
Normal Stress, ksf		1.00	2.00	4.00
Fail. Stress, ksf		1.11	2.29	3.21
Displacement, in.		0.21	0.40	0.50
Ult. Stress, ksf				
Displacement, in.				
Strain rate, in./min.		N/A	N/A	N/A

Sample Type: 2.5" X 6" TUBE
Description: CLAYEY SAND; light brown, trace of fine gravel, Very stiff.
LL= n/a **PI=** n/a
Assumed Specific Gravity= 2.65
Remarks: Test Date: 10/12/23

Client: City of Ridgecrest
Project: Sgt. John Pinney Memorial Pool Replacement
Source of Sample: B-8 **Depth:** 3'

Proj. No.: 19224 **Date Sampled:** 09/19/23

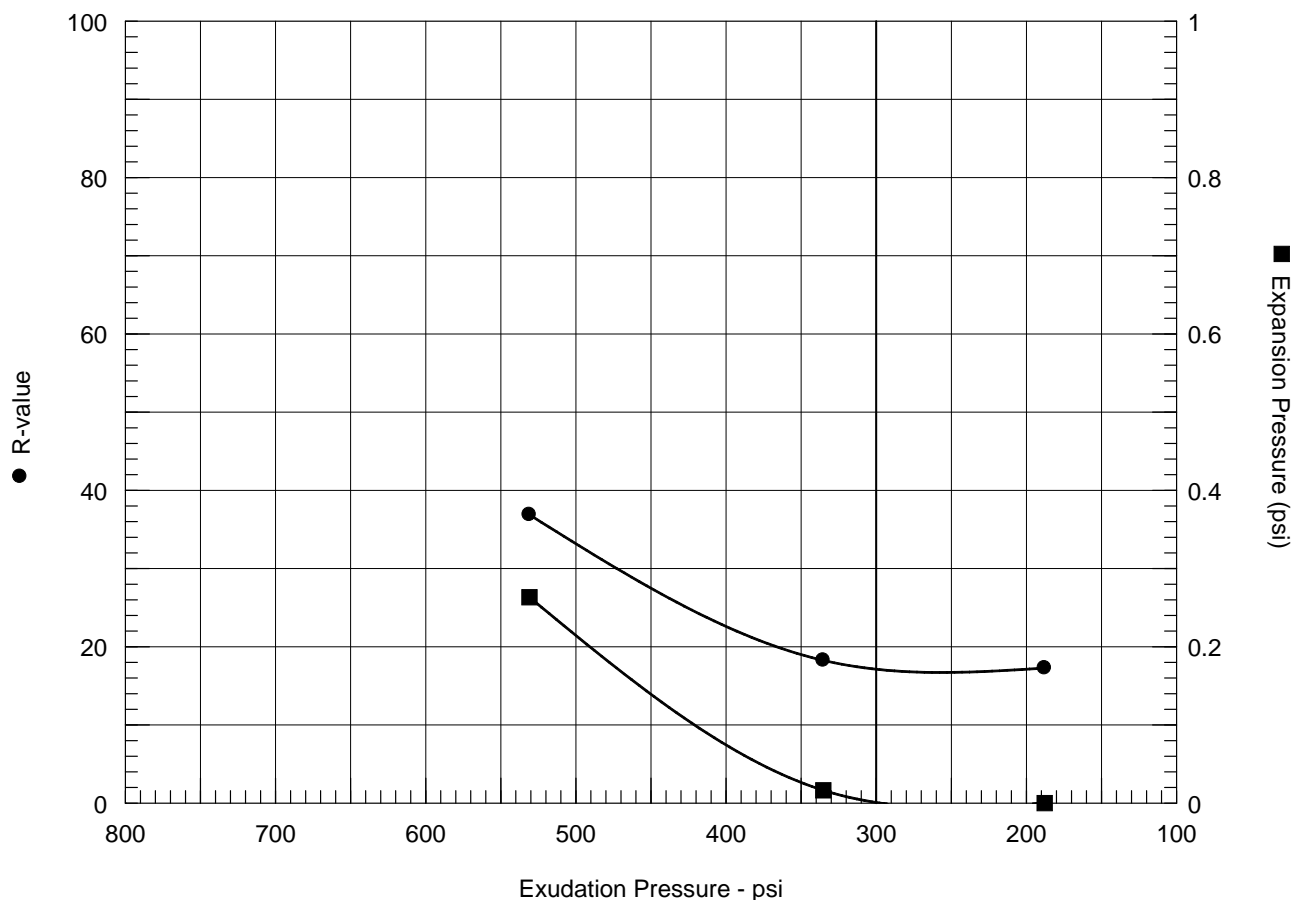
DIRECT SHEAR TEST REPORT

SOILS ENGINEERING, INC.

Figure C-3

Tested By: DH Checked By: AL

R-VALUE TEST REPORT



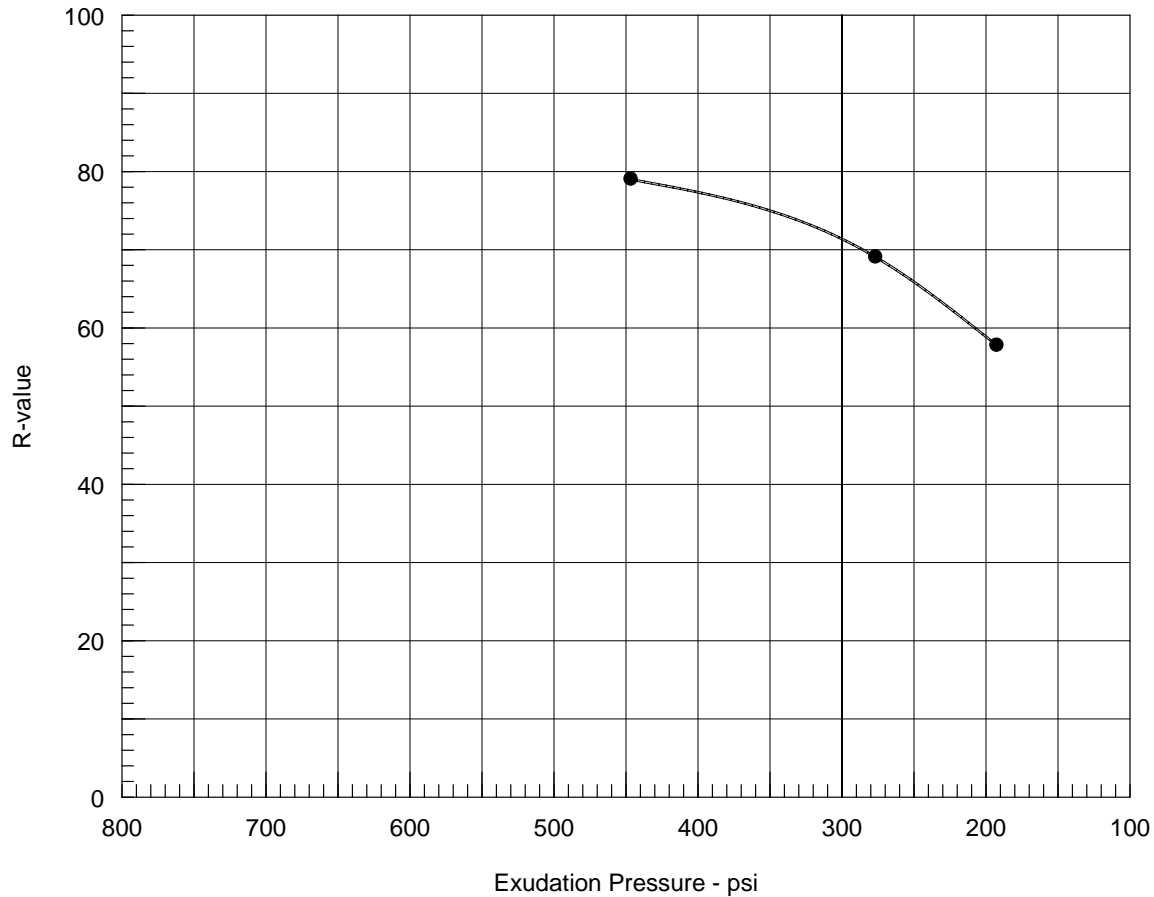
Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	210	301.0	15.5	0.26	82	2.55	531	37	37
2	130	114.2	16.6	0.02	115	2.55	335	18	18
3	75	110.9	17.6	0.00	118	2.62	188	16	17

Test Results	Material Description
<p>R-value at 300 psi exudation pressure = 17</p> <p>Exp. pressure at 300 psi exudation pressure = 0.00 psi</p>	CLAYEY SAND; light yellowish brown, fine, high plasticity.
<p>Project No.: 19224</p> <p>Project: Sgt. John Pinney Memorial Pool Replacement</p> <p>Location: B-7 @ 0-5'</p> <p>Sample Number: 90556 Depth: 0-5'</p> <p>Date: 11/6/2023</p>	<p>Tested by: RG</p> <p>Checked by: AL</p> <p>Remarks: Test Date: 09/21/23</p>
<p>R-VALUE TEST REPORT</p> <p>SOILS ENGINEERING, INC.</p>	

Figure D-1

R-VALUE TEST REPORT

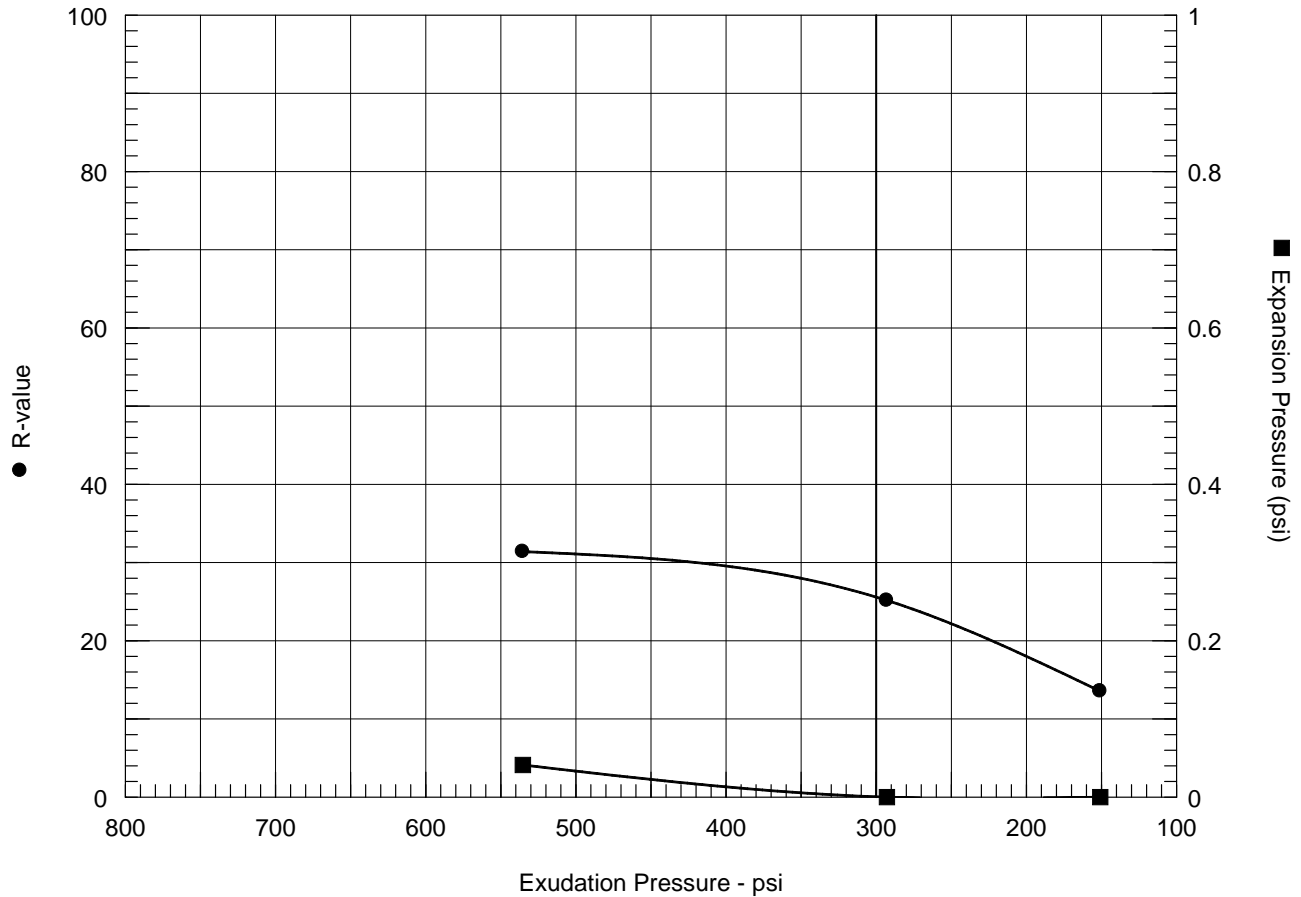


Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	350	132.4	7.5	0.00	18	2.45	446	79	79
2	350	131.1	8.5	0.00	26	2.43	276	70	69
3	350	129.6	9.6	0.00	40	2.50	192	58	58

Test Results	Material Description
R-value at 300 psi exudation pressure = 71	SILTY SAND; dark brown, moist, cohesive, trace of asphalt & gravel.
Project No.: 19224 Project: Sgt. John Pinney Memorial Pool Replacement Location: B-11 @ 0-5' Sample Number: 90557 Depth: 0-5' Date: 11/6/2023	Tested by: RG Checked by: AL Remarks: Test Date: 09/21/23
R-VALUE TEST REPORT SOILS ENGINEERING, INC.	Figure D-2

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	260	130.0	9.9	0.04	85	2.44	535	33	31
2	65	126.0	10.9	0.00	97	2.48	293	25	25
3	45	123.8	12.0	0.00	120	2.50	151	14	14

Test Results	Material Description
<p>R-value at 300 psi exudation pressure = 26</p> <p>Exp. pressure at 300 psi exudation pressure = 0.00 psi</p>	CLAYEY SAND; yellowish brown, low plasticity, trace of gravel & asphalt.
<p>Project No.: 19224</p> <p>Project: Sgt. John Pinney Memorial Pool Replacement</p> <p>Location: B-12 @ 0-5'</p> <p>Sample Number: 90558 Depth: 0-5'</p> <p>Date: 11/6/2023</p>	<p>Tested by: RG</p> <p>Checked by: AL</p> <p>Remarks: Test Date: 09/21/23</p>
<p>R-VALUE TEST REPORT</p> <p>SOILS ENGINEERING, INC.</p>	

Figure D-3

APPENDIX D

SEISMIC DESIGN DATA

SEISMIC DESIGN INFORMATION
USGS Design Map Summary and Detail Report

EQFAULT
Version 3.00

California Fault Map

Liquefaction Analysis Summary

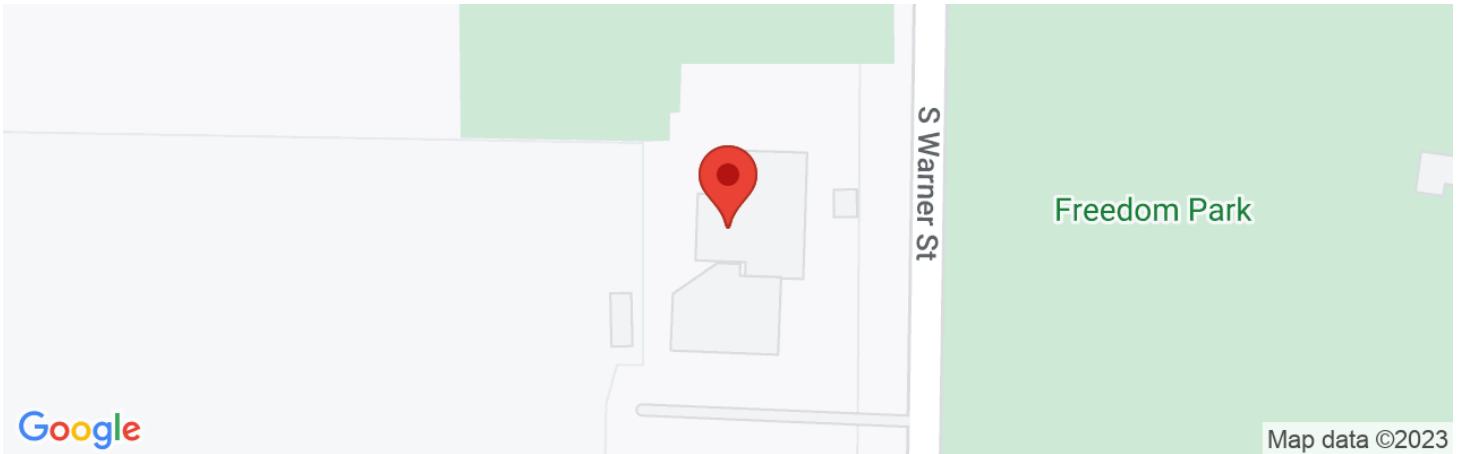
Liquefaction Analysis

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.



Sgt. John Pinney Memorial Pool Replacement

Latitude, Longitude: 35.620598, -117.674925



Date	10/23/2023, 1:43:43 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.421	MCE_R ground motion. (for 0.2 second period)
S_1	0.477	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.421	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	0.948	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.627	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.69	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
S_{sRT}	1.421	Probabilistic risk-targeted ground motion. (0.2 second)
S_{sUH}	1.586	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
S_{sD}	2.163	Factored deterministic acceleration value. (0.2 second)
S_{1RT}	0.477	Probabilistic risk-targeted ground motion. (1.0 second)
S_{1UH}	0.532	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S_{1D}	0.746	Factored deterministic acceleration value. (1.0 second)
PGAd	0.895	Factored deterministic acceleration value. (Peak Ground Acceleration)

Type	Value	Description
PGA_{UH}	0.627	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.896	Mapped value of the risk coefficient at short periods
C_{R1}	0.897	Mapped value of the risk coefficient at a period of 1 s
C_V	1.384	Vertical coefficient

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*****
*                                     *
*   E Q F A U L T   *
*                                     *
*   Version 3.00   *
*                                     *
*****
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DETERMINISTIC ESTIMATION OF
PEAK ACCELERATION FROM DIGITIZED FAULTS

JOB NUMBER: 19224

DATE: 10-23-2023

JOB NAME: Pinney Memorial Pool Replacement

CALCULATION NAME: Test Run Analysis

FAULT-DATA-FILE NAME: CGSFLTE.DAT

SITE COORDINATES:

SITE LATITUDE: 35.6206

SITE LONGITUDE: 117.6749

SEARCH RADIUS: 100 mi

ATTENUATION RELATION: 3) Boore et al. (1997) Horiz. - NEHRP D (250)

UNCERTAINTY (M=Median, S=Sigma): M Number of Sigmas: 0.0

DISTANCE MEASURE: cd_2drp

SCOND: 0

Basement Depth: 5.00 km Campbell SSR: Campbell SHR:

COMPUTE PEAK HORIZONTAL ACCELERATION

FAULT-DATA FILE USED: CGSFLTE.DAT

MINIMUM DEPTH VALUE (km): 0.0

EQFAULT SUMMARY

DETERMINISTIC SITE PARAMETERS

Page 1

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT		
		MAXIMUM EARTHQUAKE MAG. (Mw)	PEAK SITE ACCEL. g	EST. SITE INTENSITY MOD.MERC.
=====	=====	=====	=====	=====
LITTLE LAKE	3.7(6.0)	6.9	0.433	X
So. SIERRA NEVADA	7.0(11.2)	7.3	0.468	X
GARLOCK (East)	11.5(18.5)	7.5	0.305	IX
BLACKWATER	18.9(30.4)	7.1	0.171	VIII
TANK CANYON	20.4(32.8)	6.4	0.136	VIII
LENWOOD-LOCKHART-OLD WOMAN SPRGS	28.1(45.2)	7.5	0.156	VIII
GRAVEL HILLS - HARPER LAKE	28.1(45.2)	7.1	0.127	VIII
GARLOCK (West)	30.6(49.3)	7.3	0.132	VIII
PANAMINT VALLEY	32.4(52.1)	7.4	0.133	VIII
HELENDALE - S. LOCKHARDT	39.8(64.1)	7.3	0.108	VII
OWENS VALLEY	43.1(69.4)	7.6	0.119	VII
WHITE WOLF	44.7(71.9)	7.3	0.120	VII
OWL LAKE	44.8(72.1)	6.5	0.064	VI
DEATH VALLEY (Graben)	56.4(90.7)	7.1	0.090	VII
DEATH VALLEY (South)	58.6(94.3)	7.1	0.072	VI
CALICO - HIDALGO	60.5(97.4)	7.3	0.078	VII

HUNTER MTN. - SALINE VALLEY	60.6(97.5)	7.2	0.074	VII
INDEPENDENCE	65.2(105.0)	7.1	0.080	VII
LANDERS	74.1(119.3)	7.3	0.066	VI
Kern Front	76.6(123.2)	6.3	0.047	VI
SAN ANDREAS - Whole M-1a	77.4(124.6)	8.0	0.093	VII
SAN ANDREAS - 1857 Rupture M-2a	77.4(124.6)	7.8	0.084	VII
SAN ANDREAS - Mojave M-1c-3	77.4(124.6)	7.4	0.068	VI
SAN ANDREAS - Cho-Moj M-1b-1	77.4(124.6)	7.8	0.084	VII
DEATH VALLEY (Northern)	77.7(125.0)	7.4	0.068	VI
SAN ANDREAS - Carrizo M-1c-2	79.1(127.3)	7.4	0.067	VI
PLEITO THRUST	82.6(132.9)	7.0	0.064	VI
NORTH FRONTAL FAULT ZONE (West)	86.6(139.3)	7.2	0.068	VI
PISGAH-BULLION MTN.-MESQUITE LK	86.8(139.7)	7.3	0.059	VI
CLAMSHELL-SAWPIT	89.5(144.0)	6.5	0.046	VI
CLEGHORN	91.2(146.8)	6.5	0.037	V
SIERRA MADRE (San Fernando)	91.4(147.1)	6.7	0.050	VI
SIERRA MADRE	91.5(147.2)	7.2	0.065	VI
CUCAMONGA	91.8(147.7)	6.9	0.055	VI
JOHNSON VALLEY (Northern)	91.8(147.7)	6.7	0.041	V
SAN GABRIEL	92.1(148.2)	7.2	0.053	VI
SAN ANDREAS - SB-Coach. M-2b	92.5(148.9)	7.7	0.069	VI
SAN ANDREAS - San Bernardino M-1	92.5(148.9)	7.5	0.062	VI
SAN ANDREAS - SB-Coach. M-1b-2	92.5(148.9)	7.7	0.069	VI
BIG PINE	93.0(149.6)	6.9	0.045	VI

DETERMINISTIC SITE PARAMETERS

Page 2

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT		
		MAXIMUM EARTHQUAKE MAG.(Mw)	PEAK SITE ACCEL. g	EST. SITE INTENSITY MOD.MERC.
=====	=====	=====	=====	=====
VERDUGO	94.9(152.8)	6.9	0.054	VI
SANTA SUSANA	95.4(153.6)	6.7	0.048	VI
SAN JACINTO-SAN BERNARDINO	95.5(153.7)	6.7	0.040	V
HOLSER	96.6(155.4)	6.5	0.043	VI
EMERSON So. - COPPER MTN.	98.7(158.9)	7.0	0.045	VI
SANTA YNEZ (East)	99.4(159.9)	7.1	0.048	VI

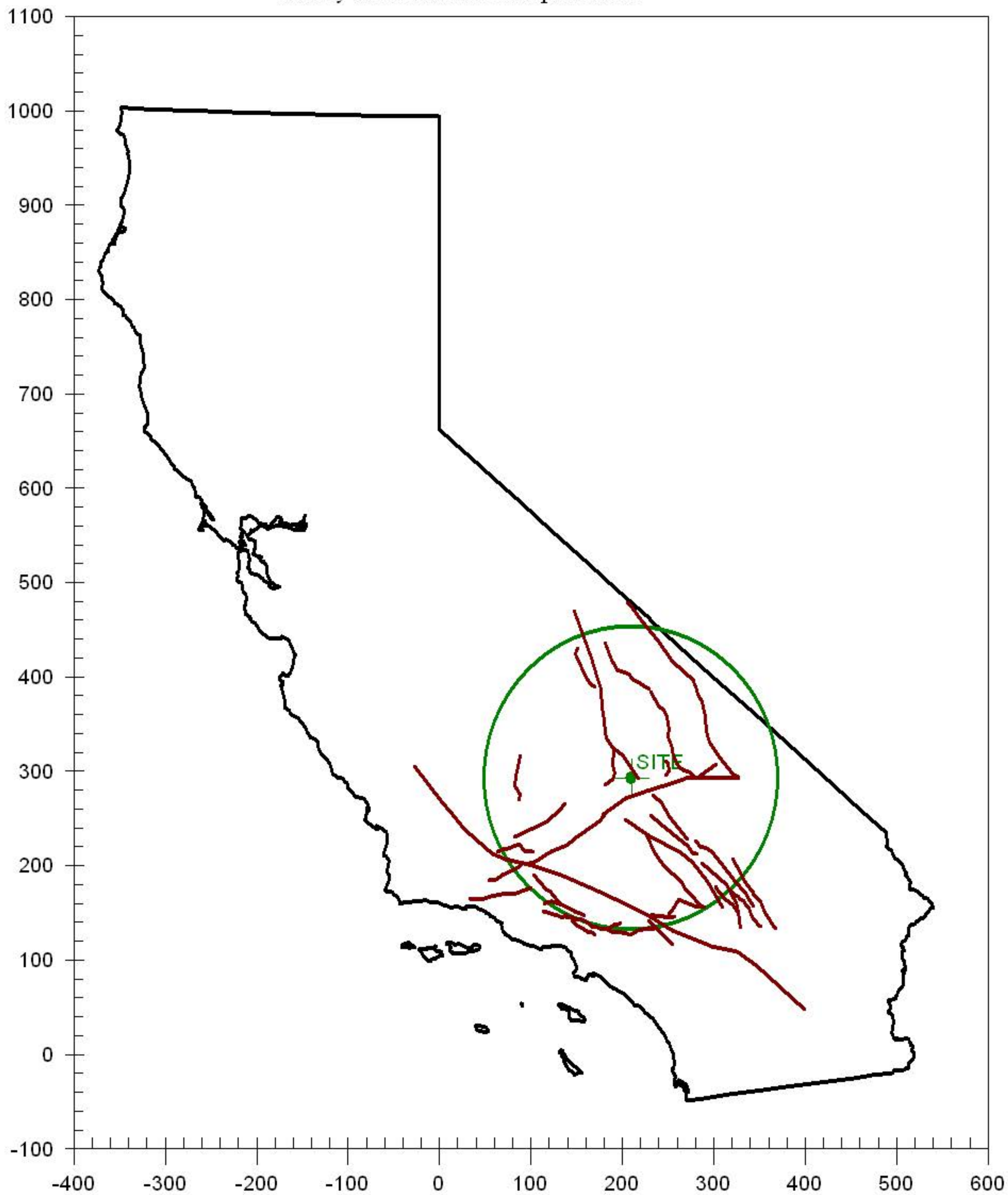
-END OF SEARCH- 46 FAULTS FOUND WITHIN THE SPECIFIED SEARCH RADIUS.

THE LITTLE LAKE FAULT IS CLOSEST TO THE SITE.
IT IS ABOUT 3.7 MILES (6.0 km) AWAY.

LARGEST MAXIMUM-EARTHQUAKE SITE ACCELERATION: 0.4679 g

CALIFORNIA FAULT MAP

Pinney Memorial Pool Replacement



APPENDIX E

Soil Fertility and Horticultural Suitability Analysis

October 5, 2023

Soils Engineering Inc
4400 Yeager Way
Bakersfield, CA 93313

Re: Lab No 23I1599-Turf Soil Samples

Enclosed are the analytical results of soil analyses. The optimum ranges are listed below each analytical component. Results are colored and bold when in problematic or wasteful ranges.

Evaluation of Results:

The Saturation Percentage (SP) can be used as an indicator of soil texture. A lower SP indicates a soil with lower clay content (and higher sand content) while a higher SP indicates higher clay content. The SP of the B-1 sample indicates a sandy loam soil texture while the SP of the B-4 sample indicates a loam or silt loam soil texture. Drainage will be slower in the B-4 area.

Soil pH levels were found to be satisfactory for turf.

Electrical Conductivity (EC_e) is a measure of the total salt concentration in the soil. Total Salt concentrations (EC's) are normal in the B-1 sample and excessive in the B-4 sample. A high EC can cause reduced growth or prevent seed germination. Reducing the EC to a satisfactory level will require soil amendments and leaching.

The dominant salt in these soils is sodium (Na). Exchangeable Sodium Percentage (ESP) is the balance between beneficial salts (Ca & Mg) and toxic salts (Na, also known as "alkali"). Exchangeable Sodium Percentage (ESP) above 5-10% may decrease water penetration and create plant toxicity hazards. Above 15% water penetration problems and toxicity hazards may be severe. The ESP is moderately high in B-1 and very high in B-4.

Gypsum requirements are necessary when sodic ("alkali") soils or low calcium soils need corrective applications of calcium. Based on these sample results, a minimum application of 2.0-2.5 tons/acre (~92-115 lbs/1000 sq ft) of 100% gypsum equivalent is recommended in the area of B-1. An application of 4-5 tons/acre (~184-230 lbs/1000 sq ft) of 100 % gypsum equivalent is recommended in the area of B-4. Gypsum should be applied prior to planting and may be tilled in or applied topically. Following soil amendment applications (and prior to planting), *significant* leaching is advised.

Leaching involves fully saturating the soil to a depth that exceeds the intended root zone, multiple times, for several weeks or months. Run the irrigation system multiple times in order to fully saturate the soil to a depth of 2-3 feet in turf/planter areas, and 4-6 feet for areas with trees, without causing significant run-off. Once the soil is fully saturated to the appropriate

depth, the water should be turned off for 2-3 days while the soil drains. After this 2-3 day period, repeat the saturation process multiple times for at least 4 weeks.

Numbers are used to indicate the presence or absence of free lime in the soil. These soils have a slight lime presence. This lime presence will act as a buffer against pH changes. Acidic amendments and fertilizers can be used without causing damage to the soil.

These soils have a high level of boron (B) which can cause toxicity in plants. It may not cause significant harm to turf, but in areas with shrubs and trees, leaching will be needed to prevent severe toxicity. After extensive leaching, re-testing is advised.

Nitrate-nitrogen ($\text{NO}_3\text{-N}$) is low in B-1 and normal in B-4. Phosphate-phosphorus ($\text{PO}_4\text{-P}$) levels are very low in each sample. Potassium (K) is within satisfactory ranges.

Fertilizers are classified using a "percent by weight" system which identifies the amount of N-P-K (% Nitrogen, % Phosphate, %Potassium) in the material. Fertilizer dealers carry materials such as: 16-16-16; 21-0-0; 16-6-8; 18-5-0; 25-5-5; etc. (IE: 5 pounds of 21-0-0 will supply about 1 pound of N).

Based on commonly available fertilizer materials and the results of these soil analyses, the best choice is a triple-mix fertilizer (N-P-K) with substantial phosphorus. A pre-plant application of around 500 lbs/acre (11-12 lbs/1000sq ft) of 6-20-20 or similar is advised. Maintenance fertilization of turf should be done with a balanced blend, such as 15-15-15, or a nitrogen only fertilizer such as ammonium sulfate (21-0-0). Turf grasses tend to consume 4-8 lbs of N per 1000 sq ft per year, depending on the growth rate. It is generally advised to split nitrogen into multiple applications, such as spring, summer and fall.

Zinc (Zn) is low in this soil; however, for turf, low zinc is not a concern. If trees will be planted in these areas, a pre-plant application of 25-30 lbs/acre (0.6-0.7 lbs/1000 sq ft) of zinc sulfate could be applied.

Any fertilizer applications prior to planting should be broadcast and incorporated into the soil.

If you have any questions, please call me.

Sincerely,



Chad Reenders
Certified Crop Advisor
Dellavalle Laboratory Inc
(559) 922-9299

Soils Engineering Inc
4400 Yeager Way
Bakersfield, CA 93313

Account# 00-0013665
Account Manager: Chad Reenders
Submitted By: SEI

Received: 09/26/2023 11:26
Reported: 10/04/2023 12:03

Samples in this Report

Lab ID	Sample	Matrix	Sampled By	Crop	Date Sampled
2311599-01	B-1@::0-5'	Soil	Luke Winder	Turf (Int-Turf)	09/19/2023
2311599-02	B-4@::0-5'	Soil	Luke Winder	Turf (Int-Turf)	09/19/2023

Notes and Definitions

Item	Definition
MCL	Drinking Water Maximum Contaminant Level
ND	Analyte NOT DETECTED at or above the reporting limit.
NES	Not Enough Sample
*	Not Taken



Laboratory Director/Technical Manager

ELAP Certification #1595
A2LA Certification #6440.02

Soils Engineering Inc
4400 Yeager Way
Bakersfield, CA 93313

Account# 00-0013665
Account Manager: Chad Reenders
Submitted By: SEI

Received: 09/26/2023 11:26
Reported: 10/04/2023 12:03

Sample Results

Sample: B-1@::0-5'
23I1599-01 (Soil)

Sampled: 9/19/2023
Sampled By: Luke Winder

Analyte	Result	Units	Reporting Limit	DIL	DW MCL	Date/Time Analyzed	Method	Notes	Batch
---------	--------	-------	-----------------	-----	--------	--------------------	--------	-------	-------

Saturated Paste

Boron, Soluble	0.9	mg/L	0.1	1		10/02/23 15:41	S 1.50		BEI0934
Calcium, Soluble meq	3.6	meq/L	0.05	1		10/02/23 15:41	S 1.60		BEI0934
Electrical Conductivity	1.73	mmhos/cm	0.01	1		10/02/23 15:41	S 1.20		BEI0934
ESP	9.6	%	0.1	1	9.9	10/02/23 15:41	Calc		BEI0934
Lime Presence	1		0	1		09/30/23 08:37	Hnbk 60-23a		BEI0934
Magnesium, Soluble meq	0.6	meq/L	0.008	1		10/02/23 15:41	S 1.60		BEI0934
Sodium, Soluble meq	11.7	meq/L	0.004	1		10/02/23 15:41	S 1.60		BEI0934
pH	7.6	units	1.0	1		09/30/23 08:37	S 1.10		BEI0934
Saturation Percentage	24	%	0.5	1		09/30/23 08:37	S 1.00		BEI0934

Extractables

Potassium, Extract	131	mg/kg	2	1		10/03/23 15:32	S 5.10		BEI0934
Nitrate Nitrogen as NO3-N, Extract	1	mg/kg	1	1		10/03/23 08:58	S 3.10		BEI0934
Phosphate as PO4P, Extract	5	mg/kg	2	1		10/03/23 08:58	S 4.10		BEI0934
Zinc, Extract	0.6	mg/kg	0.1	1		10/03/23 17:37	S 6.10		BEI0934

The results in this report apply to the samples as received and were analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. All results listed in this report are for the exclusive use of the submitting party. Dellavalle Laboratory, Inc. assumes no responsibility for report alteration, separation, detachment or third party interpretation.

Soils Engineering Inc
4400 Yeager Way
Bakersfield, CA 93313

Account# 00-0013665
Account Manager: Chad Reenders
Submitted By: SEI

Received: 09/26/2023 11:26
Reported: 10/04/2023 12:03

Sample Results (Continued)

Sample: B-4@::0-5'
23I1599-02 (Soil)

Sampled: 9/19/2023
Sampled By: Luke Winder

Analyte	Result	Units	Reporting Limit	DIL	DW MCL	Date/Time Analyzed	Method	Notes	Batch
---------	--------	-------	-----------------	-----	--------	--------------------	--------	-------	-------

Saturated Paste

Boron, Soluble	4.5	mg/L	0.1	1		10/02/23 15:42	S 1.50		BEI0934
Calcium, Soluble meq	9.3	meq/L	0.05	1		10/02/23 15:42	S 1.60		BEI0934
Electrical Conductivity	5.93	mmhos/cm	0.01	1		10/02/23 15:42	S 1.20		BEI0934
ESP	15.1	%	0.1	1	9.9	10/02/23 15:42	Calc		BEI0934
Gypsum Requirement	2.9	T/ac-6in	0.1	1		10/04/23 07:42	Hnbk 60-22d		BEJ0058
Lime Presence	1		0	1		09/30/23 08:37	Hnbk 60-23a		BEI0934
Magnesium, Soluble meq	3.0	meq/L	0.008	1		10/02/23 15:42	S 1.60		BEI0934
Sodium, Soluble meq	31.9	meq/L	0.004	1		10/02/23 15:42	S 1.60		BEI0934
pH	7.6	units	1.0	1		09/30/23 08:37	S 1.10		BEI0934
Saturation Percentage	44	%	0.5	1		09/30/23 08:37	S 1.00		BEI0934

Extractables

Potassium, Extract	347	mg/kg	2	1		10/03/23 15:32	S 5.10		BEI0934
Nitrate Nitrogen as NO3-N, Extract	22	mg/kg	1	1		10/03/23 08:59	S 3.10		BEI0934
Phosphate as PO4P, Extract	9	mg/kg	2	1		10/03/23 08:59	S 4.10		BEI0934
Zinc, Extract	0.9	mg/kg	0.1	1		10/03/23 17:38	S 6.10		BEI0934

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Soils Engineering Inc
4400 Yeager Way
Bakersfield, CA 93313

Account# 00-0013665
Account Manager: Chad Reenders
Submitted By: SEI

Received: 09/26/2023 11:26
Reported: 10/04/2023 12:03

Quality Control

Analyte	Result Qual	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch: BEI0934									
Blank (BEI0934-BLK1)				Prepared: 9/26/2023 Analyzed: 10/2/2023					
Magnesium, Soluble meq	ND	0.008	meq/L						
Boron, Soluble	ND	0.1	mg/L						
Calcium, Soluble meq	ND	0.05	meq/L						
Sodium, Soluble meq	ND	0.004	meq/L						
Reference (BEI0934-SRM3)									
				Prepared: 9/26/2023 Analyzed: 9/30/2023					
pH	7.4		units	7.460		99.9	85-115		
Saturation Percentage	31		%	35.00		89.1	80-120		
Sodium, Soluble meq	263		mg/L	265.0		99.3	70-130		
Magnesium, Soluble meq	37.9		mg/L	35.60		106	70-130		
Calcium, Soluble meq	182		mg/L	185.0		98.2	70-130		
Boron, Soluble	0.7		mg/L	0.7000		99.0	70-130		
Reference (BEI0934-SRM5)									
				Prepared: 9/26/2023 Analyzed: 10/2/2023					
Sodium, Soluble meq	96.3		mg/L	100.1		96.2	90-110		
Magnesium, Soluble meq	49.4		mg/L	50.05		98.6	90-110		
Calcium, Soluble meq	96.8		mg/L	100.1		96.7	90-110		
Reference (BEI0934-SRM6)									
				Prepared: 9/26/2023 Analyzed: 10/2/2023					
Boron, Soluble	2.0		mg/L	2.001		101	90-110		
Batch: BEJ0058									
Blank (BEJ0058-BLK1)				Prepared: 10/3/2023 Analyzed: 10/4/2023					
Gypsum Requirement	ND	0.1	T/ac-6in						

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Soils Engineering Inc
4400 Yeager Way
Bakersfield, CA 93313

Account# 00-0013665
Account Manager: Chad Reenders
Submitted By: SEI

Received: 09/26/2023 11:26
Reported: 10/04/2023 12:03

Quality Control (Continued)

Analyte	Result Qual	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch: BEI0934									
Blank (BEI0934-BLK1)									
				Prepared: 9/26/2023 Analyzed: 10/3/2023					
Nitrate Nitrogen as NO ₃ -N, Extract	ND	1	mg/kg						
Potassium, Extract	ND	2	mg/kg						
Phosphate as PO ₄ P, Extract	ND	2	mg/kg						
Zinc, Extract	ND	0.1	mg/kg						
Duplicate (BEI0934-DUP1)									
				Source: 2311594-01 Prepared: 9/26/2023 Analyzed: 10/3/2023					
Potassium, Extract	84	2	mg/kg		81			3.64	10
Zinc, Extract	2.4	0.1	mg/kg		2.4			2.52	25
Phosphate as PO ₄ P, Extract	57	2	mg/kg		59			4.18	15
Nitrate Nitrogen as NO ₃ -N, Extract	16	1	mg/kg		17			3.46	10
Reference (BEI0934-SRM1)									
				Prepared: 9/26/2023 Analyzed: 10/3/2023					
Zinc, Extract	1.3		mg/L	1.120		115	70-130		
Potassium, Extract	294		mg/L	276.6		106	85-115		
Nitrate Nitrogen as NO ₃ -N, Extract	12		mg/L	9.370		126	70-130		
Phosphate as PO ₄ P, Extract	28		mg/L	25.48		110	70-130		
Reference (BEI0934-SRM2)									
				Prepared: 9/26/2023 Analyzed: 10/3/2023					
Phosphate as PO ₄ P, Extract	26		mg/L	23.56		110	70-130		
Nitrate Nitrogen as NO ₃ -N, Extract	37		mg/L	33.88		108	70-130		
Zinc, Extract	22		mg/L	19.34		113	70-130		
Potassium, Extract	201		mg/L	178.4		113	70-130		
Reference (BEI0934-SRM4)									
				Prepared: 9/26/2023 Analyzed: 10/3/2023					
Phosphate as PO ₄ P, Extract	2		mg/L	2.000		103	90-110		
Nitrate Nitrogen as NO ₃ -N, Extract	2		mg/L	2.000		104	90-110		
Reference (BEI0934-SRM5)									
				Prepared: 9/26/2023 Analyzed: 10/3/2023					
Potassium, Extract	84		mg/L	100.1		83.9	90-110		
Zinc, Extract	5.4		mg/L	5.004		108	90-110		

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09/26/23 11:26

231599

DELLAVALLE LABORATORY, INC.

1910 W. McKinley Avenue, Suite 110 • Fresno, CA 93728

www.dellavallelab.com 559 233-6129 • 800 228-9896 • Fax 559 268-8174

BILL TO:

14224
Acct#22
Cons#

No. of Samples

2

MATERIAL

Soil

SEI File No.

10/01/23

Purchase Order No.

Results Needed By

Name: Soils Engineering, Inc. (SEI)

Address: 4400 Yeager Way

City: Bakersfield State: CA Zip: 93313

Telephone: 661-831-5100 Fax: 661-831-2111

Cell/Email: 661-201-2773 / onman@soilsengineering.com

COPY TO: andrew1@soilsengineering.com

REQUESTED BY SEI

RANCH

ID CROP Turf

Present

Stage of Growth

Turf

Intended

Date Sampled 9-19-23

Sampled By: Luke Winder

Analysis Required:

Leaf: ☐ TN ☐ L1 ☐ L2 ☐ L3
 Petiole: ☐ NO3-N ☐ P1 ☐ P2 ☐ P3
 Grape: ☐ NO3-N ☐ G1 ☐ G2 ☐ G3 ☐ G2+TN
 Petiole:

Soil: ☐ NO3-N ☐ S&S ☒ FA1 ☐ FA2 ☐ FA3
☐ FA3+OM ☐ FA4

Drop Removal Analysis: ☐ CRA1 ☐ CRA2 ☐ CRA3Manure/Compost: ☐ OSA1 ☐ OSA2 ☐ OSA3

Other:

☒ QA/QC Document☐ Copy of Chain☒ Comments/Recommendations

CHAIN OF CUSTODY

Carrier	Signature	Company	Received (Date/Time)	Relinquished (Date/Time)
First	<i>[Signature]</i>	Soils Engineering Inc	9-19-23	9-25-23
Second				
Third				
Fourth	<i>[Signature]</i>	<i>[Signature]</i>	9-26-23 11:26	

I guarantee that as the client, or on behalf of client named, I have the authority to contract the above requested services. Should it be found that I do not have such authority, I agree to be personally liable for all costs and, if there should be a dispute against me for this breach, reasonable attorneys' fees. It is understood that payment is expected to be cash with samples unless terms have been previously arranged. Terms are net 30 days; overdue accounts will be charged a late fee of 2% per month (annually 24%) or \$5.00 per month whichever is greater.

If payment is not made when due and a legitimate dispute exists concerning the product or services of Dellavalle Laboratory, Inc., it will be submitted to mediation under the Rules and Procedures of Creative Alternative to Litigation, Inc. If the dispute is not resolved in mediation, then the dispute will be submitted to binding arbitration through CAL under its Rules and Procedures. The parties will equally bear the costs of mediation/arbitration. If, however, the mediator is that no legitimate dispute exists, then debtor will pay all mediation and arbitration costs, and in the event of arbitration, reasonable attorneys' fees of Dellavalle Laboratory.

Billing Information:

Sampling hrs _____ Miles _____ Consulting _____

Shipping
\$ _____ In
\$ _____ Out

Amt Paid _____ Rec By _____ Check # _____ Date _____

Signature

Sample received in cooler with ice (coolant)

☐ Yes ☐ NO

F:\APEGGY\CUSTOM FIELDSHEETS\ Custom Fieldsheets Temp\FLDSHEET Email Soil & Tissue 2008.doc