

PROJECT MANUAL

for

OREGON MILITARY MUSEUM

LIBRARY INTERIOR IMPROVEMENTS

15300 SE MINUTEMAN WAY, BUILDING 6101
CLACKAMAS, OREGON 97015

JOB NO. 17096.02

Date: 06 May 2019



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TABLE OF CONTENTS

NOTE: Division and Section numbers listed in the Table of Contents and items of work included in each Section conform in general to CSI's MasterFormat, 2010 Upgrade Edition. Section numbers listed are merely for identification and may not be consecutive. Users of this Project Manual shall check the specification with the Table of Contents to be sure each Section is included and shall check each Section to be sure each consecutively numbered pages within each Section is included. The last page of each Section has the statement "END OF SECTION".

DIVISIONS AND SECTIONS

DIVISION 00: PROCUREMENT AND CONTRACTING REQUIREMENTS

00 01 10 TABLE OF CONTENTS
00 01 15 LIST OF DRAWINGS

DIVISION 01: GENERAL REQUIREMENTS

01 11 00 SUMMARY OF WORK
01 23 00 ALTERNATES
01 31 13 PROJECT COORDINATION
01 31 19 PROJECT MEETINGS
01 33 00 SUBMITTAL PROCEDURES
01 60 00 PRODUCT REQUIREMENTS
SUBSTITUTION REQUEST FORM
01 70 00 EXECUTION AND CLOSEOUT REQUIREMENTS
01 73 29 CUTTING AND PATCHING

DIVISION 02: EXISTING CONDITIONS

02 41 13 SELECTIVE STRUCTURE DEMOLITION

DIVISION 03: CONCRETE

03 30 10 CONCRETE

DIVISION 04: MASONRY

NOT USED

DIVISION 05: METALS

NOT USED

DIVISION 06: WOOD, PLASTICS, AND COMPOSITES

06 11 00 WOOD FRAMING
06 41 00 ARCHITECTURAL WOOD CASEWORK
06 42 00 WOOD PANELING
06 46 00 WOOD TRIM

DIVISION 07: THERMAL AND MOISTURE PROTECTION

NOT USED

DIVISION 08: OPENINGS

08 11 00 METAL DOORS AND FRAMES
08 14 00 WOOD DOORS
08 14 13 STILE AND RAIL WOOD DOORS
08 71 00 DOOR HARDWARE
08 81 00 GLASS GLAZING

TABLE OF CONTENTS

DIVISION 09: FINISHES

09 29 00 GYPSUM BOARD
09 51 00 ACOUSTICAL CEILINGS
09 65 13 RESILIENT BASE AND ACCESSORIES
09 68 13 TILE CARPETING
09 91 00 PAINTING

DIVISION 10: SPECIALTIES

10 14 00 SIGNAGE

DIVISION 11: EQUIPMENT

NOT USED

DIVISION 12: FURNISHINGS

NOT USED

DIVISION 13: SPECIAL CONSTRUCTION

NOT USED

DIVISION 14: CONVEYING EQUIPMENT

NOT USED

DIVISION 21 - FIRE SUPPRESSION

21 00 00 FIRE SUPPRESSION BASIC REQUIREMENTS
21 05 00 COMMON WORK RESULTS FOR FIRE SUPPRESSION
21 13 00 FIRE SUPPRESSION SPRINKLER SYSTEMS
21 13 19 FIRE SUPPRESSION PREACTION SPRINKLER SYSTEMS

DIVISION 22 - PLUMBING

22 00 00 PLUMBING BASIC REQUIREMENTS
22 05 29 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
22 07 00 PLUMBING INSULATION
22 10 00 PLUMBING PIPING

DIVISION 23 - HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

23 00 00 HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS
23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC
23 31 00 HVAC DUCTS AND CASINGS
23 33 00 AIR DUCT ACCESSORIES
23 37 00 AIR OUTLETS AND INLETS

DIVISION 26 - ELECTRICAL

26 00 00 ELECTRICAL BASIC REQUIREMENTS
26 05 09 EQUIPMENT WIRING
26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 29 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT
26 05 33 RACEWAYS
26 05 34 BOXES
26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 09 23 OCCUPANCY AND VACANCY SENSORS
26 27 26 WIRING DEVICES

TABLE OF CONTENTS

26 28 00	OVERCURRENT PROTECTIVE DEVICES
26 28 16	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
26 51 00	LIGHTING

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

28 00 01	ELECTRONIC SAFETY BASIC REQUIREMENTS
28 31 00	FIRE DETECTION AND ALARM

DIVISION 31: EARTHWORK

NOT USED

DIVISION 32: EXTERIOR IMPROVEMENTS

NOT USED

DIVISION 33: UTILITIES

NOT USED

DIVISION 34: TRANSPORTATION

NOT USED

DIVISION 41: MATERIAL PROCESSING AND HANDLING EQUIPMENT

NOT USED

END OF SECTION

LIST OF DRAWINGS

NOTE: Users of this Project Manual shall check the Construction Documents with the List of Drawings to be sure each sheet is included.

LIST OF DRAWINGS

TITLE

G1E TITLE SHEET

ARCHITECTURAL

A1.1E FLOOR PLAN AND REFLECTED CEILING PLANS
A4.2E INTERIOR ELEVATIONS AND SCHEDULES
A5.1E DETAILS
A5.2E DETAILS

MECHANICAL

M0.1E SYMBOLS LIST AND GENERAL NOTES - MECHANICAL
M2.1E FLOOR PLAN - BID ALT 2 - MECHANICAL

ELECTRICAL

E0.01E SYMBOLS LIST AND GENERAL NOTES & LUMINAIRE SCHEDULE - ELECTRICAL
E1.1E FLOOR PLAN AND REFLECTED CEILING PLAN - BID ALT 2 - ELECTRICAL
ED1.1E DEMO FLOOR PLAN AND DEMO CEILING PLAN - ELECTRICAL

END OF SECTION

SUMMARY OF WORK

PART 1 - GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Contractor consists of interior improvements at the library reading area in the Oregon Military Museum at 5300 SE Minuteman Way, Building 6101, Clackamas, OR 97015, as indicated on Contract Documents prepared by BBL ARCHITECTS. The Drawings and Specifications are dated 06 May 2019.
- B. Descriptive Summary: Without force and effect on requirements of contract documents, the description of the work of the contract can be summarized as follows:
 - 1. Interior remodel of Library/Archive Reading Room and adjoining reception/work area.
 - 2. Other work as indicated in Contract Documents.
- C. Contract Documents: Requirements of the work are contained in the contract documents, and include cross-references to published information, which is not necessarily bound within the documents.

1.2 PERMITS AND FEES

- A. Permits and Fees: Owner will obtain and pay for demolition and building permit, if permit required.

1.3 WORK SEQUENCE

- A. Coordinate the construction schedule and operations with the Owner's Designated Representative.
- B. Begin and complete work at times designated by the Owner's Project Manager.

1.4 CONTRACTOR USE OF PREMISES

- A. General: Owner will occupy portions of the building during the construction period. Do not interfere with the Owner's operations. Coordinate use of premises under the direction of the Owner.
- B. Use of the Site:
 - 1. Assume full responsibility for the protection and safekeeping of Products under this Contract, stored on the Site.
 - 2. Confine operations at the site to the areas permitted. Portions of the site beyond areas on which work is indicated are not to be disturbed.
 - 3. Move any stored Products, under Contractor's control, which interfere with operations of Owner or separate contractors.
 - 4. Keep existing driveways and entrances serving the premises clear and available at all times. Do not use parking areas for storage of materials.
 - 5. Maintain continuity of utility services to existing building.
 - 6. Lock automotive type vehicles and other mechanized or motorized construction equipment, when parked and unattended. Do not leave vehicles or equipment unattended with the motor running or ignition key in place.
 - 7. Do not encumber the site with materials or equipment. Confine stockpiling of materials and location of storage sheds to the areas indicated.
 - 8. Additional storage or Work areas needed for operations shall be made available. Verify exact area with Owner.

SUMMARY OF WORK

- C. Contractor's Use of the Existing Building:
 - 1. Maintain the existing building in a safe and weathertight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period.
 - 2. Keep public areas such as hallways, stairs, elevator lobbies and toilet rooms free from accumulation of waste material, rubbish, or construction debris.
 - 3. Smoking or open fires will not be permitted within the building enclosure or on the premises.
- D. Contractor's Site Conduct:
 - 1. Identifying name tags will be worn at all times.
 - a. Beyond courtesy, there should be no interaction between staff and faculty.
 - b. Keep the project free of pop cans, lunch wrappers, etc.
 - c. The supervisor will review the scheduling of any work that is excessively noisy.
 - d. Be considerate of the client and other visitors at the site.
 - e. Finally, take pride in all work.

1.5 OWNER OCCUPANCY

- A. Owner Occupancy:
 - 1. The Owner will occupy the site and the existing building during the entire period of construction.
 - 2. Cooperate fully with the Owner or his representative during construction operations to minimize conflicts and to facilitate Owner usage.
- B. Scheduling Requirements:
 - 1. Contractor shall organize and coordinate work in a manner that does not interfere with the normal operations of areas of the facility being occupied and used by the Owner.
 - 2. Contractor shall maintain safe and convenient public access to the toilet rooms at all times that the facility is normally open to the public.
 - 3. Contractor shall continuously maintain public entry to the portions of the building being used by the Owner. The Contractor shall also continuously maintain safe, direct and legal exiting routes from all areas of the building to the outside.
 - 4. Contractor may usually perform work in the building during evening hours. However, the Contractor shall be bound by the local, State and Federal regulations pertaining to such overtime work as required by the Contract Documents. Make necessary arrangements for such evening access with the Owner's Project Manager. Occasional activities may preclude Contractor's access on some evenings. Cooperate with the Owner so as not to interfere with the Owner's use of building areas being occupied by the public.
 - 5. Normal operating hours of the building are:
 - a. Weekdays: 8:00 a.m. to 5:00 p.m.
 - b. Saturdays: Closed.
 - c. Sundays: Closed.
 - d. The building is closed to the public on weekends and legal holidays.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

ALTERNATES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Description: Alternates indicated on the Bid Proposal, include changes in Work as described by the Alternates listed in this Section. Alternates may be either additive or deductive to the Base Bid. The alternate amount will either be added to or deducted from the Base Bid amount if the Owner decides to accept a corresponding change in either scope of work or in products, materials, equipment, systems, or installation methods described in the Contract Documents.
- B. Coordination: Coordinate related Work and modify or adjust surrounding Work that is affected by each accepted alternate and insure that work is complete and fully integrated as required to complete the Project under each alternate.
- C. Note that the Information for Bidders requires that bidders bid upon all Alternates that may be indicated on the Bid Proposal. Bid the Alternate as Lump Sums which will be considered independently of each other.
- D. The Owner's electing to exercise any Alternate does not relieve the Contractor of timely completion of the project, within the periods indicated.
- E. Evaluation of Alternate Prices: Bid evaluation will be based on lowest total of base bid modified by Owner accepted alternates.
- F. Notification: Immediately following award of Contract, prepare and distribute to each party involved, notification of the status of each alternate. Indicate whether alternates have been accepted, rejected, or deferred for consideration at a later date.
- G. Schedule:
 - 1. A "Schedule of Alternates" is included at the end of this section.
 - 2. Specification Sections that may be referenced in each Alternate contain pertinent requirements for materials and installation to achieve the Work described by each Alternate.
 - 3. Include as part of each Alternate, miscellaneous devices, appurtenances and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

2.1 SCHEDULE OF ALTERNATES

- A. Additive Bid Alternate No. 1 – If Additive Bid Alternate No. 1 is exercised by the Owner, provide custom casework in lieu of wood paneling at West wall of Reading Room 143 per Drawings (Detail 2 on Sheet A4.1E).
- B. Additive Bid Alternate No. 2 – If Additive Bid Alternate No. 2 is exercised by the Owner, provide wood paneling and modify ceiling layout at Reading Room 143 as indicated on Drawings (Detail 3 on Sheet A1.1E).

END OF SECTION

PROJECT COORDINATION

PART 1 - GENERAL

- A. Coordinate various elements of the work and entities engaged to perform work.
- B. Coordinate the work with existing facilities/conditions, and with work by separate contractors (if any) and by the Owner.

1.2 INSTALLER INSPECTIONS

- A. Require installer of each major unit of work to inspect substrate and conditions for installation and to report unsatisfactory conditions in writing.
- B. Correct unsatisfactory conditions before proceeding with installation.
- C. Inspect each product immediately before installation.
- D. Do not install damaged or defective products, materials or equipment.
- E. Start of installation shall be understood as acceptance of substrate conditions by the installer.

1.3 CLEARANCES

- A. Review the Construction Documents for possible conflicts prior to rough-in. Contractor is responsible for verification that equipment will fit in the space provided. Resolve conflicts with the Architect prior to rough-in work.

1.4 CUTTING AND PATCHING FOR MODIFICATION OF EXISTING AND NEW WORK

- A. Execute cutting, fitting, or patching of work required to remove and replace defective Work or Work not conforming to Contract Documents.
- B. Inspect existing conditions of work, including elements subject to movement or damage during cutting and patching.
- C. Provide shoring, bracing, and support as required to maintain structural integrity of the Project.
- D. Execute cutting, product removal, and patching by methods which will prevent damage to other work, will provide proper surfaces to receive installation of repairs, and comply with specified tolerances and finishes.
- E. Fill openings cut oversized to install equipment systems or sleeves until finished surface is tight against the equipment, system, or sleeve installed in the opening.
- F. Repair surfaces adjacent to cut areas to match the adjacent finish.

PART 2 - PRODUCTS (Not Used)

PROJECT COORDINATION

PART 3 - EXECUTION

3.1 PREPARATION

- A. Pre-Installation Conference:
 - 1. Prior to starting installation of each major component of the work, hold a pre-installation conference attended by each entity involved or affected by planned installation.
 - 2. Include technical representatives of product manufacturers and others recognized as expert or otherwise capable of influencing success of the installation.
 - 3. Review significant aspects of requirements for the work. Record discussion and distribute as plan of action.
 - 4. Pre-installation conferences are specifically required for (but not limited to) the following installations:
 - a. Section 02 41 13 SELECTIVE STRUCTURE DEMOLITION: Pre-demolition Meeting.
 - b. Section 09 51 00 ACOUSTICAL CEILINGS: Pre-Installation Meeting.
 - c. Section 21 13 00 FIRE SUPPRESSION SPRINKLER SYSTEMS: Coordination Meeting with Architect.
 - d. Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC: TAB Conference.
 - e. Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC: Pre-Balancing Meeting.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations to the extent printed information is more detailed or stringent than requirements contained directly in the contract documents.
- B. Timing: Install work during time and under conditions which will ensure best possible results, coordinated with required inspection and testing.
- C. Anchor work securely in place, properly located by measured line and level, organized for best possible uniformity, visual effect, operational efficiency, durability, and similar benefit to Owner's use. Sufficiently isolate non-compatible materials from contact to prevent deterioration.
- D. Mount individual units of work at industry-recognized mounting heights, if not otherwise indicated. Refer uncertainties to Architect before proceeding.

3.3 CLEANING AND PROTECTION

- A. Clean each element of work at time of installation.
- B. Provide sufficient maintenance and protection during construction to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION

PROJECT MEETINGS

PART 1 - GENERAL

1.1 PRE-BID CONFERENCE

- A. A Mandatory Pre-Bid Conference will be held at the Project Site at time designated by Owner's Project Manager to review Project conditions and requirements.

1.2 PRE-CONSTRUCTION CONFERENCE

- A. Purpose:
 - 1. To discuss items of interest in such detail that the Contractor shall have a clear understanding of the Owner's requirements, Contract Documents, and conditions affecting the Work. Items to be discussed include, but are not limited to:
 - a. Roles of Architect, Owner's Project Manager, Contractor, and Inspectors.
 - b. Procedures for handling change orders, requests for payment, and other administrative details.
 - c. Procedures for handling shop drawing, substitutions, inspections, etc.
 - d. Scheduling of the work.
 - e. Contractor's comments on any inaccuracies or ambiguities found in the Contract Documents.
 - f. To discuss any and all questions by the Contractor to make sure that the Contractor is aware of all conditions affecting the work prior to the awarding of the Contract.
 - 2. For the General Contractor to discuss with the Owner's Project Manager, Architect, subcontractors, and other interested parties the design, methods, organization, schedule of the work, contract requirements, mutual understandings relative to the Contract Documents, and procedures of the Administration of the Contract. Items to be discussed include, but are not limited to:
 - a. Construction Schedule.
 - b. Project Coordination: Designation of responsible personnel.
 - c. Procedures and processing of submittals, pay requests, change orders.
 - d. Record Document maintenance.
 - e. Hazardous materials.
 - f. Review of existing building conditions.
- B. Date of Conference: Before actual construction begins, when scheduled by the Owner's Project Manager.
- C. Attendance: The Owner's Project Manager, Architect, Contractor, and his superintendent shall attend as well as subcontractors and suppliers designated by the Owner, Architect, or Contractor.
- D. Place: To be designated by the Owner's Project Manager.

1.3 PROGRESS MEETINGS

- A. Purpose: Project meetings will be held on an as-needed basis, from beginning of construction to final acceptance, to discuss items of mutual interest regarding coordination and progress of the work.
- B. Day of Week: To be mutually determined by the Architect, Owner's Project Manager, and the Contractor.

PROJECT MEETINGS

- C. Attendance: The Owner's Project Manager, Architect, Contractor, and his superintendent shall attend, or their representatives. Other subcontractors, suppliers, or manufacturer's representatives shall attend when requested by the Contractor, Owner's Project Manager, or Architect.
- D. Place: Project site or as otherwise designated by the Owner's Project Manager.
- E. Chairman: The Owner's Project Manager shall chair the meeting.
- F. Meeting Date Changes: Only the Owner's Project Manager can change the meeting date after 24 hour notice. The Owner's Project Manager will set the new date.
- G. Meeting Report: The Owner's Project Manager will later issue a meeting report to the Contractor and Owner.
- H. The Contractor shall be responsible for notifying subcontractors and other representatives of scheduled construction meetings where their attendance is requested.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Submit overall construction schedule, 3-week work schedule, shop drawings, product data, samples, schedule of values, record documents, and products list as specified.
 - 1. Submit to Architect only through Contractor.
 - 2. Do not submit directly to Consulting Engineers without prior approval by the Architect for each individual submittal.

1.2 QUALITY ASSURANCE

- A. Within 15 days of the Award of Contract, submit schedules of values, list of principal subcontractors and suppliers, progress schedule, copies of building permits, and similar start-up authorization.

PART 2 – PRODUCTS

2.1 CONSTRUCTION SCHEDULE

- A. Content: Within 15 days of the award of contract, submit a comprehensive progress schedule indicating a time bar for each significant category of work to be performed. Show product and installation dates for major products. Show dates for each construction activity, Substantial Completion and punch list preparation, Final Completion, and Occupancy.
- B. Designate in the Construction Schedule, the dates for submission and review of Shop Drawings, product data and samples that are needed for the product. Show critical submittal dates or prepare a separate coordinated listing of critical submittal dates.
- C. Updating: Indicate progress of each activity and show revised completion dates. Provide listing of current and anticipated accelerations and delays. Describe proposed corrective action when required. Revise at intervals matching payment requests and redistribute with each payment request.

2.2 SCHEDULE OF VALUES

- A. Submit a Schedule of Values covering various parts of work including quantities aggregating the total sum of the Contract. Show dollar value and percent of total for each unit of work scheduled. This Schedule will be the basis for the Contractor's Application for Payment.
- B. Submit on the latest edition of AIA Document G703, Continuation Sheet, within 15 days of Award of Contract and with each payment request. Revise each time schedule is affected by change order or other revision.
- C. Upon request by the Architect, support values given with data that will substantiate their correctness.

2.3 PAYMENT REQUESTS

- A. Submit a request each calendar month. Use the latest edition of AIA Document G702, Application and Certificate for Payment, fully completed, notarized, and executed.

SUBMITTAL PROCEDURES

2.4 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- A. General:
 - 1. Review, stamp with Contractor's stamp, and sign each submittal to certify Contractor has reviewed submittal for compliance with Contract Documents prior to submitting to the Architect. Submittals issued without the Contractor's review may be returned to the Contractor without being reviewed by the Architect.
 - 2. Provide 3" x 4" clear space on each submittal for the Architect's stamp.
 - 3. Provide additional copies as required by governing authorities.
 - 4. The Architect will not mark-up more copies than the number established at the Pre-Construction meeting.
 - 5. Submit electronic submittals (pdf's) when possible and practical.
- B. Shop Drawings:
 - 1. Submit shop drawings showing connections, details, dimensions, finishes, fasteners, etc.
 - 2. Submit 4 blackline prints. Maintain 1 print as a mark-up copy for the "Record Drawings".
 - a. Electronic submittals (pdf's) may be substituted for blackline prints when possible and practical.
 - 3. In the event that the submittal is a partial submittal, identify related shop drawings to be submitted at a later date.
- C. Product Data:
 - 1. Submit manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations, and other description data on manufactured products and systems.
 - 2. Mark each copy to indicate the actual product to be provided. Show selections from among options in the manufacturer's printed product data.
 - 3. Submit 4 copies to Architect. Submittal is for information and record purposes only. Maintain 1 copy at the project site for reference purposes.
 - 4. Submit electronic submittals (pdf's) when possible and practical.
- D. Office Samples:
 - 1. Submit 3 sets of samples; 2 sets will be returned. Maintain one returned set at the project site for purposes of quality control comparisons.
 - 2. Sample submittals are for Architect's observation of color, texture, pattern, and "kind".
- E. Miscellaneous Submittals: Provide copies of miscellaneous submittals as follows:
 - 1. Warranties: Submit 3 executed copies, plus additional copies as required for maintenance manual.
 - 2. Field Records: Submit 3 copies, including 1 copy that will be returned for inclusion in the submittal of "Record Documents".
 - 3. Maintenance Manuals: Submit 3 bound copies.
 - 4. "Record Drawings": Submit original maintained marked-up prints.
 - 5. Construction Schedule and Schedule of Values: Submit 4 copies to the Architect.
 - 6. In addition, submit electronic submittals (pdf's) of above items.

2.5 3-WEEK WORK SCHEDULE

- A. Each week, provide to the Architect a 3-Week Work Schedule on a form approved by the Architect. Each 3-Week Work Schedule is to show the description of all phases of the work to be accomplished during the week submitted and the 2 following weeks. The 3-Week Work Schedule is to be updated every week and presented to the Architect.

SUBMITTAL PROCEDURES

PART 3 - EXECUTION

3.1 CONTRACTOR'S SUBMITTAL

- A. Review submittals prior to submission and provide stamp of approval signed or initialed by the Contractor indicating the Contractor has inspected the submittals and certifying that they are complete, correct, in compliance with the Contract Documents and suitable for the Project.
- B. Verify field measurements and other field construction criteria prior to submission of submittals.
- C. Submit submittals required by each Specification Section to the Architect. Notify the Architect in writing at time of submission of deviation in submittals from requirements of the Contract Documents.

3.2 ARCHITECT'S REVIEW

- A. Architect will review submittals for design concept and conformance with the Contract Documents and return submittals to the Contractor for distribution with corrections noted thereon.
- B. Stamp: The Architect will stamp each submittal to be returned with a uniform, self explanatory action stamp, appropriately marked and executed to indicate the status of the submittal. The stamp indicates and requires the follow action:
 - 1. No Exception Taken: No further action is required.
 - 2. Make Corrections Noted: Make the corrections upon fabrication of the material only.
 - 3. Rejected: The material submitted is not acceptable and another material submission is required.
 - 4. Revise and Resubmit: The material submittal is not acceptable and it is to be elaborated upon or corrected and resubmitted prior to material fabrication.
 - 5. Submit Specified Item: Submittal is rejected and the material specified is to be submitted.
 - 6. Checking is only for general conformance with the design concept of the Project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for dimensions which shall be confirmed and correlated at the job site, fabrication processes and techniques of construction, coordination of his work with that of all other trades and the satisfactory performance of his work.
- C. Contractor's responsibility for deviations in submittals from requirements of the Contract Documents is not relieved by the Architect's review of submittals unless the Contractor has made written request for the deviations and the Architect gives written acceptance of specific deviations requested.

3.3 CORRECTIONS

- A. Immediately incorporate all required corrections in the submittals and resubmit for further review, if required.

3.4 TIME SCHEDULE FOR SUBMITTALS

- A. Construction Schedule: Submit to the Architect no later than 5 calendar days after receipt of the Notice to Proceed.

SUBMITTAL PROCEDURES

- B. Shop Drawings: Submit to the Architect for review. The Architect will review within 15 calendar days. Schedule submissions to allow ample time for ordering and delivery of materials after review.
- C. Product Data: Submit to the Architect for review. The Architect will review within 15 calendar days. Schedule submissions to allow ample time for ordering and delivery of materials after review.
- D. Office Samples: Submit to the Architect for review. The Architect will review within 15 calendar days. Schedule submissions to allow ample time for ordering and delivery of materials after review.
- E. Schedule of Values: Submit to the Architect no later than 15 calendar days after receipt of the Notice to Proceed.

3.5 SUBMITTAL SCHEDULE

- A. Submittals required by Specifications and the Drawings shall be made regardless of whether or not they are scheduled herein. Each specification section should be reviewed for exact submittal requirements. All submittals must be reviewed by the Architect prior to being used and must be submitted in sufficient time to preclude a delay in meeting the approved Construction Schedule.

SECTION NUMBER	SECTION NAME	REQUIRED SUBMITTAL
01 33 00	Submittal Procedures	Construction Schedule Schedule of Values 3 Week Work Schedule
01 70 00	Execution and Closeout Requirements	Substantial Completion Notice Final Completion Notice Project Record Documents Closeout Manuals Release of Liens Documents
06 41 00	Architectural Wood Casework	Shop Drawings Product Data
06 42 00	Wood Paneling	Shop Drawings Office Samples
06 46 00	Wood Trim	Shop Drawings Office Samples
07 92 00	Joint Sealants	Guarantee
08 11 00	Metal Doors and Frames	Shop Drawings Product Data Warranty

SUBMITTAL PROCEDURES

SECTION NUMBER	SECTION NAME	REQUIRED SUBMITTAL
08 14 33	Stile and Rail Wood Doors	Shop Drawings Samples Product Literature Certification Warranty
08 71 00	Door Hardware	Hardware Schedule Samples Templates Warranty
08 81 00	Glass Glazing	Product Data Glazing Schedule Product Certificates Installers Qualification Data Preconstruction Adhesion and Compatibility Test Report Warranty
09 29 00	Gypsum Board	Product Data Texture Sample Product Preparation Instructions and Recommendations Storage and Handling Requirements Installation Methods
09 51 00	Acoustical Ceilings	Samples Shop Drawings Reflected Ceiling Plans Assembly Drawings Manufacturer's Data System Details Color Chart Maintenance Materials
09 65 13	Resilient Base and Accessories	Samples
09 68 13	Tile Carpeting	Office Samples Shop Drawings Product Data Certification Warranty
09 91 00	Painting	Product Data Office Samples

SUBMITTAL PROCEDURES

SECTION NUMBER	SECTION NAME	REQUIRED SUBMITTAL
10 14 23	Signage	Shop Drawings Product Data Office Samples
21 00 00	Fire Suppression Basic Requirements	Shop Drawings Calculations Product Data Sheets Samples Operation and Maintenance Manuals/Owner's Instructions Record Drawings Calculations Hydraulic Calculations Sway Brace Calculations Warranty Coordination Documents Letter of Conformance
21 05 00	Common Work Results for Fire Suppression	Seismic Calculations Warranty
21 13 00	Fire Suppression Sprinkler Systems	Hydraulic Calculations Sway Brace Calculations Details of Sway Bracing Details of Interval and End of Branch Line Restraints Details of Flexible Sprinkler Hose Fitting Assembly Details of Oversized Ceiling Penetrations and Oversized Sprinkler Escutcheons Trapeze Hanger Details and Calculations Sprinkler List Warranty Extra Stock
21 13 19	Fire Suppression Preaction Sprinkler Systems	Section 21 00 00 Submittals Warranty Extra Stock
22 00 00	Plumbing Basic Requirements	Product Data Shop Drawings Samples Operation and Maintenance Manuals Owner's Instructions Certificates Record Drawings Warranty Coordination Documents

SUBMITTAL PROCEDURES

SECTION NUMBER	SECTION NAME	REQUIRED SUBMITTAL
22 05 00	Hangers and Supports for Plumbing Piping and Equipment	Section 22 00 00 Submittals Warranty
22 07 00	Plumbing Insulation	Section 22 00 00 Submittals Installer Qualifications Product Data Material Test Reports Installer Certificates Manufacturer's Installation Instructions Warranty
22 10 00	Plumbing Piping	Section 22 00 00 Submittals Warranty
23 00 00	Heating, Ventilating and Air Conditioning (HVAC) Basic Requirements	Product Data Shop Drawings Samples Operation and Maintenance Manuals Owner's Instructions Record Drawings Warranty
23 05 00	Hangers and Supports for HVAC Piping, Ductwork and Equipment	Section 23 00 00 Submittals Warranty
23 05 29	Vibration and Seismic Controls of HVAC Equipment	Section 23 00 00 Submittals Vibration Isolation Product Data Vibration Isolation Shop Drawings Vibration Isolation Design Calculations Riser Diagrams and Calculations Riser System Certification Seismic Restraint Shop Drawings Seismic Restraint Calculations Seismic Restraint Details Interlocking Snubbers Load Deflection Curves Welding Certificates Equipment Certification Warranty Extra Materials
23 05 53	Identification for HVAC Piping, Ductwork and Equipment	Section 23 00 00 Submittals Warranty

SUBMITTAL PROCEDURES

SECTION NUMBER	SECTION NAME	REQUIRED SUBMITTAL
23 05 93	Testing, Adjusting, and Balancing for HVAC	Section 23 00 00 Submittals Quality-Assurance Submittals Pre-Construction Phase Report Pre-Construction Phase TAB Plan Contract Documents Examination Report Strategies and Procedures Plan Required Reports Certified TAB Reports Sample Report Forms Test Instrument Calibration Final Report Additional Reports Dictated by Commissioning Specifications Warranty/Guarantee
23 07 00	HVAC Insulation	Section 23 00 00 Submittals Installer Qualifications Product Data Material Test Reports Installer Certificates Manufacturer's Installation Instructions Warranty
23 11 23	Facility Fuel - Natural Gas Piping and Systems	Section 23 00 00 Submittals Warranty
23 31 00	HVAC Ducts and Casings	Section 23 00 00 Submittals Welding Certificates Field Quality Control Reports Warranty
23 33 00	Air Duct Accessories	Section 23 00 00 Submittals Manufacturer's Catalog Data and Fabrication/Installation Drawings Shop Drawings Manufacturer's Installation Instructions Maintenance Materials Warranty
23 37 00	Air Outlets and Inlets	Section 23 00 00 Submittals Data Sheet Performance Data Schedule Warranty

SUBMITTAL PROCEDURES

SECTION NUMBER	SECTION NAME	REQUIRED SUBMITTAL
26 00 00	Electrical Basic Requirements	Product Data Shop Drawings Samples Operation and Maintenance Manuals Owner's Instructions Record Drawings Warranty Coordination Documents
26 05 09	Equipment Wiring	Section 26 00 00 Submittals Warranty
26 05 19	Low-Voltage Electrical Power Conductors and Cables	Section 26 00 00 Submittals Cable Insulation Test Reports Warranty
26 05 26	Grounding and Bonding For Electrical Systems	Section 26 00 00 Submittals Test Reports Warranty
26 05 29	Hangers and Supports for Electrical Systems and Equipment	Warranty
26 05 33	Raceways	Section 26 00 00 Submittals Warranty
26 05 34	Boxes	Section 26 00 00 Submittals Warranty
26 05 53	Identification for Electrical Systems	Warranty
26 09 23	Occupancy and Vacancy Sensors	Section 26 00 00 Submittals Wiring Diagrams Layout of Sensors Warranty
26 27 26	Wiring Devices	Section 26 00 00 Submittals Receptacles Data Wall Plates Data In-Use Cover Data Warranty

SUBMITTAL PROCEDURES

SECTION NUMBER	SECTION NAME	REQUIRED SUBMITTAL
26 28 00	Overcurrent Protective Devices	Section 26 00 00 Submittals Product Data Instantaneous Let-Through Current Curves Average Melting Time Current Curves for Fuses Warranty
26 28 16	Enclosed Switches and Circuit Breakers	Section 26 00 00 Submittals Warranty
26 51 00	Lighting	Section 26 00 00 Submittals Product Data Submittal Cutsheets Operating and Maintenance Instructions Warranty LED Luminaire Manufacturer's Warranty
28 00 01	Electronic Safety Basic Requirements	Product Data Shop Drawings Samples Operation and Maintenance Manuals Owner's Instructions Certificates Record Drawings Warranty Coordination Documents
28 31 00	Fire Detection and Alarm	Section 28 00 00 Submittals Shop Drawings Letter Confirming Inspections Have Been Completed and System is Installed and Functioning in Accordance with Specifications Manufacturer Representative's Certification of Installation Letter of Warranty Operation and Maintenance Manuals Warranty

END OF SECTION

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 MATERIAL AND EQUIPMENT SELECTION

- A. Comply with Standards and these Specifications including size, make, type, and quality specified, or as accepted in writing by the Architect.
- B. Manufactured and Fabricated Products:
 - 1. Design, fabricate, and assemble in accordance with the best engineering and shop practices.
 - 2. Manufacture like parts of duplicate units to standard sizes and gauges and to be interchangeable.
 - 3. Two or more items of the same kind shall be considered identical and by the same manufacturer.
 - 4. Provide products suitable for service conditions.
 - 5. Adhere to equipment capacities, sizes, and dimensions shown or specified unless variations are specifically approved in writing.
- C. Do not use material or equipment for any purpose other than that for which it is designed or is specified.
- D. Fabricate and install equipment to deliver its full rated capacity at the efficiency for which it was designed.
- E. Select and install equipment to operate at full capacity without excessive noise or vibration.
- F. Provide electrical products with Underwriter's Laboratories Label or as approved by the local inspection authority.

1.2 MANUFACTURER'S INSTRUCTIONS

- A. Perform work in accordance with manufacturer's printed installation instructions, obtain and distribute copies of such instructions to parties involved in the installation, including 3 copies to the Architect.
- B. Maintain one set of complete instructions at the job site during installation and until completion.
- C. Handle, install, connect, clean, condition, and adjust products in strict accordance with manufacturer's printed instructions and in conformity with specified requirements.
 - 1. Consult with the Architect for further instructions should job conditions or specified requirements conflict with manufacturer's instructions.
 - 2. Do not proceed with work without clear instructions.
- D. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by the Contract Documents.

1.3 TRANSPORTATION AND HANDLING

- A. Arrange deliveries of products in accord with construction schedules; coordinate to avoid conflict with work and conditions at the site.
 - 1. Deliver products in undamaged condition and in manufacturer's original containers or packaging with identifying labels intact and legible.
 - 2. Immediately upon delivery, inspect shipments to assure compliance with requirements of the Contract Documents and to assure products are properly protected and undamaged.

PRODUCT REQUIREMENTS

- B. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

1.4 STORAGE AND PROTECTION

- A. Store products in accordance with manufacturer's instructions with their seals and labels intact and legible.
 - 1. Store products subject to damage by the elements in weathertight enclosures.
 - 2. Maintain temperature and humidity within the ranges required by the manufacturer's instructions.
 - 3. Protect equipment and systems from moisture, chemical, or mechanical damage before and after installation.
 - 4. Protect shafts and bearing housings from rust.
- B. Exterior Storage:
 - 1. Store fabricated products above the ground on blocking or skids to prevent soiling or staining. Cover products that are subject to deterioration with impervious sheet covering. Provide adequate ventilation to avoid condensation.
 - 2. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
- C. Inspection: Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions and free from damage or deterioration.
- D. Protection after Installation:
 - 1. Provide substantial coverings as necessary to protect installed products from damage by traffic or subsequent construction operations.
 - 2. Plug or cap pipe and conduit openings to prevent the entrance of foreign matter.
 - 3. Remove when no longer needed.

1.5 PRODUCT OPTIONS

- A. Compliance with Standards: Where the specifications require only compliance with an imposed standard, code, or regulation, select any product that complies with specified requirements provided no product names are indicated and meet the specified standard.
- B. Single Product Named: For products specified by naming one product or manufacturer and "or accepted substitute", the Contractor must submit a request for substitution for any product or manufacturer not specifically named. Submittal is to be in accordance with this Section.
- C. Two or More Products Named: For products specified by naming several products or manufacturers and "or accepted substitute", select any one of the products or manufacturers named, provided the product selected complies with the specifications. If another product or manufacturer not named is to be used, the Contractor must submit a request for substitution for that product or manufacturer in accordance with this Section.
- D. "Or Accepted Substitute" and "Or Equal" Provisions: Where products or manufacturers are specified by name accompanied by the term "or equal", provide either the product named or comply with the requirements for gaining approval of "substitutions" for the use of an unnamed product.

PRODUCT REQUIREMENTS

- E. Performance Requirements: Where the specifications require compliance with indicated performance requirements, the Contractor has the option of selecting any product that complies with the specific performance requirements, provided no product names are indicated.
- F. Visual Requirements: Where the specifications indicate that a product is to be selected from the manufacturer's standard options, without naming the manufacturer, the Architect has the option of making the selection after the Contractor has determined or selected the manufacturer.
- G. Oregon Products: In the selection of equipment, products, and materials specified in the Contract Documents, preference shall be given to those items manufactured or produced in the State of Oregon, if price, fitness, availability, and quality are otherwise equal. Under the same conditions, next preference shall be given to items the major portion of which are manufactured or produced within the State of Oregon
- H. No materials or products containing any hazardous materials are to be used in the construction of this Project. If any material or product specified in this Project Manual is known to contain hazardous materials, it shall be brought to the attention of the Architect before ordering or fabricating that material or product.

1.6 SUBSTITUTION PROCEDURES

- A. Format: Substitution requests will be considered only if they are prepared on a copy of the Northwest Chapter Construction Specifications Institute "Substitution Request Form" included at the end of this Section. Additional copies may be obtained from the Architect.
- B. Supporting Data: Submit a separate request for each product, supported with complete data, drawings, and samples as appropriate. Include the following information, as appropriate, with each request for substitution:
 - 1. Provide complete product documentation, including product data and samples.
 - 2. Provide detailed performance comparisons and evaluation, including testing laboratory reports where applicable.
 - 3. Provide coordination information indicating the effect of the substitution on other work and the time schedule.
 - 4. Provide the Contractor's general certification of the recommended substitution.
- C. Substitution Requests: Mechanical and electrical substitution requests shall be sent directly to respective consulting engineers with a copy to the Architect.

1.7 PRE-BID REQUESTS

- A. Time Limitation: To obtain acceptance of unspecified products, the bidders shall submit requests at least 10 calendar days prior to opening of proposals. **FAXED SUBSTITUTION REQUESTS WILL NOT BE CONSIDERED WITHOUT PRIOR APPROVAL BY THE ARCHITECT.**
- B. Acceptance: If the bidder complies with the requirements of this Section, and in the Owner's and Architect's opinion the proposed product is acceptable in lieu of the one or more specified, the Architect will include it in an addendum which will be issued to all bidders.

PRODUCT REQUIREMENTS

- C. Last Addendum: The last Addendum will be issued no later than 5 calendar days prior to the bid date. Any questions asked after the last Addendum has been issued will not be answered when it would have an effect on the Bids by giving any advantage to a Bidder. An Addendum may be issued during this 5 day period only for the extension of the Bid date and will be faxed to Plan Centers and the registered General Contractors holding plans.

1.8 AFTER AWARD OF CONTRACT REQUESTS

- A. Normally, requests for substitutions after the contract has been signed will not be allowed.
- B. Consideration: Requests for substitution of specified products after the construction contract is signed will be considered only when they are reasonable, timely, fully documented, and for any one of the following reasons:
 - 1. Owner's or Architect's request.
 - a. Reduction in contract time or contract sum.
 - b. Specified product is not available from any source.
 - c. Specified product would cause significant delay in the Contract time.
- C. Submittal: Submit requests on Northwest Chapter Construction Specifications Institute "Substitution Request Form" included at the end of this Section. Additional copies may be obtained from the Architect.
 - 1. Include written request for substitution and cite reason(s) for the request.
- D. Acceptance: If the Contractor complies with the requirements of this Section, and in the Owner's and Architect's opinion the proposed product is acceptable in lieu of one or more specified, the Architect will issue an Architect's Supplemental Instructions (AIA G710), where contract sum or time is not effected, or a Change Order (AIA G701) or Construction Change Directive (AIA G714), where contract sum or time is affected.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. The Contractor warrants to the Owner that the materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

PART 3 - EXECUTION

3.1 NAMEPLATES

- A. Except as otherwise indicated for required labels and operation data, do not permanently attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces or products which will be exposed to view either in occupied spaces or on the exterior of the completed project.

END OF SECTION

SUBSTITUTION REQUEST

TO:

PROJECT:

SPECIFIED ITEM:

Section	Page	Paragraph	Description
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PROPOSED SUBSTITUTION:

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of request including identification of applicable data portions.

Attached data also includes description of changes to Contract Documents and proposed substitution requires for proper installation.

Undersigned certifies following items, unless modified by attachments, are correct:

1. Proposed substitution does not affect dimensions shown on drawings.
2. Undersigned pays for changes to building design, including engineering design, detailing, and construction costs caused by proposed substitution.
3. Proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.
4. Maintenance and service parts available locally or readily obtainable for proposed substitution.

Undersigned further certifies function, appearance, and quality of proposed substitution are equivalent or superior to specified item.

Undersigned agrees, if this page is reproduced, terms and conditions for substitutions found in Bidding Documents apply to this proposed substitution.

Submitted by:

Name (Printed or typed)	
Signature	
Firm Name	
Address	
City, State, Zip	
Date	
Tel:	Fax:

General Contractor (if after award of Contract)

For use by A/E

- | | |
|---------------------------------------|--------------------------------------------|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Approved as noted |
| <input type="checkbox"/> Not Approved | <input type="checkbox"/> Received too late |

By

Date

Remarks

The Construction Specifications Institute
Northwest Region

September 1997



EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provisions of this Section apply to the procedural requirements for the actual closeout of the Work, not to administrative matters such as Final Payment and the changeover of insurance.
- B. Closeout requirements relate to both Substantial and Final Completion of the Work. They also apply to individual portions of completed work as well as the total Work.
- C. Specific requirements contained in other Sections have precedence over the general requirements contained in this Section.

1.2 CLOSE OUT AGENDA

- A. Required Procedures:
 - 1. Notify the Architect when project is ready for substantial completion inspection. Also applies to certain areas completed for use by the Owner prior to completion of the entire project. The first review copy of the O&M Manuals must be submitted prior to request for substantial completion inspection.
 - 2. The Architect will establish the substantial completion inspection date when the Architect determines that the project, or certain Owner requested areas, is ready for Substantial Completion review.
 - 3. The Architect, Contractor, and Owner make substantial completion inspection.
 - 4. The Architect issues written list of items to be completed or corrected. Substantial Completion date is established and noted on prepared form. The contractor is to issue a letter to the Owner confirming that no asbestos products were used in the construction of the facility or addition.
 - 5. The Contractor is normally given adequate time to correct deficiencies shown on correction list.
 - 6. The Contractor returns completed project record documents and final payment request including change order adjustments, and requests final inspection.
 - 7. The Architect reviews project record documents and schedules final inspection.
 - 8. Final inspection made when required submittals are delivered.
 - 9. Final payment forthcoming when work is completed and submittals have been received and approved.

1.3 SUBSTANTIAL COMPLETION

- A. Prerequisites: Comply with the General Conditions and commence the following before requesting Architect's inspection of the Work, or a designated portion of the Work, for certification of Substantial Completion.
 - 1. Submit executed warranties, workmanship bonds, maintenance agreements, inspection certificates, and similar required documentation for specific units of work enabling Owner's unrestricted occupancy and use.
 - 2. Submit record documentation, maintenance manuals, tools, keys, and similar operational items.
 - 3. Commence instruction of Owner's operating personnel and start-up of systems.
 - 4. Commence final cleaning and remove temporary facilities and tools.
- B. Submit written notice to the Architect that Work, or designated portion thereof, is substantially complete. The Architect and Owner will review the Work within 7 days.

EXECUTION AND CLOSEOUT REQUIREMENTS

- C. If the Architect determines that Work is not substantially complete, he will promptly notify Contractor in writing. The Contractor shall complete the Work and submit a second written notice of substantial completion to the Architect. The Architect will again observe the Work.
- D. When the Architect concurs that the Work is substantially complete, he will prepare a Certificate of Substantial Completion on AIA Form G704 with a tentative list of items to be completed or corrected. The Architect will submit the Certificate and tentative list to the Contractor for his written acceptance of responsibilities assigned to him in the Certificate.

1.4 FINAL COMPLETION

- A. Submit written certificate that Contract Documents have been reviewed, Project has been inspected, Work is completed in accordance with the Contract Documents, equipment and systems have been tested in the presence of the Owner's Designated Representative and are operational, and Work is ready for review. Architect will review Work within 7 days.
- B. Should the Architect determine that the Work is incomplete or defective, he will notify the Contractor in writing, listing the incomplete or defective Work. The Contractor shall remedy the deficiencies and send a second written certification to the Architect that the Work is complete. The Architect will review the Work.
- C. When the Architect finds that the Work is acceptable under the Contract Documents, he will request the Contractor to make closeout submittals.

1.5 REOBSERVATION FEES

- A. Should the Architect perform more than one reobservation due to failure of the Work to comply with the claims of status of completion made by the Contractor,
 - 1. Owner will compensate the Architect for such additional services, and
 - 2. Owner will deduct the amount of such compensation from the final payment to the Contractor.

PART 2 - PRODUCTS

2.1 PROJECT RECORD DOCUMENTS

- A. Maintain, at the site, 1 copy of the Bid Documents, Contract Forms, Project Manual, Contract Drawings, Construction Change Directives, Addenda, Change Orders, reviewed Shop Drawings, Office Samples, Field Test Records, Architect's Supplemental Instructions, etc.
- B. Store documents and samples in the Contractor's field office separate from documents used for construction.
- C. Keep current record of documents and label "Project Record." Record location of concealed items and utility lines, field changes in dimension or detail, and changes in materials furnished on Project Record Documents. Record changes from the Architect's Supplemental Instructions, Change Orders, Construction Change Directives, and Details not on Contract Drawings.
- D. Project record documents will be reviewed monthly. The Contractor and his subcontractors are required to update project record documents monthly. The Architect will review the updated project record documents on a monthly basis at the time of the Contractor's application for payment. Failure to have project record documents updated will delay payment. Deliver the project "Record Documents" to the Architect at the end of the project with the Closeout Manuals.

EXECUTION AND CLOSEOUT REQUIREMENTS

- E. The Owner shall receive one copy each in hard copy, electronic PDF, and CAD form of all As-Built Drawings. The as-built drawings will be collected from the contractor(s), reviewed for correctness, assembled as one "clean" document and submitted to Owner by the project architect/engineer. Notations and comments concerning changes are encouraged. Hand drawn drawings or mark ups are not acceptable for final as-built documents.
- F. The as-built drawings will include an update of all previous work of the building or area with the intention of providing an updated, complete and accurate site conditions drawing. The drawing will be reviewed for correctness, assembled as one "clean" document and submitted to Owner by the project architect/engineer. The Owner shall receive one copy each in hard copy, electronic PDF, and CAD form of all As-Built Drawings. Notations and comments concerning changes are encouraged. Hand drawn drawings or mark ups are not acceptable for final as-built documents.
- E. Refer to Division 22, Plumbing, Division 23, Heating, Ventilating, and Air Conditioning (HVAC), Division 26, Electrical, and Division 27, Communications, specification sections for project record document requirements for mechanical and electrical work. Submit per those requirements.

2.2 CLOSEOUT MANUALS

- A. General:
 - 1. The Owner shall receive one copy each in hard copy, electronic PDF, and CAD form of all As-Built Drawings, Operation and Maintenance Manuals, and Guarantees/Warranties. Operations and Maintenance Manuals shall be submitted for approval prior to substantial completion. Printed information submitted shall have a minimum 12-pt font size. Facility Operations Director shall sign off on all as-builts as a condition of closeout.
 - 2. The Owner shall receive one copy each in hard copy, electronic PDF, and CAD form of Approved Shop Drawings. Printed information submitted shall have a minimum 12-pt font size.
 - 3. For hard-copy requirements provided in 1. or 2. above, documents shall be bound in fully-indexed, 3-ring loose leaf binders as applicable. The cover page shall reference the project name, project number, year of construction, name of contractor, and the name of the design firm associated with the element of work. Even in cases which a single Contract includes projects at multiple school locations, there shall be individual documents produced for each School in the Contract, containing only that information pertaining to work at that particular School.
- B. Form of Manuals: Provide 3 complete copies of the manual.
 - 1. Prepare data in the form of instructional manuals for use by the Owner. Use 8-1/2" x 11" manual format in 3-ring binder.
 - 2. Include drawings, indexed tabs, and title for the manual.
- C. Content of Manuals:
 - 1. List products, equipment, and systems used in the Project. List project installers, maintenance program, and local source of supply for replacement parts.
 - 2. Include product data with specific product clearly identified.
 - 3. Include drawings of control diagrams, flow diagrams, and system relationships.
 - 4. Include a copy of the letter to the Owner confirming at no asbestos products were used in the construction of the facility.
- D. Materials and Finishes: Provide the following information for products to be included with the manuals.
 - 1. Include manufacturer's data, catalog number, color, and texture of finishes used.
 - 2. Include instructions for care and maintenance on finishes including cleaning agents, methods, and cleaning and maintenance schedule.

EXECUTION AND CLOSEOUT REQUIREMENTS

- E. Equipment and Systems: Provide the following information for products to be included with the manuals.
 - 1. Include the manufacturer's description, operating characteristics, performance data, testing and balancing data, and printed operating and maintenance instructions.
 - 2. Include the manufacturer's catalog number and replaceable parts list.
 - 3. Include start-up, break-in, operating instructions, control, stopping, emergency instructions, shut-down, and operating sequence.
 - 4. Include summer and winter operating instructions, maintenance procedures, servicing and lubrication schedule, sequence of operation, and control diagrams.
 - 5. Include as-installed color coded piping diagrams and list of piping identification markers.
 - 6. Include circuit directories of panel boards and as-installed color coded wiring diagrams.
 - 7. Include as-installed color coded duct and damper layouts with design air volumes air flow ratings and fan sizes.
 - 8. Include valve tag directory listing tag number, location, service, size, manufacture, model number, and normal position.
 - 9. Include name plate directory listing equipment designation, name plate data, location of equipment, location of switch, and normal position of switch.
- F. Warranties and Bonds: Provide the following information for products to be included within the manuals.
 - 1. Assemble warranties, bonds, service and maintenance contracts executed by each manufacturer, supplier, and subcontractor.
 - 2. Include table of contents, beginning date, and duration of warranty, bond, or service contract, and party to contact in case of claim against warranty.

PART 3 - EXECUTION

3.1 INSTRUCTION OF OWNER'S PERSONNEL

- A. Contractors shall provide training programs for all major equipment and systems. Enumerate precise requirements for hours of training for each element in the Specification Section pertaining to that element of work. Training shall be given for items such as (this is not intended to be an exhaustive list) irrigation systems, specialty flooring system care, fire protection, mechanical equipment, mechanical controls systems, electrical equipment, fire alarm. Training shall be given to both Facility Operations and Custodial Staffs, with the level of training given to each group dependent upon the required familiarity of each group with each system.
- B. Prior to Final Completion or acceptance, fully instruct the Owner's Designated Representative and maintenance personnel in the operation, adjustment, and maintenance of all products, equipment, and systems.

3.2 MAINTENANCE MATERIAL HANDLING

- A. Label packages and deliver spare parts and maintenance materials to Owner's storage area. Submit quantity specified in each product section.

3.3 PAYMENTS AND RELEASE OF LIENS

- A. Submit 2 executed copies of the Contractor's Affidavit of Payment of Debts and Claims, AIA G706.
- B. Submit 2 executed copies of subcontractors' and suppliers' release or waiver of liens, as requested by the Owner's Project Manager.

EXECUTION AND CLOSEOUT REQUIREMENTS

3.4 SCHEDULE OF CLOSEOUT SUBMITTALS

- A. Submit 3 copies in final form of the Closeout Manuals 15 days prior to final review or acceptance.
- B. Obtain and submit the Certificate of Occupancy.

3.5 CLEANING PRIOR TO SUBSTANTIAL COMPLETION INSPECTION

- A. At the time of project close out, clean or reclean the Work to the condition expected from a normal, commercial building cleaning and maintenance program.
- B. Complete the following cleaning operations before requesting the Architect's inspection for certification of Substantial Completion.
 - 1. Remove grease, dust, dirt, stains, manufacturer's labels, fingerprints, etc., from sight exposed surfaces.
 - 2. Remove non-permanent protection and labels.
 - 3. Repair, patch, and touch up marred surfaces.
 - 4. Remove construction debris.
 - 5. Police yards and grounds.
- C. Maintain in cleaned condition until Final Completion or the Owner's occupancy.

3.7 11TH MONTH WARRANTY REVIEW

- A. An 11th month warranty walk-through will be organized and scheduled by Architect/Engineer using a standard electronic calendaring method and invite all attendees including the design team, contractor and the Owner's representative(s). The resulting warranty list will act as notification and will be distributed to the contractor(s) as required. The General Contractor will distribute to all subcontractors and suppliers as required. The General Contractor will ensure notice is given to subcontractors within the 1- year time frame.

END OF SECTION

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Definition: "Cutting and patching" includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.
- B. Refer to other sections of these specifications for specific cutting and patching requirements and limitations applicable to individual units of work.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Work:
 - 1. Do not cut-and-patch structural work in a manner resulting in a reduction of load-carrying capacity or load/deflection ratio.
 - 2. Submit proposal and request and obtain Engineer's approval before proceeding with cut-and-patch of structural work.
- B. Operational Limitations:
 - 1. Do not cut-and-patch operational elements components in a manner resulting in decreased performance, shortened useful life, or increased maintenance.
 - 2. Submit written requests and obtain the Engineer's approval before proceeding with cutting and patching.
- C. Visual/Quality Limitations:
 - 1. Do not cut-and-patch work exposed to view (exterior or interior) in a manner resulting in noticeable reduction of aesthetic qualities of existing or new work.
- D. Limitation on Approvals: The Architect's approval to proceed with cutting and patching does not waive the right to later require removal and replacement of work found to be cut-and-patched in an unsatisfactory manner, as judged by the Architect.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use materials for cutting and patching that are identical to existing materials.
- B. If identical materials are not available or cannot be used, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect.
- C. Use materials for cutting and patching that will result in equal-or-better performance characteristics

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before cutting, examine surfaces to be cut and patched and conditions under which the work is to be performed.
- B. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the Work.

CUTTING AND PATCHING

3.2 PROTECTION

- A. Temporary Support: To prevent failure, provide temporary support of work to be cut.
- B. Protect other work during cutting and patching to prevent damage.
- C. Provide protection from adverse weather conditions for that part of the project that may be exposed during cutting and patching operations.
- D. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- E. Take precautions not to cut existing pipe, conduit, or duct serving the building but scheduled to be relocated until provisions have been made to bypass them.

3.3 CUTTING

- A. Cut the work using methods that are least likely to damage work to be retained or adjoining work.
- B. Where possible review proposed procedures with the original installer. Comply with original installer's recommendations.
- C. Where cutting is required, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut through concrete and masonry using a cutting machine such as carborundum saw or core drill. Cut holes and slots neatly to size required with minimum disturbance of adjacent work. Do not over cut edges.
- D. To avoid marring existing finished surfaces, cut and drill from the exposed or finished side into concealed surfaces.
- E. Temporarily cover openings when not in use.

3.4 PATCHING

- A. Patch with seams that are durable and as invisible as possible.
- B. Comply with specified tolerances for the work.
- C. Restore exposed finishes of patched areas. Where necessary extend finish restoration into retained adjoining work in a manner that will eliminate evidence of patching and refinishing.

END OF SECTION

SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide selective building demolition necessary and preparatory to construction. Refer to the Drawings for location of existing materials requiring removal. Verify existing conditions at the Site of the work and include all work evident by inspection.
- B. Provide for the salvage of existing materials for the Owner as indicated at the end of this Section.

1.2 REFERENCES

- A. Oregon Administrative Rules (OAR), Department of Human Services, Public Health Division: Chapter 333, Division 70 Renovation, Repair and Painting Activities Involving Lead-Based Paint.
- B. Code of Federal Regulations: 40 CFR: Protection of the Environment.

1.3 QUALITY ASSURANCE

- A. Regulatory Agency Requirements: Comply with applicable codes and ordinances concerning demolition operations and refuse removal.
- B. Pre-demolition Meeting: Meet at the Site with the Owner's Project Manager. Review location of service lines. The Contractor shall be responsible for protection from dust and water damage and flying aggregate. Establish location of interior dust barriers.

1.4 SITE CONDITIONS

- A. Traffic Control: Do not close or obstruct public streets, walks, or required exit passageways without written permission from authorities having jurisdiction.
- B. Exterior Dust Control: Keep exposed demolition debris damp to control dust.
- C. Interior Dust Control: Provide dust control barriers consisting of curtains or doors to limit the spread of demolition dust and debris in construction work. Use all precautions to confine dust to the work area. Maintain throughout the construction process.
 - 1. Install clear plastic sheeting over both sides of the double doors leading into the Exhibit Hall as directed by Owner's Project Manager.

PART 2 - PRODUCTS (Not Used)

2.1 EQUIPMENT

- A. Sawing Equipment: Use diamond edged saw blades of proper size for depth of cut.
- B. Drilling Equipment: Use non-impact rotary tool with diamond core drills.

SELECTIVE STRUCTURE DEMOLITION

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection: Provide protection and conduct demolition operations to prevent personal injury or property damage.
- B. Service Disconnection: Disconnect existing service lines to be abandoned and cap exposed service lines to be maintained.
- C. Interior Demolition:
 - 1. Provide slurry control to protect all existing facilities from water damage during sawing and drilling.
 - 2. Provide dust barriers inside the existing building until completion of demolition work.
 - 3. Install bracing and shoring prior to sawing structural components.
 - 4. All floor materials indicated to be removed are to include the stripping of the adhesive to the concrete substrate.

3.2 HAZARDOUS MATERIALS

- A. Removal: Removal of hazardous materials shall be included in the Demolition Work of this Contract. Employ a licensed abatement personnel to remove all accessible hazardous-containing materials.
- B. Copies of the asbestos surveys and abatement specifications will be provided by the Owner for reference by the demolition contractor
- C. During the course of demolition work, additional hazardous materials may be encountered. If hazardous materials are encountered, this contractor shall immediately notify the Owner's Project Manager.
- D. If any hazardous material is damaged during the course of the demolition work, immediately evacuate non-trained personnel. Clean up of the area and decontamination of personnel shall be at the direction of the Owner's hazardous material abatement consultant.
- E. Lead Base Paint: For renovations, repairs and painting (RRP) in "Child-Occupied Facilities" (where kids under the age of 6 regularly spend time and built before 1978), the General Contractor shall follow all Federal, State and local rules (including OSHA and US EPA rules and Oregon Administrative Rules Chapter 333, Division 70) associated with lead-based paints (LBP).
 - 1. The Contractor is responsible for the identification of LBP hazards and providing engineering controls for trigger activities that disturb LBP.
 - 2. Any time painted surfaces are disturbed, the work must be performed by a certified firm with a trained and certified "renovator" in accordance with *40 CFR (including Part 745.82 Lead)*.
 - 3. Post the areas of the building that will be affected with appropriate signage warning of the potential hazard.

3.3 DEMOLITION

- A. Remove existing materials as indicated on the Drawings.
- B. Remove existing plumbing fixtures as indicated on Drawings.
 - 1. Provide temporary caps at waste lines.
- C. Remove abandoned plumbing and electrical lines to concealed spaces and cap.

SELECTIVE STRUCTURE DEMOLITION

- D. Sprinkle and dampen debris and rubbish with water to control dust. Remove debris from the Site as demolition progresses and do not allow accumulation on the premises.
- E. Save and protect existing utilities shown to remain. Notify the Owner's Project Manager at once if unknown utilities are found in the work.
- F. Execute the demolition in an orderly and careful manner with due consideration for the Owner and the public. Provide mufflers for compressors and other noisy motors.
- G. Provide shoring and bracing as required at saw cutting areas. Do not over cut corners.
- H. Mechanical Demolition: See Drawings.
- I. Electrical Demolition: See Drawings.
 - 1. Provide all required temporary lighting during demolition.
 - 2. The demolition of all electrical devices including light fixtures, wiring devices, alarm equipment, mechanical, equipment, telephone equipment, wiring, etc., must be performed by a licensed electrician.

3.4 ADJUSTING AND CLEANING

- A. Clean-up: Remove all demolition debris from the building as soon as selective demolition has been completed.
- B. Disposal: Remove debris from the site as demolition progresses and do not allow to accumulate on the premises.
 - 1. Do not store, sell, or burn demolished or salvaged materials on the Site.
 - 2. Transport debris to an approved and licensed land fill area.
 - 3. Repairs: Repair damage to existing facilities and adjacent property to meet conditions existing prior to demolition operations.
- C. Cleaning: Broom clean interior surfaces, exterior slabs, and paving that have been soiled by demolition activities. Vacuum ducts and replace air filters at the end of demolition work.

3.5 SALVAGE SCHEDULE

- A. Items to be Stockpiled for Owner's Use:
 - 1. Light fixtures.

END OF SECTION

CONCRETE

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide concrete where indicated on the Drawings and as specified herein.

1.2 REFERENCES

- A. ASTM International (ASTM):
1. ASTM A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 2. ASTM C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 3. ASTM C33: Standard Specification for Concrete Aggregates.
 4. ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 5. ASTM C94: Standard Specification for Ready-Mixed Concrete.
 6. ASTM C143: Standard Test Method for Slump of Hydraulic Cement Concrete.
 7. ASTM C150: Standard Specification for Portland Cement.
 8. ASTM C172: Standard Practice for Sampling Freshly Mixed Concrete.
 9. ASTM C494: Standard Specification for Chemical Admixtures for Concrete.
- B. American Concrete Institute (ACI):
1. ACI 304R: Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 2. ACI 305R: Hot Weather Concreting.
 3. ACI 306R: Cold Weather Concreting.
 4. ACI 347R: Guide to Formwork for Concrete.
- C. Oregon Structural Specialty Code (OSSC), 2014 Edition.

1.3 QUALITY ASSURANCE

- A. Workmanship: Set and maintain screeds, lines, and forms within the following tolerance limits:
1. Variations from Plumb: $\pm 1/8$ " per foot not cumulative; not to exceed 1/4" in 10 feet.
 2. Variations from Grade: $\pm 1/8$ " per foot not cumulative; not to exceed 1/4" in 10 feet.
 3. Finish Floor Slabs: 1/8" in 10 feet and 1/16" per foot.
- B. The Owner may employ a separate testing laboratory to evaluate concrete delivered to and placed at the site.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials for Concrete:
1. Portland Cement: ASTM C150, type as required.
 2. Aggregates: ASTM C33.
 3. Water: Clean, free of oils, acids, and organic matter.
 4. Water-Reducing Admixture: ASTM C494, Type A.
- B. Reinforcing Bars and Dowels: ASTM A615, Grade 40.

CONCRETE

2.2 MIXES

- A. Ready-Mixed Concrete: ASTM C94, Mix Design Alternate No. 3; and in addition:
 - 1. Minimum Cement Content per Cubic Yard: 470-pounds.
 - 2. Slump for Flat Work: 4" maximum (plus 0, minus 2-1/2").
- B. Compressive Strength: 3,000-psi minimum at 28-days per ACI 301.

PART 3 - EXECUTION

3.1 FORMING AND PLACING CONCRETE

- A. Surface Preparation: Remove loose material from the compacted sub-base surface immediately before placing concrete.
- B. Reinforcement: Provide as indicated on Drawings. Position, support, and secure reinforcement against displacement. Locate and support with metal chairs, runners, bolsters, spacers and hangers, and cinder blocks as required. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- C. Concrete Placement:
 - 1. Comply with ACI 304R. Do not begin placement until work of other trades affecting concrete has been completed.
 - 2. Consolidate placed concrete using mechanical vibrating equipment with hand rodding and tamping, so that concrete is worked around reinforcement and other embedded items and into all parts of forms.
 - 3. Protect concrete from physical damage or reduced strength due to weather extremes. In cold weather, comply with ACI 306R. In hot weather, comply with ACI 305R.

3.2 CONCRETE FINISHES

- A. Slab Trowel Finish: Apply trowel finish to monolithic slab surfaces that are exposed-to-view or are to be covered with resilient or other thin film coating. Consolidate concrete surface by finish troweling, free of trowel marks and uniform in texture and appearance.

3.3 CURING

- A. Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72-hours. Continue curing by use of moisture-retaining cover or membrane-forming curing compound.
- B. Provide protection to prevent damage to exposed concrete surfaces.

3.4 CONCRETE TESTING

- A. When required by Chapter 17, Structural Tests and Inspections, of the 2012 International Building Code (IBC) and the Oregon 2014 Structural Specialty Code Amendments, the Owner will employ a separate testing laboratory to evaluate concrete delivered to and placed at the Site. Concrete strength tests for quantities less than 50 cubic yards will not be required when waived by the Building Official and the Architect.
- B. Testing laboratory shall comply with the 2012 International Building Code (IBC) and the Oregon 2014 Structural Specialty Code Amendments, Section 1903, Specifications for Tests and Materials, and Section 1904, Durability Requirements, for evaluation and acceptance of concrete.

CONCRETE

- C. Testing laboratory shall test one field cured cylinder prior to removing shoring under structural slabs, joists, or beams.
- D. When required, testing laboratory shall perform tests as follows:
 - 1. Sampling: ASTM C172.2.
 - 2. Slump: ASTM C143, one test for each truck load at point of discharge for ready mixed concrete and each batch of Site mixed concrete.
 - 3. Air Content: ASTM C31, one for each set of compressive strength specimens.
 - 4. Compressive Strength: ASTM C39, one set for each day of structural concrete pour or each 50-cubic yards, or fraction thereof of each class of concrete. Two specimens tested at 7 days, two specimens tested at 28 days, and one retained for later testing if required.

END OF SECTION

WOOD FRAMING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide lumber framing and accessories for wall and ceiling framing systems as indicated on the Drawings and as specified herein.

1.2 REFERENCES

- A. U.S. Department Of Commerce: PS 20, American Softwood Lumber Standard.
- B. ANSI/ASME Standard B18.2.1.
- C. ASTM International (ASTM):
 - 1. ASTM F 1667: Standard Specification of Driven Fasteners: Nails, Spikes, and Staples.
- D. ICC Evaluation Service, LCC (ICC):
 - 1. ICC-ES Report ESR-1539 "Power-Driven Staples and Nails".
- E. National Design Specification (NDS): Design Values for Wood Construction.
- F. Oregon Structural Specialty Code, 2014 Edition (OSSC) based on 2012 International Building Code (IBC).
- G. West Coast Lumber Inspection Bureau (WCLIB): No. 17 Standard Grading Rules.
- H. Western Wood Products Association (WWPA).

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Wrap, cover, and protect lumber products in shipment and while stored on the site to prevent weather exposure and damage. Maintain stacks neat and in good order; level and off ground or floors; raised on pallets or dunnage to prevent contact with water or earth.

PART 2 - PRODUCTS

2.1 SAWN LUMBER

- A. Sawn lumber shall conform to the requirements as indicated in the currently accepted National Design Specification (NDS) Design Values for Wood Construction and conforming to the West Coast Lumber Inspection Bureau or Western Wood Products Association Grading Rules. Lumber shall be the species, grade, and moisture content noted below:

<u>Use</u>	<u>Species and Grade</u>	<u>Moisture Content</u>
Lumber 2" to 4" thick x 5" or wider (joist/rafters)	Douglas Fir-Larch No. 2	MC/KD 15
Lumber 2" to 3" thick x 4" to 6" wide (studs)	Douglas Fir-Larch Stud	S-Dry, MC/KD 15

WOOD FRAMING

- B. Pressure Treated Lumber: Treat all lumber in contact with concrete or used for insulation stops with Chemonite, Wolmanized, Osmose K-33, or accepted substitute.
 - 1. All lumber in contact with concrete shall be pressure treated, unless an approved moisture barrier is provided.
- C. Blocking/backing: 1 inch thick AC, plywood 12 inches by stud width for door hardware, toilet accessories, hand towel and soap dispensers.

2.2 FRAMING ACCESSORIES, NAILS, AND BOLTS

- A. Framing Accessories: Framing accessories shall be manufactured by Simpson Strong Tie (or approved equal) and of the size and type shown on the Drawings.
 - 1. If a substitution is made, a document shall be submitted to the Architect for approval outlining the framing accessories being replaced and the substituted framing accessories. Allowable loads for the Simpson accessories shall be tabulated along with allowable loads for the substituted accessories, which clearly indicate the substituted accessories having an equal or greater capacity.
- B. Framing Nails:
 - 1. All framing nails shall be of the size and quantity indicated on the Drawings and conform to ASTM F 1667, "Standard Specification of Driven Fasteners: Nails, Spikes, and Staples" and ICC-ES Report ESR-1539 "Power-Driven Staples and Nails".
 - 2. Nails shall be identified by labels (attached to their containers) that show the manufacturer's name and ICC-ES Report Number, nail shank diameter, and length and shall be submitted to the Architect prior to framing.
 - 3. Nailing not shown shall be as indicated on OSSC Table 2304.9.1 or ESR-1539.
 - 4. Nail sizes shall be as scheduled below and are to be used with the nail length determined by minimum penetration into framing member.
 - a.

Nail Type	Shank Diameter	Min. Penetration into Framing Member
6d	0.113"	1.125"
8d	0.131"	1.375"
10d	0.148"	1.500"
12d	0.148"	1.500"
16d	0.148"	1.500"
- C. Bolts and lag screws shall conform to ANSI/ASME Standard B18.2.1. All bolts and lag screws shall be installed with standard cut washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Post-installed Concrete Anchors (Concrete Screws): Install anchors in strict accordance with manufacturer's recommendations and product evaluation reports. Embedments specified on drawings are "effective" embedments. Reference manufacturer literature for corresponding actual embedment depths.
- B. Steel Framing Connectors: Install with nails or bolts of sizes and type specified by manufacturer of connector. Provide "U" type hangers where joists and beams frame into side of beams or headers.
- C. Steel Post Connectors: provide PC post caps at post to beam connections and PB or EPB post bases at post to footing connections.

WOOD FRAMING

- D. Fasteners: Minimum fasteners per the 2012 International Building Code (IBC) and the Oregon 2014 Structural Specialty Code (Table 2304.9.1, Fastening Schedule), or as indicated on the Drawings.
- E. Bolting: provide standard plate washers under heads and nuts of bolts bearing on wood. Soap threads of lag bolts prior to installing.
- F. Structural Blocking: Locate as indicated and as required to support toilet accessories, cabinets, toilet partitions, plumbing, fire sprinkler, mechanical, and electrical equipment. Solid block joists and rafters at bearing walls and beams.
- G. Fire Blocking: Provide required fire blocking in wood framing as follows.
 - 1. Block wood-framed walls and partitions at floor and ceiling lines.
 - 2. Block double stud wood-framed walls and partitions at maximum horizontal intervals of 10 feet.
 - 3. Block all similar combustible blind spaces exceeding 10 feet in any dimensions to the effect that a barrier to the passage of flame is provided at maximum intervals, both vertical and horizontal, of 10 feet.
- H. Bridging: Provide code-required bridging between structural joists, rafters, and trusses.
- I. Framing: Install framing members at not more than 24" on center and at spacing indicated on the Drawings. Moisture content of framing shall be as specified.
- J. Cutting and notching of joists and studs shall conform to the typical wood details provided or OSSC Sections 2308.4.2.4, 2308.5.9 and 2308.7.4 where no details are specified.
- K. Install pressure treated framing at locations where wood framing is in contact with concrete. The end cuts of all pressure treated wood shall have a preservative applied. Hot dipped galvanized nails shall be used with preservative applied wood per the Oregon Structural Specialty Code (2304.9.5).
- L. Framing Accessories: All nail holes shall be filled with structural fasteners, unless noted otherwise on the Drawings and fasteners shall be installed following all manufacturers requirements.

3.2 MINIMUM NAILING SCHEDULE FOR FRAMING

- A. Per Oregon Structural Specialty Code (OSSC), Table 2304.9.1 FASTENING SCHEDULE.

END OF SECTION

ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide custom casework and specified associated accessories where shown on the Drawings and as specified herein.
 - 1. Base Bid: Provide all casework indicated on Drawings except for Casework at West wall of Reading Room 143.
 - 2. Alternate No. 1: If Alternate No. 1 is exercised by the Owner, provide casework at West wall of Reading Room 143 as indicated on Drawings and as specified herein.
- B. Include shop fabricated cabinets, casework, countertops, cabinet hardware, and shelving.

1.2 REFERENCED STANDARDS

- A. Quality Standards: Except as herein modified, materials and workmanship grades shall be as defined in Architectural Woodwork Standards, published by the Architectural Woodwork Institute.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Show layout, dimensions, profiles, joint details, and other pertinent items.
 - 2. Show connections to adjacent work, and complete assembly whether or not materials are furnished by the cabinet shop.
 - 3. Include the manufacturer's descriptive literature for specialty items.
 - 4. Identify each item as to location, material grade, workmanship grade, wood species, finish, plastic laminate color, and location of casework
- B. Product Data: Provide low emitting adhesives. All adhesives and sealant installed inside of the weatherproofing system shall meet testing and product requirements of CDPH Standard Method c1.1-2010. Examples include greenguard gold, collaborative for high performance schools and SCS Indoor Advantage Gold. VOC contents wet applied on site must meet applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver products to jobsite until notified by the Contractor that the project is conditioned and prepared to handle and store casework products without damage. Coordinate delivery to comply with job requirements.
- B. Protect all casework from damage during shipment, handling, and storage.

1.5 JOB CONDITIONS

- A. Temperature and Humidity Requirements: Maintain temperature and relative humidity within 5% of the amounts expected during operation of the building. Maintain materials within these limits for 48 hours prior to and during field finishing of materials.
- B. Maintain 50°F minimum in spaces where casework and shelving are being stored.
- C. Coordinate with other trades affecting or affected by the work of this Section.

ARCHITECTURAL WOOD CASEWORK

- D. Protect other surfaces against damage or discoloration caused by the work of this Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Wood Panels:
1. Comply with AWS Section 4 veneer face grade description for Grade AA veneers.
 2. Provide thicknesses as indicated; if not indicated, provide minimum thicknesses required by AWS for Grade AA veneers.
 3. Wood veneer for clear finish:
 - a. Ash Veneer: AWS Premium AA face, plain sliced (flat cut) ash, narrow heart figure.
 - b. Minimum thickness 1/28-inch at 12% moisture content.
 - c. Manufactured from veneer leaves of equal width, book and balance match on the panel. Horizontal grain to be end, book, and butt matched.
 4. Panel Core:
 - a. Fire rated MDF, Class 1 fire rating, meeting UL standards for surface burning characteristics of building materials, UL 723, 45 lb. density Industrial Grade, 3/4-inch thick.
 - 1) Meet UL and ICBO Class 1 flame spread rating (25 or less).
 - b. Manufacturers: "Decospan" MDF (Fire-Resistant), or accepted substitute.
 5. Back: Hardwood back grade veneer of a similar species to balance face veneer.
 6. Edges: Provide solid ash edging as detailed on all four edges.
 7. Binders and glue to be formaldehyde free, no or low VOC.
- B. High Pressure Laminate:
1. Manufacturers: Formica, Nevamar, Wilsonart, or accepted substitute.
 2. Thickness and NEMA Type:
 - a. Countertops, Splashes, and Countertop Edges: 0.048" (HGS)
 - b. Vertical Exposed Surfaces: 0.028" (VGS)
 - c. Semi-Concealed Backing: 0.020" (CLS).
 - d. Concealed Backing: 0.020" (BKL).
 3. Color: Provide all high pressure laminate in colors as scheduled at the end of this Section.
- C. Wood Trim:
1. Lumber Species for Transparent Finish: Plain-sawn (flat cut) Ash, premium grade.
 2. Lumber Species for Opaque Finish: Any closed-grain hardwood listed in referenced woodworking standard, originating in "certified well-managed" forests.
 3. Wood trim shall have a radius or be finished in a way that eliminates sharp edges.
- D. Casework Door Glazing: 1/8" minimum thickness clear float glass, glazing quality. Provide tempered glass where noted on the Drawings.
- E. Sliding Glass Panels: 1/4" thick clear float glass, glazing quality; tempered.
- F. Casework Countertop Edge Profiles: Countertop edge shall have a radius or be finished in a way that eliminates sharp edges.
- G. Fasteners: Nails, staples and screws to comply with Section 400 in AWI Quality Standards.

ARCHITECTURAL WOOD CASEWORK

- H. Standard Adhesives: Urea, Resorcinol, P.V.A. and Contact adhesives as selected by the cabinet manufacturer, meeting AWI Quality Standards, building code requirements, and VOC limits of the South Coast Quality Management District Rule #1168.
- I. Provide low emitting adhesives. All adhesives and sealant installed inside of the weatherproofing system shall meet testing and product requirements of CDPH Standard Method c1.1-2010. Examples include greenguard gold, collaborative for high performance schools and SCS Indoor Advantage Gold. VOC contents wet applied on site must meet applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005.

2.2 FINISH HARDWARE

- A. Adjustable Casework Shelf Supports for Glass Shelves: 32mm line boring with zinc coated steel K Line Glass Shelf Pins (Italiana Ferramenta Brand) by Richelieu Hardware, or accepted substitute.
- B. Adjustable Casework Shelf Supports for Wood Shelves: 32mm line boring with nickel plated steel shelf clips, Knappe & Vogt No. 345NP.
- C. Side-Mounted Drawer Slides: Knappe & Vogt No. 8400 for medium duty drawers; Knappe & Vogt No. 1300 for deep drawers; or accepted substitute. Provide full extension slides at file drawers. Blum BS230M, 100 self-closing slides, and Blum BS430E, full extension slides, are approved. Attach with 5mm EURO screws.
- D. Hinges: Fully adjustable, fully concealed with minimum 110° angle of opening. Mepla, Hetal, Stanley, Blum, or accepted substitute. Mount with 5mm EURO screws.
- E. Provide low emitting adhesives. All adhesives and sealant installed inside of the weatherproofing system shall meet testing and product requirements of CDPH Standard Method c1.1-2010. Examples include greenguard gold, collaborative for high performance schools and SCS Indoor Advantage Gold.
- F. Drawer and Door Locks: Corbin 0737, Olympus Model CN, KABA Rim Lock (#230.06.224) by HAFELE, or accepted substitute. Provide with dead bolt and metal strike, rosette and 5-pin minimum tumbler lock. Provide two keys per lock and all locks keyed to a master system per the Owner. Color to match finish hardware specified in Section 08 71 00, Door Hardware.
- G. Elbow Catches: Hafele spring loaded, chrome plated deluxe model elbow catch (Item #245.74.200), or accepted substitute. Provide elbow catches on inactive doors as required.
- H. Grommets: PVC wire access grommets. 2-1/2" diameter hole; 3" outside diameter by Doug Mockett and Company, Inc., (<http://www.mockett.com>); HAFELE; or accepted substitute. Finish as selected by the Architect from the manufacturer's standard (black) color options.
- I. Sliding Glass Door Fittings: Hafele (Specifications Base), or accepted substitute.
 - 1. Lock: End Cap, with Lock for Cylinder Core, with Counterpiece and Center Groove for Slido Design IF, zinc alloy, nickel-plated. Hafele Item # 233.02.410, or accepted substitute.
 - a. Cylinder Core: Hafele 210.30.601 Slido Design Cylinder Core for Sliding Glass Cabinet Doors - Keyed Alike.

ARCHITECTURAL WOOD CASEWORK

2. Sliding Glass Door Fittings: Hafele Slide Design 25 IF G, or accepted substitute.
 - a. Set Components (Hafele, or accepted substitute) to include:
 - 1) Running Gear (Item #415.13.103); Quantity: 4.
 - a) Material: Steel.
 - b) Finish: Galvanized Roller: White, plastic-coated.
 - 2) Installation Tool for Running Gear (Item #415.13.060); Quantity: 1.
 - a) Material: Plastic.
 - 3) Glass profile, bottom, for mounting the running gear to the glass door (Item #415.12.925); Quantity: 1.
 - a) Material: Aluminum.
 - b) Finish: Silver colored anodized.
 - 4) U-Shaped glazing gasket for for glass door, for installation into glass profile, for 1/4" glass (Item #415.13.642); Quantity: 1.
 - a) Material: Plastic.
 - b) Finish: Gray.
 - b. Individual Components (Hafele, or accepted substitute) to include:
 - 1) Double upper guide track, for screw mounting (Item #415.10.925). Quantity: 1.
 - a) Material: Aluminum.
 - b) Finish: Silver colored anodized.
 - 2) Double bottom guide track, for screw mounting (Item #415.11.925).
 - a) Material: Aluminum.
 - b) Finish: Silver colored anodized.
 - 3) Gasket for installation into double upper guide track, for anti-derailment (Item #415.13.050). Quantity: 6.
 - a) Material: Plastic.
 - b) Finish: White translucent.
 - 4) End Caps (Item #415.13.021). Quantity: 2.
 - a) Material: Plastic.
 - b) Finish: Chrome-plated matt.
- J. Concealed Mounting Clips: Extruded aluminum "Panelclip" or "Kingclip" by Brooklyn Hardware LLC, (503) 232-1151, or accepted substitute. The contractor at his option may use a wood French cleat in place of the mounting clips.
- K. Countertop Brackets: A&M Hardware C-24L, or accepted substitute.
- L. Bookcase Door Pulls: Solid brass, 1 1/8" ball knobs. Rockwood Part No. 841 by ASSA ABLOY, or accepted substitute.
 1. Finish: Polished chrome plated brass (US26D).

2.3 FABRICATION

- A. General:
 1. AWI Fabrication Style: Frameless cabinets are approved where matching casework is not required. Door style to be fully overlay.
 2. AWS Fabrication Grade: Premium grade.
 3. Conform to AWS Section 10 Casework, and Section 11 Countertops except as noted.
 4. All shelves adjustable.
 5. Verify dimensions of items to be built into cases and counters.
 6. Assemble at shop where feasible.

ARCHITECTURAL WOOD CASEWORK

7. Conceal end grain in exposed and semi-exposed surfaces.
 8. Assemble cases with adhesive.
 9. Assemble drawers with dados and adhesive.
 10. Use concealed mounting clips to attach casework to the wall.
 11. Use concealed screws and bolts where required for strength and rigidity.
 12. Install finish hardware specified herein at shop.
 13. Install adjustable shelf standards to full height of space where adjustable shelves are shown and recess flush into cabinet sides.
 14. Countertop edges and backsplashes are to be sealed to wall surface.
 16. No exposed fasteners allowed for attachment to wall surface or to other cabinets without Architect's prior approval.
- B. Materials:
1. Exposed High Pressure Plastic Laminate Surfaces: Includes countertops..
 2. Exposed Veneer Plywood Surfaces: Where indicated on the Drawings. Sequence matched panels and components, including wood paneling specified in Section 06 42 00, Paneling, and wood doors specified in Section 08 14 00, Wood Doors.
 3. Semi-exposed and Concealed Surfaces: MDL, Selply, or accepted substitute.
 4. Countertop Substrate: 3/4" thick general particleboard or INT-DFPA plybase "B-D" grade at countertops.
 5. Countertop Substrate: At typical locations match or coordinate with existing finishes adjacent. Backsplashes and edges to be integral; 4" minimum. Laminate counters installed over 3/4" APA, B-C Grade fir plywood or premium industrial grade particleboard with minimum density of 45 lbs per cubic foot. Laminate to be 0.039" thick and postformed with integral backsplash and front edge. Provide raised drip edge at wet locations.
 6. Storage and Adjustable Shelving: Minimum 1" thick particleboard with low pressure plastic laminate on both surfaces. All 4 edges of all shelves are to receive PVC edge banding.
 7. Casework Components: Sides, tops, bottoms, and fronts to be 3/4" particleboard with overlay as specified. Cabinet backs to be 1/4" MDL, Selply, or accepted substitute.
 8. Drawer Box: sides, backs, and sub-fronts to be 15/32" minimum 7-ply hardwood plywood with no inner core voids, with low pressure plastic laminate.
 9. Edge Banding: Provide at exposed particleboard edges in accordance with AWI Standards and as specified herein. Edge band all edges of shelving. **No "F" or "T" molding allowed on new casework.**

PART 3 - EXECUTION

2.4 EXISTING CONDITIONS

- A. Verify that surfaces to receive casework, countertops, and shelving are straight, plumb, true, rigid, and otherwise properly prepared. Notify Contractor of any defects requiring correction prior to starting work. Do not start work until corrections have been made and are satisfactory.
- B. Verify that solid blocking has been properly installed to support casework and accessories.

2.5 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If any measurement differs substantially, notify the Architect prior to fabrication.

ARCHITECTURAL WOOD CASEWORK

2.6 INSTALLATION

- A. Miter corners, bevel-cut, and glue joints.
- B. Provide continuous bases under in-line base casework unless otherwise indicated.
- C. Secure casework in place plumb, square, true, level, and without distortion. Level where necessary with concealed shims.
- D. Anchorage: Secure countertops to grounds, furring, and solid blocking with countersunk fasteners and blind nailing as required. Anchor wall standards for open wall mounted adjustable shelving to solid framing.
- E. Layout anchoring system based on existing conditions. Anchoring for a typical upper capable of supporting 200 lbs per lineal foot.
- F. Install wall hung cabinets on concealed mounting clips. No exposed screw heads or fasteners allowed.
- G. Accurately scribe face plates, filler strips, and trim strips to adjacent surface irregularities.
- H. Ease sharp external corners prior to finishing.
- I. Cabinet doors between 4'-0" and 6'-0" in height will require 3 hinges per door. Doors above 6'-0" in height will require a minimum of 4 hinges per door. The width of any cabinet door shall never exceed its height.

2.7 ADJUSTMENTS, CLEANING, AND REPAIRING

- A. Adjust moving parts to operate satisfactorily at time of project Substantial Completion and during warranty period.
- B. Damage Adjustments: Repair damaged or defective work as directed. Touch up finish as required. Remove and refinish damaged areas of finish.
- C. Cleaning: Clean exposed and semi-exposed surfaces. Remove labels from exposed plastic laminate finish.
- D. Including work of other trades, clean, repair, and touch-up or replace, when directed, any products that have been soiled, discolored, or damaged by work of this Section.
- E. Leave surfaces ready for finishing specified in other Sections.
- F. Remove debris from project site upon work completion or sooner, if directed.
- G. Provide protective cover on counter tops until project acceptance.

ARCHITECTURAL WOOD CASEWORK

2.8 COLOR SCHEDULE

- A. Casework:
 - 1. Countertops, Splash, and Edge:
 - a. Plastic Laminate Color: Match Formica, Colorado Slate Matte Finish – 7014-58.
 - 2. Cabinets: Ash, plain sliced (flat cut).

END OF SECTION

WOOD PANELING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide interior wood veneer paneling as indicated on the Drawings and specified herein.
- B. Alternate No.1: If Alternate No. 1 is exercised by the Owner, delete wood paneling at West wall of Reading Room 143 where new casework is being added as indicated on Drawings.
- C. Alternate No. 2: If Alternate No. 2 is exercised by the Owner, provide wood paneling at ceiling of Reading Room 143 as indicated on Drawings and as specified herein.

1.2 REFERENCES

- A. Architectural Woodwork Quality Standards (AWS): Architectural Woodwork Standards, Guide Specifications and Quality Certification Program, Edition 1, adopted and published jointly by Architectural Woodwork Institute, Architectural Woodwork Manufacturers Association of Canada and The Woodwork Institute.
 - 1. Architectural Woodwork Institute: AWI Standards, Sections 100, 200, and 500.
- B. Hardwood Plywood and Veneer Association (HPVA): HPVA FE-86, Voluntary Standard for Formaldehyde Emission from Hardwood Plywood Wall Paneling, Wood Composition Board Wall Paneling and Industrial Panels Having Face Veneers.
- C. National Hardwood Lumber Association (NHLA).
- D. UL 723: Test for Surface Burning Characteristics of Building Materials
- E. U.S. Product Standard PS1 and Architectural Woodwork Quality Standard, latest editions.

1.3 QUALITY ASSURANCE

- A. Pre-Installation Conference: Meet with Owner's Project Manager and Architect prior to start of installation to review field conditions and mounting methods. Review hidden panel mounting systems manufacturer's installation instructions.

1.4 SUBMITTALS

- A. Product Data: Provide product data for composite wood products indicating the product is documented to have low formaldehyde emissions that meet the California Air Resources Board ACTM for formaldehyde requirements for ultra low emitting formaldehyde resins or no added formaldehyde resins.
- B. Shop Drawings: Submit full or half size profile sections of molding and trim items.
- C. Office Samples:
 - 1. Submit three 12" x 12" square samples of specie, grade, and pattern of veneer paneling mounted onto specified substrate. Architect will review for color and appearance only.
 - 2. One approved sample of each submittal will be used by painter for finish samples.

WOOD PANELING

PART 2 - PRODUCTS

2.1 WOOD PANELING MATERIALS

- A. Wood Paneling:
 - 1. Comply with AWS Section 4 veneer face grade description for Grade AA veneers.
 - 2. Provide thicknesses as indicated; if not indicated, provide minimum thicknesses required by AWS for Grade AA veneers.
 - 3. Wood veneer for clear finish:
 - a. Ash Veneer: AWS Premium AA face, plain sliced (flat cut) ash, narrow heart figure.
 - b. Minimum thickness 1/28-inch at 12% moisture content.
 - c. Manufactured from veneer leaves of equal width, book and balance match on the panel. Horizontal grain to be end, book, and butt matched.
 - 4. Panel Core:
 - a. Fire rated MDF, Class 1 fire rating, meeting UL standards for surface burning characteristics of building materials, UL 723, 45 lb. density Industrial Grade, 3/4-inch thick.
 - 1) Meet UL and ICBO Class 1 flame spread rating (25 or less).
 - b. Manufacturers: "Decospan" MDF (Fire-Resistant), or accepted substitute.
 - 5. Back: Hardwood back grade veneer of a similar species to balance face veneer.
 - 6. Edges: Provide solid ash edging as detailed on all four edges.
 - 7. Binders and glue to be formaldehyde free, no or low VOC.

2.2 ACCESSORIES

- A. Fasteners and Anchorages: Provide nails, screws, and other anchoring devices of type, size, material, and finish suitable for intended use and required to provide secure attachment; concealed where possible.
 - 1. Nails: Finish nails for all face nailing. Use nail size as required for material and in lengths necessary to penetrate solid framing.
 - 2. Screw Nails: Rockler metal piercing trim head square drive screws for all face nailing. Use screw nail size as required for material and in lengths necessary to penetrate solid framing.
 - 3. Adhesive: Marsh, Miracle Adhesive, 3M Co., or U.S. Plywood Weldwood.

2.3 FABRICATION

- A. Fabrication Standards: Comply with Sections 100, 200, 300, and 500 in AWI "Architectural Woodwork Quality Standards".
- B. Finishing: Sand exposed surfaces and edges.

PART 3 - EXECUTION

2.4 INSTALLATION

- A. Install milled wood plumb, level, true, and straight. Cut to fit. Scribe where required.

WOOD PANELING

- B. Wall Paneling:
 - 1. Perform all work with workmen experienced and skilled in the application of materials specified.
 - 2. Verify the surface over which paneling is to be applied and have unsatisfactory conditions corrected prior to installation.
 - 3. Maintain room temperature at minimum 70°F for at least 48 hours prior to the start of installation.
 - 4. Take field measurements and be responsible for fit of work. All work preassembled in as large units as practical to ship and install. Make ample allowance for cutting and fitting.
 - 5. Pre-plan layout and verify joint locations as detailed. Cut equal panel widths for corner or end wall installation with full panel widths between.
 - 6. Make all cuts with fine tooth saw and sand edges smooth as required for good appearance. Apply concealed panel clips level for level and plumb installation.
 - 8. Provide adequate ventilation and proper fire extinguishing equipment during installation.

2.5 ADJUSTING AND CLEANING

- A. Replace or patch and refinish wood improperly installed or wood that does not meet the quality standards specified.
- B. Clean all plastic laminate panels with approved adhesive solvent, dry, and polish surfaces with a clean cloth at completion of installation.
- C. Clean surfaces and sand exposed corners prior to field finishing.

END OF SECTION

WOOD TRIM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Base Bid: Provide interior finished solid wood standing and running trim as indicated on the Drawings and as specified herein.
 - 1. If Alternate No. 2 is exercised by the Owner, provide wood trim at new wood ceiling panels as indicated on Drawings.

1.2 REFERENCES

- A. Architectural Woodwork Institute (AWI): AWI Standards.
- B. American Woodwork Manufacturers Association of Canada (AWMAC).
- C. Architectural Woodwork Quality Standards (AWS): Architectural Woodwork Standards, Guide Specifications and Quality Certification Program, Edition 1, adopted and published jointly by Architectural Woodwork Institute, Architectural Woodwork Manufacturers Association of Canada and the Woodwork Institute.
- D. ASTM International (ASTM): ASTM A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- E. National Hardwood Lumber Association (NHLA).

1.3 SUBMITTALS

- A. Shop Drawings: Submit three full or half size profile sections of molding and trim items. Provide profile drawing of wood frames and frame corner connection details.
- B. Office Samples: Submit three 12" long samples of each wood species and cut of transparent finished wood.

1.4 QUALITY ASSURANCE

- A. Quality Grade: Unless otherwise specified, perform work and provide products in accordance with AWI/AWMAC/AWI Architectural Woodwork Standard (AWS), Premium Grade.
- B. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Single Source Responsibility: Provide and install this work from single fabricator.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection: Protect finish materials from dirt and moisture during delivery and while stored on the job. Store at site in a protected dry area with heat and ventilation as required to keep lumber dry. Do interior work only in areas where wet work has been completed and work area is dry, heated and ventilated.

WOOD TRIM

PART 2 - PRODUCTS

1.4 INTERIOR WOOD MATERIALS

- A. Hardwood Lumber: Comply with AWI "Quality Standard" for quality of materials, fabrication and with requirements indicated.
- B. Hardwood Finish Lumber, Trim, Base, and Molding: NHLA FAS (first and seconds) Ash, kiln dried.
 - 1. Moisture Content: Kiln dry finish lumber and molding to 15% maximum moisture content.
- C. Interior Wood Standing and Running Trim for Opaque Finish: Paint grade Birch, Poplar, or Hemlock fabricated to match existing patterns, sizes, and profiles. The use of pine is prohibited for any interior finish carpentry.

1.5 ACCESSORIES

- A. Fasteners and Anchorages: Provide nails, screws, and other anchoring devices of type, size, material, and finish suitable for intended use and required to provide secure attachment; concealed where possible. Stainless steel or hot-dip galvanized fasteners for work exposed to exterior and high humidities to comply with ASTM A153.
 - 1. Nails: Finish nails for all face nailing. Use nail size as required for material and in lengths necessary to penetrate solid framing.
 - 2. Screw Nails: Rockler metal piercing trim head square drive screws for all face nailing. Use screw nail size as required for material and in lengths necessary to penetrate solid framing.
 - 3. Adhesive: Marsh, Miracle Adhesive, 3M Co., or U.S. Plywood Weldwood.

PART 3 - EXECUTION

2.1 PREPARATION

- A. Deliver exterior wood to painting subcontractor for the application of shop applied pre-stain and backprime on all surfaces. Provide the delivery back to the job site after shop work is complete.

2.2 INSTALLATION

- A. General:
 - 1. Install work plumb, level, true, and straight with no distortions. Shim as required using concealed shims.
 - 2. Scribe and cut items to fit adjoining work.
 - 3. Anchor items securely to supports and substrates, using concealed fasteners and blind nailing where possible. Use fine finishing nails for exposed nailing except as indicated, countersink and fill flush with finished surface.
- B. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces from maximum length of lumber available. Cope at returns and miter at corners to produce tight fitting joints. Use scarf joints for end-to-end joints. Wood trim fasteners shall be staggered at 12" on center.
- C. Millwork and trim shall have a radius or be finished in a way that eliminates sharp edges. The use of finger jointed material requires the approval of the Owner's Project Manager.

WOOD TRIM

- D. Cutting, Fitting and Jointing: Install standing and running trim and boards in one-piece continuous lengths wherever practical with no spliced piece less than 6-feet long. Scarf end splices and make inconspicuous, with end grains matched if work is transparent finished. Miter outside intersecting corners of trim and molding, cope inside corners. Miter and return at exposed ends of trim to conceal end grain.
- E. Nailing: Set fastener heads and fill with wood putty.
- F. Workmanship: Work to AWS Custom Grade standards throughout. Finish sand all work and leave smooth and dirt free, without blemishes visible through finishes as scheduled. Remove and replace or resurface all work showing hammer marks, splits, tool marks, torn grain, and other appearance of defective workmanship as directed by Architect.

END OF SECTION

METAL DOORS AND FRAMES

1.1 WORK INCLUDED

- A. Provide hollow metal door and hollow metal door frame at locations indicated on the Drawings and as specified herein.

1.2 REFERENCES

- A. American National Standards Institute, Inc.: ANSI A115, Frames.
- B. ASTM International (ASTM):
 - 1. ASTM A1008: Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - 2. ASTM A653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM A1011: Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- C. Factory Mutual.
- D. Hollow Metal Manufacturers Association (HMMA), a Division of the National Association of Architectural Metal Manufacturers (NAAMM): HMMA 861, Guide Specifications for Commercial Hollow Metal Doors and Frames.
- E. International Conference of Building Officials (ICBO).
- F. Steel Door Institute (SDI): SDI 100-91, Recommended Specification, Standard Steel Doors and Frames.

1.3 SUBMITTALS

- A. Shop Drawings: Submit shop drawings of all hollow metal frames. Include details showing the construction of the door vision frames.
- B. Product Data:
 - 1. Submit product information on door and relight frames. Show frame fabrication and details of glazing of relite frames. Provide product information on factory finish and hardware preparation.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver to job in time for building into walls and partitions and protect from weather and construction damage. Replace dented and bent hollow metal work with new undamaged work as directed. Filled dents and straightened work are not acceptable.

1.5 WARRANTY

- A. Provide 10 year warranty on door and relight frames.

METAL DOORS AND FRAMES

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The American Welding and Manufacturing Co. (Amweld).
- B. The Ceco Corporation.
- C. Curries.
- D. Mesker Door, Inc.
- E. NCS Manufacturing.
- F. Republic Builders Products Corporation.
- G. Stiles Custom Metal, Inc.
- H. Steelcraft, American-Standard.
- I. Or accepted substitute.

2.2 MATERIALS

- A. Door Face Sheets: Commercial quality, level, cold- rolled steel conforming to ASTM A1008 or hot-rolled, pickled and oiled steel conforming to ASTM A1011. Provide steel free of scale, pitting, coil breaks, buckles, waves, or other surface blemishes. Provide steel free of defects caused by the use of improperly leveled sheets.
 - 1. Interior Door Face Sheets: 16-gage minimum thickness, having a zinc coating applied by the hot-dip process conforming to ASTM A653 (A60 or G60) with a coating weight of not less than 0.60 ounces per square foot (0.30 ounces per square foot per side).
- B. Frame Steel: Commercial quality, cold-rolled steel conforming to ASTM A1008 or hot rolled, pickled, and oiled steel conforming to ASTM A1011. Provide steel free of scale, pitting, coil breaks, or other surface defects.
 - 1. Interior Frames: Provide zinc coating applied by the hot-dip process conforming to ASTM A653 (A60 or G60) with a coating weight of not less than 0.60 ounces per square foot (0.30 ounces per square foot per side).
 - 2. Interior frames at Openings 3’-6” Feet or Less: 16-gage minimum thickness.
 - 3. Interior frames at Openings Greater Than 3’-6” Feet: 14-gage minimum thickness.

2.3 INTERIOR DOOR FABRICATION DATA

- A. Fabrication Data: Standard: HMMA 861.
- B. Thickness: 1-3/4".

METAL DOORS AND FRAMES

- C. Stiffen doors with continuous vertically formed steel sections spanning the full thickness of the interior space between the door faces.
 - 1. Interior Doors: A honeycomb core shall be laminated to the inside of both face panels with an adhesive. The honeycomb material shall have a crushing strength of not less than 4000-psf and the lamination shall withstand not less than 1100-psf in shear.
 - 2. Interior doors shall have a continuous welded hollow metal frame grouted in place or must be framed in wood with two king studs and a trimmer on each side.
- D. Edge Treatment: Join door face sheets at their vertical edges by a continuous weld extending the full height of the door, with no visible seams on their faces or vertical edges.
- E. Close top and bottom edges with a continuous channel not less than 16-gage thickness, spot welded to both face sheets. Treatment can be either flush or inverted.
- F. Edge Profiles on Both Vertical Edges of Doors:
 - 1. Single Acting Doors: Beveled 1/8" in 2" profile.
- G. Finish: Manufacturer's standard prime finish.
- H. Provide integral frame, spot-welded to the door faces and flush with the door faces. Provide with removable stop on interior side of door. Exterior glazing stop shall be nonremovable. All seams filled and bonded. Provide watertight construction at exterior doors.

2.4 **FRAME FABRICATION**

- A. Standard Interior Door Frames and Relight Frames:
 - 1. 2" face, height and width as indicated on the Drawings with 5/8" high integral stop. Continuously weld faces and soffits with the faces finished smooth and free of any visible seam. Continuously weld and finish smooth all other face joints. Provide surface applied glass stops with surface fasteners as detailed at relites.
- B. Anchors: Provide frames with minimum 18 gage anchor for attachment to floor. For wall conditions that do not allow the use of a floor anchor, an additional jamb anchor shall be provided. Provide frames with a minimum of three anchors per jamb as required for the adjoining wall construction. Provide anchors of not less than 18 gage steel or 7 gage diameter wire.
- C. At frames in masonry wall openings wider than 4 feet, provide an angle or channel stiffener factory welded into the head when the head is grouted. Provide 12-gage minimum thick stiffener and not longer than opening width.

2.5 **HARDWARE PREPARATION**

- A. General:
 - 1. Prepare doors and frames to receive finish hardware, including cutouts, reinforcing, drilling, and tapping for mortised hardware, complying with ANSI A115.
 - 2. Provide manufacturer's standard reinforcing complying with these Specifications at hinge pockets, lockset, latchset openings, and closers.
 - 3. Prepare single door frames to receive 3 silencers on strike jambs and double door frames to receive 2 or 4 silencers on head.

METAL DOORS AND FRAMES

- B. Doors and Frames:
 - 1. Mortise, reinforce, drill, and tap doors and frames at the factory for completely templated mortised hardware in accordance with final accepted hardware schedule and templates provided by the hardware supplier.
 - 2. Reinforce doors and frames where surface mounted, anchor hinges, or non-templated mortise hardware are to be applied.
 - 3. Minimum Gages for Door Hardware Reinforcement:
 - a. Full Mortise Hinges and Pivots: 7-gage.
 - b. Reinforcement for Lock Fronts, Concealed Holders, Surface Mounted Closers: 12-gage.
 - c. Internal Reinforcements for All Other Surface Applied Hardware: 14-gage.
 - 4. Minimum Gages for Frame Hardware Reinforcing Plates:
 - a. Hinge and Pivot Reinforcements: 7-gage x 1-1/4" x 10" in length.
 - b. Strike Reinforcements: 12-gage.
 - c. Closer Reinforcements: 12-gage.
 - d. Flush Bolt Reinforcements: 12-gage.
 - e. Reinforcements for Surface Applied Hardware: 12-gage.
 - f. Reinforcements for Hold Open Arms: 12-gage.

2.6 FINISHING

- A. Shop prime frame surfaces, using manufacturer's standard rust-inhibitive primer. Doors and frames are to be thoroughly cleaned and chemically treated to insure maximum paint adhesion. All surfaces of the door and frame exposed to view shall receive a factory applied coat of rust inhibiting primer, either air dried or baked on. The finish shall meet the requirements for acceptance stated in ANSI A224.1. "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces." The prime finish is not intended to be the final layer of protection from the outside elements. Field painting shall be performed in accordance with the recommendations of the door and frame manufacturer.
- B. Coat inside faces of door frames with approved sound deadening material.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install steel door frames in accordance with the manufacturer's instructions and HMMA 861. Anchor frames to wall as recommended by the manufacturer. Secure door frames to floor with 2 fasteners at each jamb.
- B. Seal opening between door frames and exterior walls with sealants as indicated on the Drawings and as specified in Section 07 92 00, Joint Sealants.
- C. Doors must be installed plumb, level and square. Assist as necessary to insure that the door operates without binding, tightness, or stickiness from finish hardware installation.
- D. Fit doors to frame providing clearances as specified in HMMA 861. The nominal clearance between the door and frame head and jambs shall be 1/8" in the case of both single swing and pairs of doors. The nominal clearance at the bottom shall be 1/4". The nominal clearance between the face of the door and door stop shall be 1/16".

METAL DOORS AND FRAMES

3.2 ADJUSTING AND CLEANING

- A. Adjust door clearances and hardware placement to allow for smooth operation.
- B. Clean frame surfaces and touch up scratched prime and factory finished paint.
- C. Seal openings between frame and wall as directed.

END OF SECTION

STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide stile and rail wood doors as shown on the Drawings, finished and machined for hardware, and as herein specified.

1.2 REFERENCES

- A. Comply with the following publications as a minimum standard:
 - 1. National Wood Window and Door Association (NWWDA).
 - 2. Woodwork Institute of California (W.I.C.)
 - 3. Architectural Woodwork Institute (AWI) Quality Standards:
 - a. Section 1400, Stile and Rail Doors.
 - b. Section 1500, Factory Finish.

1.3 SUBMITTALS

- A. Shop Drawings: Submit shop drawings showing location, handing, size, frame material, and elevations.
- B. Samples:
 - 1. Submit, for the Architect's acceptance, 3 random samples of proposed veneers, showing natural color and grain appearance.
 - 2. For factory finished doors, submit, for the Architect's acceptance, 3 samples of proposed finish on veneers to be used, showing natural color and grain appearance.
- C. Product Literature: Submit manufacturer's product literature. Include copies of "How to Store, Handle, Finish, Install, and Maintain Wood Doors" pamphlet issued by the National Woodwork Manufacturers' Association.
- D. Certification: Submit manufacturer's written certification stating that:
 - 1. Doors meet or exceed the requirements specified herein.
 - 2. Specified shop finishing has been performed.

1.4 QUALITY ASSURANCE

- A. All materials and workmanship shall conform with Architectural Woodwork Institute (AWI) Premium Quality Standards in selection and grading as specified.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver doors until the building and storage areas are sufficiently dry so doors will not be damaged by excessive changes in ambient humidity and relative moisture content.
- B. All doors leaving the manufacturer's mill shall be evenly spaced on pallets and be clearly marked with customer name, order number, salesperson, and date.
- C. Mixed orders with varying door sizes shall be palletized by the manufacturing mill with the largest door on the bottom, and the smallest door on the top whenever possible.
- D. Provide protection during transit and job storage. Manufacturing mill shall provide foam slip sheets between every door to avoid slippage and scratching, with the top of the load covered with cardboard.

STILE AND RAIL WOOD DOORS

- E. If doors are shipped via common carrier, the doors shall be securely crated and banded in a crate designed to facilitate forklift handling. Individual doors shall be polywrapped prior to packaging to prevent moisture absorption while in route to the Site.
- F. Stack doors flat, never lean against support at an angle, and never store directly on concrete.
- G. Handle doors carefully using proper care to avoid impact, debris, and/or chemical contact from materials of other trades.
- H. Provide adequate ventilation to allow doors to adjust to temperature and humidity of jobsite for at least 7 days.
- I. Handle with gloves to avoid fingerprints. Always pick doors up individually, taking care not to slide doors against each other.

1.6 WARRANTY

- A. Provide products adhering to manufacturer's standard warranty.
- B. Provide lifetime warranty for interior doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Woodtech, Inc.
 - 2. Or accepted substitute.

2.2 DOOR MATERIALS

- A. Stiles and Rails: 1-3/4" thick stiles and rails. Veneered, AWS Premium Grade (Grade AA) plain sliced (flat cut), center and book matched select Ash with closed-grain hardwood edges.
- B. Moldings and Sticking: Manufacturer's standard design or as shown on the Drawings. Miter all corners and install using nails, staples, or glue. Hardwood molding required for labeled doors.
- C. Cores (For Stiles and Rails): Laminated material and fingerjointed Douglas Fir or denser material with a pre-glue moisture content between 6% and 8%. The pieces shall be free of any warp or bow, and calibrated to a 0.003" tolerance prior to veneer application.
- D. Veneers: Free of knots, check, sap, or mineral deposits with a pre-glue moisture content of not greater than 8% and not less than 6%.
 - 1. Species: Ash.
 - 2. Veneer Thickness: As specified pre-assembly calibration.
- E. Bands: Same species and coloring of the face veneer unless otherwise specified. Bands to be free of defects with a pre-glue moisture content between 6% and 8%. Not less than 1/2" band thickness after final milling of part.
- F. Gluing: Type 1 exterior glue at all glue related phases of construction; cold pressing of parts, doweling, and assembly. Minimum press time for parts shall be not less than 4 hours, while minimum time under pressure at assembly shall not be less than 5 minutes.

STILE AND RAIL WOOD DOORS

2.3 FABRICATION AND CONSTRUCTION OF DOORS

- A. Provide doors and frames in style, size, pattern, and profile as indicated on the Drawings.
- B. Defects: All parts shall be inspected, prior to machining, for structural defects or aesthetic damage caused by handling. Parts with defects shall not be used in the construction of the doors.
- C. Milling Tolerances: Machine parts to the following tolerances:
 - 1. 0.007" gap x 15% of joint length where any rail and stile meet.
 - 2. 0.007" x 3" gap where any panel profile fits into sticking, or molding is applied over tongue and groove construction.
- D. Sanding: Finish sand all doors to flush out joints and clean up any marks or scuffing incurred during handling. A 0% tolerance for flushness variation (the alignment of 2 similar shaped surfaces) is required in the final products.
- E. Sanding Grit Sequences at Final Sanding:
 - 1. Premium Grade: 80, 120, 150, 180 with no cross scratches permitted.
 - 2. Custom Grade: 80, 120, 150 with cross scratches not exceeding 1/4" permitted.
- F. Squareness: All 4 corners of the door shall be square (right angles). The length of the diagonal measurement from top left to bottom right corner shall not exceed 3/32" from the opposing corner's measurements.
- G. Warp: Not to exceed 1/4" in any 3'-0" width by 7'-0" length of door.

2.4 FACTORY FINISH

- A. Use AWS System 3 finish.
- B. Finish shall be water-base, meeting California Air Quality Standards and a minimum 1994 VOC Standard.
- C. Color and Appearance: To match existing doors as directed and accepted by the Architect.

2.5 FIELD FINISHING

- A. Field Finishing: Transparent finish; see Section 09 91 00, Painting.
- B. Provide door manufacturer's written field finishing recommendations to the Contractor for field finisher's reference

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect and verify that all frames are in proper condition to receive the work of this Section. Solidly anchor all frames allowing no deflection when doors are hung.
- B. Correct all openings found to be inadequate prior to hanging of doors.
- C. Use experienced, qualified craftsmen to hang doors.

STILE AND RAIL WOOD DOORS

3.2 PREPARATION

- A. Condition doors to average prevailing humidity in installation area prior to hanging.
- B. Allow sealing of jobsite cut surfaces under Section 09 91 00, Painting, before final hanging of doors.

3.3 INSTALLATION

- A. **Factory Machining For Door Hardware:** Completely machine doors at the factory for all hardware. Accurately locate hardware on doors by dimension, jig, and template. Carefully rout or bore all mortises to recess hardware. Predrill all screw fastening device holes. In addition, cut hinge mortises with not over 1/32" clearance in height and width. Install hardware perfectly fitted and in proper operation and adjustment. No through bolting will be allowed for hardware attachment.
- B. Hang doors in accordance with the manufacturer's recommendations.
 - 1. Fit doors to frame for proper fit and uniform clearance at each edge, and machine for hardware.
 - 2. Fit doors for width by planing; for height by sawing.
 - 3. Clearances:
 - a. Allow maximum of 1/8" at jamb and head.
 - b. Allow maximum of 3/16" over threshold or saddle.
 - c. Allow 3/8" over decorative floor coverings at openings without saddles and thresholds or as indicated.
 - d. Bevel lock and hinge stile edges 1/8" in 2" to operate without binding.
 - e. Undercut when specially noted on the Drawings or Schedule.
 - f. Back cut edges of doors for smoke gaskets.
 - g. Fit for other clearances when required by special details, hardware, or floor coverings.

3.4 ADJUST AND CLEAN

- A. Replace or rehang doors that do not swing or operate freely.
- B. Refinish or replace doors damaged during installation.

END OF SECTION

DOOR HARDWARE

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide finish hardware for doors as scheduled on the Drawings and as specified herein.

1.2 REFERENCES

- A. Americans with Disabilities Act (ADA): ADA Accessibility Guidelines for Buildings and Facilities (ADAAG).

1.3 SUBMITTALS

- A. Hardware Schedule: Submit 5 copies of the final hardware schedule. Comply with construction progress schedule requirements.
- B. Samples:
 - 1. Furnish only upon request and prior to submittal of the last draft of the hardware schedule and prior to delivery of hardware.
 - 2. Submit 1 sample of each exposed hardware unit, finished as required, and tagged with full description for coordination with the schedule.
 - 3. Samples will be returned to the supplier. Units that are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be used in the work.
- C. Templates: Furnish hardware templates and copy of approved hardware schedule to each fabricator of doors and frames within 2 weeks after approval of hardware schedule.

1.4 QUALITY ASSURANCE

- A. Manufacturer: To the greatest extent possible, obtain each type of hardware from only 1 manufacturer.
- B. Supplier: Provide hardware supplier who has furnished hardware in the same market area as the project for a period of not less than 2 years, and who has in his employment an experienced hardware consultant who is available for project hardware consultation to the Owner, Architect, and Contractor.
- C. ADA Compliance:
 - 1. Interior Doors: All interior doors are required to meet ADAAG requirement that the force for pushing or pulling open interior swinging egress doors, other than fire doors, shall not exceed 5-pounds. Any interior swinging egress door not meeting this requirement will not be allowed.
 - 2. Exterior Doors: The maximum opening force allowed is to not exceed 8-1/2-pounds.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide secure lock up for hardware delivered to the project, but not yet installed.
- B. Control the handling and installation of hardware items that are not immediately replaceable, so that the completion of the work will not be delayed by hardware losses, both before and after installation.
- C. Coordinate the delivery of hardware with the scheduled installation and fabrication of doors and frames.

DOOR HARDWARE

- D. Tag each item or package separately, with identification related to the final hardware schedule. Include basic installation instructions in the package.
- E. Deliver individually packaged hardware items at the times and to the shop or field for installation, as directed by the Contractor.
- F. Key Delivery:
 - 1. Place sets of change keys in suitable individual envelopes tagged and plainly marked with the change number or symbol, door designation and all other identifying information as required. Assemble change key envelopes into 1 package and deliver to the Owner.
 - 2. Forward masterkeys by registered mail. See Section 01 70 00, Execution and Closeout Requirements.
 - 3. Place construction masterkeys in 1 envelope, clearly identified and deliver with the hardware.

1.6 WARRANTY

- A. Provide the following warranties:
 - 1. Extra Heavy Duty Cylindrical and Mortise Locksets: 10 year warranty.
 - 2. Heavy and Standard Duty Cylindrical Locksets: 10 year warranty.
 - 3. Surface Closers:
 - a. Hydraulic Closers: 30 year factory guarantee.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Finish Hardware Manufacturers:
 - 1. Hinges: Ives, or accepted substitute.
 - 2. Auto Flush Bolt: Ives.
 - 3. Dust Proof Strike: Ives.
 - 4. Storeroom Locks: Schlage Locks.
 - 5. Cylinders: Medeco.
 - 6. Coordinators: Ives.
 - 7. Surface Closers: LCN.
 - 8. Cush Shoe Support: LCN.
 - 9. Kick Plates: Ives.
 - 10. Wall Stops: Ives, or accepted substitute.
 - 11. Gasketing: Zero International.
- B. Door hardware finish to be Satin Chrome US26D unless the existing finish is otherwise.

2.2 MATERIALS

- A. Fasteners:
 - 1. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws to match the hardware finish, or if exposed in surfaces of other work, to match the finish of such other work.
 - 2. Provide concealed fasteners for hardware units which are exposed when the door is closed whenever possible.
 - 4. Do not use through bolts where the bolt head or nut on the opposite face is exposed. Where it is not possible to adequately reinforce the work, use machine screws or concealed fasteners with flush heads.

DOOR HARDWARE

5. Provide fasteners that are compatible with both the unit fastened and the substrate.
- B. Hand of Door: The drawings show the swing or hand of each door leaf (left, right and reverse bevel). Furnish each item of hardware for proper installation and operation of the door swing as indicated.
- C. Hardware Finishes: Provide finish as scheduled at the end of this Section in the Hardware Schedule.
- D. Hinges (Butts):
 1. Provide full mortise butts in exact width required to clear projection of trim.
 2. Provide butts with flat tips and retainer device to prevent rising during use.
 3. Provide butts for exterior out-swinging doors and where noted with non-removable pins.
- E. Lock Sets:
 1. Design: ND Series, as scheduled.
 2. Strikes: Provide locks and latches with curved lip wrought box strikes in matching metal and finish.
 3. Furnish with anti-friction latchbolts.
- F. Surface Door Closers:
 1. Type: Liquid-controlled, all weather fluid.
 3. 10 year factory guarantee of satisfactory performance on all hydraulic closers. 2 year warranty on all electrified closers.
 4. Provide closers that permit the door to open as far as construction conditions permit and do not limit the door swing.
 5. Provide closers with key-type regulating screws.
 6. Closers to have independent closing, latch and backcheck valves and adjustable spring power.
 7. Door closers to be external not internal.
- G. Kickplates: Provide 10" high (unless scheduled otherwise) kickplates at all designated doors. Finish as scheduled. Provide with all edges beveled.
- H. Automatic Flush Bolts:
 1. Provide bolts that retract without manual actuation. Provide bolts with minimum throw or 3/4" and override feature to prevent damage to door or bolts.
 2. Provide bolts with UL label and dustproof strikes with suitable floor attachment screws and bolts.
- I. Door Silencers: Provide 3 silencers for single acting single doors and 4 silencers for single acting pairs of doors in steel frames.

2.3 KEYING AND KEY CONTROL SYSTEM

- A. Provide locks and cylinders with masterkeying, grand masterkeying, and construction masterkeying, using a 6 pin system, removable core cylinders. Key to existing master key system.
- B. Upon receipt of approved hardware schedules, hardware supplier shall request Architect to arrange a keying meeting between hardware supplier and the Owner. Submit a detailed keying schedule in triplicate for final approval prior to ordering locks and cylinders.
- C. Keys: Provide nickel silver keys in the following quantities:
 1. Change Keys: 3 keys each lock or cylinder.
 3. Construction Masterkeys: 2 keys.

DOOR HARDWARE

- D. Stamp Keys: "Do Not Duplicate."
- E. Locksets to be provided with keying capability to accommodate great grand master key, grand master key and master key. Provide locksets with removable cores for construction period and provide ten construction keys per building for the construction period. Installation of final post construction keying to be done by Owner. Constructor to provide Door Schedule submittal referencing room numbers with associated key numbers to be used for final keying. Provide two construction removable keys.

PART 3 - EXECUTION

3.1 HARDWARE MOUNTING HEIGHTS

- A. Where hardware mounting heights are not indicated in other Sections of this specification, use the following heights as a guide:
 - 1. Top Hinges: 5" header rabbet to top of hinge.
 - 2. Bottom Hinge: 10" finish floor to bottom of hinge.
 - 3. Center Hinge: Equal distance between top and bottom hinges.
 - 4. Locksets/Latchsets: 40" finish floor to center of knob.
 - 5. Deadlocks/Deadlatches: 60" finish floor to center of cylinder.
 - 6. Push Plates: 45" finish floor to center of plate.
 - 7. Door Pulls: 42" finish floor to center of pull.
 - 8. Other Hardware: Install in heights recommended by the manufacturers.

3.2 INSTALLATION

- A. Installation on Field Finished Surfaces:
 - 1. Wherever cutting and fitting is required to install hardware on field finished surfaces, install hardware and then remove and store hardware in a secure place during application of field finish.
 - 3. After completion of the field finish, reinstall hardware.
 - 4. Do not install surface-mounted items until field finishes have been completed.
- B. Install kickplates with oval-head full-thread screws spaced uniformly at a maximum of 5" on center along kickplate perimeter.
- C. Install extruded aluminum thresholds with a clear anodized finish and a positive anchoring device or lead expansion shield and anchor bolts. Set in full bed of sealant.
- D. Provide backing and blocking in walls where door stops or door holds are attached.
- E. On all exterior doors, standards or bollards must be mounted at a maximum of 100 degrees and if applicable, no less than 3" inboard of the foundation pad or sidewalk edge.
- F. Double doors must be used at exterior entries to goods receiving areas, gyms, cafeterias, loading docks and kitchen areas. Provide these doors with removable and lockable center mullion. Door coordinators, astragals, vertical rods and automatic flush bolts are not permitted.

3.3 ADJUSTING AND CLEANING

- A. Check and adjust operating hardware and each door operation to ensure proper operation. Lubricate moving parts with type of lubrication recommended by the manufacturer. Use silicone type if no other recommended.

DOOR HARDWARE

- B. Verify that the doors have been installed plumb, level, and square, without binding, tightness, or stickiness from gaskets. The door must have smoothly operating door bottom seals and hinges. Door latching including fire and security hardware must operate smoothly without sticking. Adjust, repair, or replace any hardware that does not meet all of these requirements.
- C. Replace hardware that cannot be adjusted and lubricated to operate freely and smoothly as intended.
- D. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- E. Where hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make a final check and adjustment of all hardware and doors.

3.4 HARDWARE SCHEDULE

- A. Furnish the following hardware groups for each door as indicated on the Door Schedule, and as required for a complete project:

HW SET: 08

FOR USE ON DOOR(S):

143B

EACH OPENING TO HAVE:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	SURFACE CLOSER	4011 H TBWMS	689	LCN
1	EA	WALL STOP	WS406/407CVX	630	IVE
BALANCE OF EXISTING HARDWARE TO REMAIN					

HW SET: 09

FOR USE ON DOOR(S):

143C

EACH OPENING TO HAVE:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	ND80LD ATH	626	SCH
1	EA	CYLINDER	CYLINDER-PURCHASE FROM OREGON LOCK	626	MED
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	SURFACE CLOSER	4011 H TBWMS	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

DOOR HARDWARE

LISTED MANUFACTURERS SYMBOL IDENTIFICATION

IVE	IVES
LCN	LCN CLOSERS
MED	MEDECO
SCH	SCHLAGE LOCK
ZER	ZERO INTERNATIONAL

END OF SECTION

GLASS GLAZING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide glass and glazing sealant systems as indicated on the Drawings and as specified herein. Provide at:
 - 1. Interior doors.
- B. Examine glass requirements of this project and furnish and install all glass in accordance with the requirements of the Building Code and the US Consumer Product Safety Commission.
- C. Provide all clips, glazier's points, blocks, felt, and other items required to set all glass throughout the building.

1.2 REFERENCES

- A. American National Standards Institute (ANSI).
- B. ASTM International (ASTM):
 - 1. ASTM C1036, Flat Glass.
 - 2. ASTM C1376, Sputter Coated Glass.
 - 3. ASTM C1048, Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.
 - 5. ASTM E2190, Sealed Insulating Glass Units.
- C. Glass Association of North America (GANA), (formerly FGMA) Glazing Manual, Installation Recommendations.
- D. U.S. Consumer Product Safety Commission Standard: 16 CFR 1201, Safety Standard
- E. American National Standards Institute: ANSI Z 97.1, Safety Glazing.

1.3 DEFINITIONS

- A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by traditional thickness designations according to ASTM C1036.
- C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

GLASS GLAZING

- B. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS

- A. Submit the following in accordance with Division 1 Section "Submittal Procedures."
- B. Product Data: For each glass product and glazing material indicated.
- D. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- E. Product Certificates:
 - 1. Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- F. Qualification Data: For installers.
- G. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.
 - 1. Product Test Reports: For each of the following types of glazing products:
 - c. Glazing sealants.
 - d. Glazing gaskets.
- I. Glass warranties and guarantees.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, coated float glass, and insulating glass.
- C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- D. Glass Product Testing:
 - 1. Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
 - 2. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated.

GLASS GLAZING

- E. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
 - 1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
 - 2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
- F. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:
 - 1. Testing will not be required if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, glazing materials matching those submitted.
 - 2. Use ASTM C1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
- H. Safety Glazing Products: Comply with certification requirements in Consumer Product Safety Commission 16 CFR 1201.
 - 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
 - 2. Where glazing units, including ASTM C1038 Kind FT glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.
- I. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. IGMA Publication for Insulating Glass: IGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

GLASS GLAZING

1.8 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
2. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.9 WARRANTY

- A.** In addition to the glass manufacturer's warranty, include a guarantee for replacement and reglazing of units that become defective during a two year warranty period, at no cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A.** Basis-of-Design Product: The design for each glazing product is based on the product named. Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. Viracon, Inc.
 2. PPG Industries.
 3. Guardian Glass.
 4. Old Castle Glass.
 5. Cardinal Glass.
- B.** Other Products: Manufacturers are listed in Paragraph 2.2.
- C.** Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

- A.** General: Glass thicknesses specified are minimum required.
- B.** Glass Standards:
1. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
 2. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
- C.** Accessories: Furnish all clips, blocks, felt, and other items required to set all glass throughout the building.
- D.** Glazing Tape, Sealants:
1. Glazing Tape:
 - a. Color: Black.
 - b. Manufacturers: Norton "Norseal."

GLASS GLAZING

- 2. Structural Glazing Silicone Sealants:
 - a. One-part silicone at glass-to-glass and glass-to-aluminum, as tested for compatibility and engineered for expected joint movement.
 - b. Color: Black.
 - c. Manufacturers:
 - 1) Dow Corning.
 - 2) Momentive (formerly General Electric).
 - 3) Tremco.
- E. Elastic Glazing Compound:
 - 1. Sealant, metal sash types.
 - 2. Manufacturers: Dow "Insta Glaze."
- G. Clear Float Glass (CG): 1/4-inch minimum thickness clear float glass, glazing quality.
- H. Clear Tempered Glass (CTG): 1/4-inch minimum thickness, ASTM C1048 Kind FT (fully tempered) clear float glass, tempered after cutting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Maintain original labels on each piece of glass, naming manufacturer, quantity and thickness. Deliver other glazing material in original containers with original manufacturer's labels attached. Remove labels as soon as possible after installation.

GLASS GLAZING

- C. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- D. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- E. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- F. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

3.5 INTERIOR GLAZING

- A. Set glass using elastic glazing compound; apply ample compound in rabbet to bed entire perimeter of glass and place necessary setting blocks; press glass, centered, into rabbet.

GLASS GLAZING

- B. For lites held in place by stop beads all around, bed beads against glass and bottom of rabbet with compound.
- C. Secure bead with countersunk fasteners. Strip surplus compound from both sides of glass at an angle; do not undercut.

3.6 CLEANING

- A. Clean and remove all stains and excess glazing compound and sealants from glass, sash, and adjoining surfaces. Washing of glass is specified in Division One.

3.7 PROTECTION

- A. Protect all glazing from breakage. Re-glaze wherever work or material are defective. Replace all glazing damaged prior to Substantial Completion.
- B. Do not apply paint or attach temporary signs or festoons directly to glass faces.

3.8 SCHEDULE

- A. Vision Panels at Interior Doors: ¼" thick, clear safety glass (CTG).
 - 1. See Door Types on Drawings for locations.

END OF SECTION

GYPSUM BOARD

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide gypsum drywall partitions, ceilings and soffits on wood framing and wood furring. Include backing for applied finishes and installation of acoustical insulation as scheduled on the Drawings.
- B. Provide coordination with the electrical subcontractor and provide fire rated enclosures over recessed electrical fixtures in gypsum board ceilings. Each enclosure is to have one 2" vent hole cut in the top. The cost of the enclosures is to be included in the gypsum drywall subcontractor's bid price.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM A641: Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - 2. ASTM C475: Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - 3. ASTM C557: Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
 - 4. ASTM C645: Standard Specification for Nonstructural Steel Framing Members.
 - 5. ASTM C754: Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel.
 - 6. ASTM C840: Standard Specification for Application and Finishing of Gypsum Board.
 - 7. ASTM C919: Standard Practice For Use of Sealants in Acoustical Applications.
 - 8. ASTM C1396: Standard Specification for Gypsum Board.
 - 9. ASTM E119: Standard Test Methods for Fire Tests of Building Construction and Materials.
- B. Gypsum Association:
 - 1. GA-214: Recommended Levels of Gypsum Board Finish.
 - 2. GA-216: Application and Finishing of Gypsum Panel Products.

1.3 SYSTEM DESCRIPTION

- A. Structural Requirements:
 - 1. Steel Framing Systems: Maximum deflection of L/240 for design loads.
 - 2. Steel Ceiling Suspension Systems: Maximum deflection of L/360 for design loads.
 - 3. Seismic Loads: Provide steel bracing members to carry loads created by seismic movement of the ceiling systems.
- B. System Tolerances: Do not exceed 1/4" variation in 8'-0" from plumb, level and true lines.

1.4 SUBMITTALS

- A. Product Data: Submit the manufacturer's specifications and installation instructions for each gypsum drywall product component, including other data as may be required to show compliance with these specifications.
- B. Submit wall and ceiling texture sample on 24" x 24" gypsum board materials properly prepared to match specified wall finishing or on 10 square feet of prepared wall surface for the Architect's review. Acceptable texturing may be retained as finish surface. Remove all texturing that is not approved prior to drying on the wall surface. Texturing to be applied by the technician scheduled to do the texturing.

GYPSUM BOARD

- C. Submit product preparation instructions and recommendations, storage and handling requirements and installation methods.

1.5 QUALITY ASSURANCE

- A. Regulatory Agency Requirements:
 - 1. Comply with building code and governing authorities requirements for fire-rated partitions and ceilings.
 - 2. Provide materials, accessories and use application procedures that have been listed and approved by UL, ICC, and tested in accordance with ASTM E119 for the type of construction scheduled. When requested, provide UL design numbers for fire-rated wall and ceiling assemblies.
- B. Field Samples: Provide 100 square foot minimum of in-place wall and ceiling joint and fastener treatment for the Architect's review prior to the joint finishing of gypsum board surfaces. The Architect will review smoothness and hiding of board joints and fasteners only. Acceptable samples may be incorporated in the work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate the delivery of materials with the installation to minimize storage periods. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store gypsum and steel materials in dry, ventilated space, under cover protected from weather, direct sunlight, and above grade floor slabs. Neatly stack gypsum boards flat to prevent sagging.
- C. Protect structural members from excessive stress during delivery and erection.
- D. Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal corner beads and trim from being bent or damaged.

1.7 SITE CONDITIONS

- A. Temperature Requirements: Do not begin installing gypsum board until building is enclosed or ambient temperature remains above 55°F.
- B. Cold Weather Protection: When ambient outdoor temperatures are below 55°F, maintain continuous, uniform, comfortable building working temperatures of not less than 55°F for a minimum period of 48 hours prior to, during, and following application of gypsum board and joint treatment materials or bonding of adhesives.
- C. Ventilation: Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent too rapid drying.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Obtain all components and materials of the gypsum drywall system from a single manufacturer, or from producers recommended by the manufacturer, unless otherwise indicated.

GYPSUM BOARD

2.2 WALL FRAMING MATERIALS

- A. Wood Studs: Specified in Section 06 11 00 WOOD FRAMING.
- B. Metal Framing: As indicated on Drawings. See "Cold Formed Metal Framing" on Structural Notes on Drawings
- C. Screw Furring Channels: ASTM C645, roll-formed, hat shaped, 25-gage hot dipped galvanized steel, knurled face, 1-3/8" wide by 7/8" deep with hemmed legs.
- D. Resilient Furring Channels: Roll-formed, single leg z-shaped, 25-gage zinc-coated steel with knurled face, 2-3/4" wide by 1/2" in depth.
- E. Steel Cold Rolled Channels: ASTM C754, 3/4" and 1-1/2" wide, 16 gage galvanized or black painted steel.
- F. Fasteners: Screws and powder actuated fasteners as recommended by manufacturer and ASTM C754 for application required. Type "G" and Type "S", bugle head, in required length and to suit requirement of application to 25-gage metal studs or wood studs. Type "S-12" in required length for attachment to heavier gage metal framing. Nails will not be allowed for attachment to wood studs.

2.3 CEILING SUSPENSION SYSTEM

- A. Provide UL fire rated assembly system where required and identified on the Drawings as a rated ceiling.
- B. Main Runners: 1-1/2" x 15/16" steel tees of 12'-0" nominal length.
- C. Cross Tees or Channels: 2-7/8" x 7/8" hat shaped channel or 1-1/2" x 15/16" double web tee, galvanized, 4 feet nominal length.
- D. Wall Angle or Channel: 1-1/8" x 1-1/8" angle or 1-9/16" x 1" channel, 12'-0" long.
- E. Hanger Wire: ASTM A641, soft, Class 1, minimum 12-gage galvanized steel.
- F. Tie Wire: Minimum 16-gage galvanized steel.
- G. Resilient Furring Channels: Roll-formed, 1/2" x 2-1/2", single leg with pre-punched holes at 4" on center, 25-gage (0.018") zinc-coated steel with knurled face.
- H. Hanger Anchorage Devices:
 - 1. Screws, clips, bolts, cast-in-place concrete inserts or other devices applicable to the indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven through standard construction practices or by certified test data.
 - 2. Size devices for 3x calculated load supported except size direct pull-out concrete inserts for 5x calculated loads.

2.4 FACE AND BACKING BOARDS

- A. Gypsum Face Panels: ASTM C1396. Long edges tapered. 5/8" thick, 48" wide, Type "X" gypsum core, UL classified. Provide 1/4" thick panels over existing wall surfaces where so indicated on Drawings.
- B. Gypsum Base Panels: ASTM C1396, Type "X" fire retardant type, UL classified, with long edges tapered.

GYPSUM BOARD

2.5 GYPSUM ACCESSORIES

- A. Acoustical Sealants: U.S. Gypsum Acoustical sealant, Tremco Drywall Sealant, A.C. Horn Vulcatex Thriftube, non-setting, non-staining, acoustically tested caulking, or accepted substitute.
- B. Acoustical Insulation: U.S. Gypsum Thermafiber sound attenuation fire blankets, 3" thick, 15-25 flame spread, smoke developed 0; Certainteed Acoustitherm Batts, Owens/Corning Fiberglas Sonobatts, unfaced, 3-1/2" thick, Type II, smoke developed 10; or accepted substitute.
- C. Screw Fasteners: ASTM C645. No nailing of gypsum materials will be allowed.
- D. Fastening Adhesive for Wood Framing: ASTM C557. Supplement adhesive with permanent or temporary fasteners as recommended by the manufacturer.
- E. Laminating Adhesives: Product recommended by gypsum board manufacturer.
- F. Gypsum Board Metal Trim: Manufacturer's standard 26-gage galvanized steel. All trim to have fine mesh expanded metal flanges. Fine mesh corner beads: Mini-Bead 800/900 by ClarkDietrich Building Systems, Niles Mini-Bead 800/900, Mini Veneer Bead by Phillips Manufacturing Co., or accepted substitute.
- G. Interior Joint Reinforcing Tape: Fiber tape not less than 2-1/4" wide, ASTM C475.
- H. Interior Joint Treatment Materials: ASTM C475, ready-mixed type as recommended by gypsum wallboard manufacturer. Provide 2 separate grades, 1 specifically for bedding tapes and filling depressions and 1 for topping and sanding. Use chemical-hardening type for bedding and filling where required.
- I. Skim Coat: "First Coat" by U.S. Gypsum, Georgia-Pacific "Ready-Mix All-Purpose Joint Compound", or accepted substitute.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection: Provide temporary covering to eliminate splattering of joint compound on adjacent finished surfaces.
- B. Adjusting Location of Steel Framing: Coordinate ceiling suspension wire locations with plumbing, heating, ventilating, fire protection piping and electrical work. Adjust framing locations to align new finish flush with existing finish, where required.
- C. Suspension wires must be supported from structure above unless approved otherwise by the Architect.
- D. Do not bridge building expansion joints with support systems, frame both sides of joints with furring and other supports as indicated.

3.2 INSTALLATION OF WALL, SOFFIT, AND CEILING PANELS

- A. General and Fire Rating Requirements:
 - 1. Comply with Gypsum Association Specifications GA-216.

GYPSUM BOARD

2. Install acoustical insulation where indicated, without gaps and with snug fit against studs and support where necessary to prevent movement or dislocation. Install full height of partition, unless otherwise indicated. Fit carefully behind electrical outlets and other work that penetrates partition or face of wall.
3. Install panels of thickness indicated and as required meeting structural and fire rating requirements.
4. Glue and screw wallboard to wood framing members as recommended by the manufacturer. Nailing of gypsum panels will not be allowed.
5. For vertical partition wallboard installation, offset panel joints on opposite sides of stud framing.
6. In areas where gypsum wallboard is scheduled for wall and ceilings, install the ceiling first then the wallboard.
7. Verify that acoustical insulation is in place, where scheduled, prior to completing panel installation.
8. Where partitions are sound or fire rated construction, acoustical sealant shall be applied to all cutouts and intersections with adjoining structure as described herein. This will require that the gypsum board be cut for loose fit around the partition perimeter leaving a space approximately 1/8" wide.
9. Cut board neatly and fit around pipes, electrical outlets, mechanical work, etc. Remove any loose face paper at cuts and fill holes or openings with quick setting plaster.
10. Use panels of maximum practical length to minimize end joints. Arrange joints on opposite sides of partition walls to occur on different studs and stagger butt joints on the same surface. Where partitions intersect exterior walls, start installation at exterior end to position butt joints as far away from exterior wall as possible. Board shall be brought into contact but not forced into place with all ends and edges neatly fitted. Bottom edge of gypsum board on walls shall be a maximum of 1/4" above floor.
11. Attach to framing with all edges over framing members using screw fasteners. Space screws at 12" on center on ceiling and 16" on center on walls, staggered on abutting edges. Power drive screws at least 1/32" deep. Space screws at not less than 3/8" from edge and ends of board. Where board may appear loose from framing, install second fastener within 1-1/2" for the first fastener.
12. While fasteners are being driven, hold the gypsum board in firm contact with underlying supports, fastening from the center of the board toward ends and edges. Drive fasteners home with heads slightly below surface, taking care to avoid breaking the paper face.
13. Install gypsum base panels as a substrate for face panels where 2 layers are required. Fasten both the base layer and face layer separately to framing members with screws.
14. Finish in every location with metal edge and corner bead unless other finishing details are given and edge is covered with molding or trim. Install control joints vertically at corners of door and relite frames, and at a maximum of 30 feet apart on unbroken wall surfaces whether shown on the Drawings or not. Extend control joint from head to ceiling and from window sill to floor. Verify all expansion joint locations with the Architect prior to installation of gypsum board. Use casing beads at exposed edges of plaster and drywall and corner beads with 1 1/4" minimum width flange at outside corners.

3.3 INSTALLATION OF METAL CEILING SUSPENSION SYSTEMS

- A. Main Runners: Secure hanger wires to overhead construction spacing at not over 48" on center in each direction to support main runners installed with web verticals at 48" on center. Provide hangers within 6" of runner ends and at all interruptions of ceiling or grillage. Wrap hanger wire at least 3 full turns. Each hanger is to support not over 16 square feet of ceilings weighing a maximum of 10 pounds per square foot. Install additional hangers to support any additional weight supported by the ceiling.

GYPSUM BOARD

- B. Cross Tees or Channels: Connect to main runners and space at 16" on center by saddle tying the furring channels to the main runners with 2 strands of 16-gage tie wire. Place additional cross members at 8" from ends of gypsum board panels, adjacent to recessed light fixtures, or any other openings interrupting the installation.
- C. Wall Angle or Channel: Attach perimeter wall track or angle wherever support system meets vertical surfaces. Mechanically join support members to each other and butt-cut to fit into wall track.
- D. Install auxiliary framing at termination of drywall work, and at openings for light fixtures and similar work, as required for support of both the drywall construction and other work indicated for support thereon.
- E. Comply with manufacturer's printed instructions. Comply with ASTM C754 for member and fastener spacing.
- F. Adjust ceiling height to meet maximum deflection limits of L/360.
- G. Relocate hanger wire, cross tees and main runners to allow for installation of mechanical and electrical equipment. Add additional wires as required.

3.4 SEALANT APPLICATIONS

- A. Partition Perimeter: Apply a 1/4" minimum bead of sealant on each side of plates, including those used at intersections with dissimilar wall construction. Immediately install gypsum board, squeezing sealant to form contact with adjacent surfaces. Fasten board as specified. Conform to ASTM C919 for sealant application.
- B. Partition Intersections: Seal edges of face layer of wallboard abutting intersection partitions, before taping and finishing.
- C. Openings: Apply a 1/4" bead of acoustical sealant around all cut outs to seal openings of electrical boxes, ducts, pipes and similar penetrations. Seal sides and backs of all electrical boxes.
- D. Control Joints: Before installing control joints, apply sealant in back of joint to reduce flanking sound path.
- E. Install acrylic latex sealant where required to fill exposed openings.

3.5 PATCHING EXISTING SURFACES

- A. This subcontractor shall check the Drawings and building site to determine areas requiring patching in the area of the Work described on the Drawings. Wherever patching is necessary or indicated, perform this work using materials as specified. The same materials are to be used as the material of the adjoining surfaces and finished the same. Exercise care in the finishing of the patched area. Feather and blend to the adjoining surface to produce as invisible a joint as possible.
- B. Patched materials and surfaces must be finished so that existing and new materials match one another, not only in color but also in patterns and surface texture. The intent is to not have a patched appearance. In areas where partitions must be removed to create new areas, careful planning is required to ensure that finishes of the existing and the newly created surfaces are homogenous. The existing materials should blend into the new so that the transitions form one material to the other cannot be readily observed. IF the desired level of finish cannot be achieved, arrange contrasting materials in a pleasing design.

GYPSUM BOARD

3.6 FINISHING

A. Levels of Finish:

1. Level 2: All joints and interior angles shall have tape embedded in joint compound and wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Fastener heads and accessories shall be covered with a coat of joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable. Mop down all walls after the final mud coat prior to priming. Joint compound applied over the body of the tape at the time of tape embedment shall be considered a separate coat of joint compound and shall satisfy the conditions of this level.
2. Level 4: All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. All joint compound shall be smooth and free of tool marks and ridges. Mop down all walls after the final mud coat prior to priming.
3. Level 5:
 - a. All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. A thin skim coat shall be trowel applied to the entire surface. The surface shall be smooth and free of tool marks and ridges.
 - b. The skim coat is applied with a fine knap roller over the entire surface to fill imperfections in the joint work, smooth the paper texture, and provide a uniform surface. Goobers and smeared roller marks will not be accepted.

B. Exposed Board in Finished Areas: Provide Level 5 finish.

3.7 CLEAN UP

- A. Do not dispose of or leave excess drywall materials or debris on the premises. Leave each area "broom clean" after completing drywall work. Clean spots and spills of taping and finishing compounds off of all adjacent surfaces and equipment.**

END OF SECTION

ACOUSTICAL CEILING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Base Bid: Provide ceiling system at Reading Room 143 and at portion of Storage 143A as indicated on Drawings and as specified herein.
- B. Alternate No. 2: If Alternate No. 2 is exercised by the Owner, provide wood paneling and modify ceiling system at Reading Room 143 as indicated on Drawings.

1.2 RELATED DOCUMENTS

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

1.3 REFERENCES

- A. ASTM C635, Standard Specifications for Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
- B. ASTM C636, Recommended Practice for Installation of Metal Suspension System for Acoustical Tile and Lay-In Panels.
- C. ATSM E84, Fire Hazard Classification.
- D. CISCA Ceiling Systems Installation Handbook.

1.4 SUMMARY

- A. This Section includes rigid, linear and curvilinear tees.
- B. Related Sections include the following:
 - 1. Division 9 – Section 09250 – Gypsum Board.
 - 2. Division 15 Sections – Mechanical.
 - 3. Division 16 Sections – Electrical.

1.5 SUBMITTALS

- A. Samples: Submit panel finish and suspension system main and cross tees for acceptance.
- B. Shop Drawings:
 - 1. Reflected Ceiling Plans: Submit ceiling system layout to indicate ceiling modules, and related lighting and mechanical systems.
 - 2. Assembly Drawings: Indicate module dimensions, accessory attachments, and installation of system components.
- C. Manufacturer's Data:
 - 1. System Details: Submit manufacturer's catalog cuts, literature, or standard drawings showing details of system with project conditions clearly identified and manufacturer's recommended installation instructions.
 - 2. Color Chart: Submit manufacturer's standard color chart sample or match of color choice for approval.

ACOUSTICAL CEILING

- D. Maintenance Materials: Provide 15% of amount of main tees, cross tees, and panels.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Deliver materials in original unopened packages, clearly labeled with manufacturer's name, item description, specification number, type, and class, as applicable.
- B. Inspection: Promptly inspect delivered materials, file freight claims for damage during shipment, and/or replacement materials, as required.
- C. Storage: Ceiling material storage time at the jobsite should be as short as possible, and environmental conditions should be as near as possible to those specified for occupancy. (See Occupancy conditions below.) Excess humidity during storage can cause possible warp, sag, or poor fit after installation. Chemical changes in the reinforcement mat and/or coatings can be aggravated by excess humidity and cause discoloration during storage, even in unopened cartons. Cartons should be removed from pallets and stringers to prevent distortion of material. Damaged or deteriorated materials should be removed from the premises. Immediately before installation, to stabilize the ceiling coffers, store them at a location where temperature and humidity conditions duplicate ambient during installation and anticipated for occupancy.
- D. Occupancy Conditions: These ceiling coffers and suspension products are designed for installation and use under standard occupancy conditions of temperature and humidity 60-85 °F (16-29 °C), no more than 70% relative humidity (RH).
- E. Handling: Handle in such a manner as to ensure against racking, distortion, or physical damage of any kind.

1.7 QUALITY ASSURANCE

- A. Subcontractor Qualifications: Installer shall have not less than three years of successful experience in the installation of ceiling suspension systems on projects with requirements similar to requirements specified.
- B. Requirements of Regulatory Agencies: Codes and regulations of authorities having jurisdiction.
- C. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.8 PROJECT CONDITIONS

- A. Coordination with Other Work:
 - 1. General: Coordinate with other work supported by or penetrating through the system.
 - 2. Mechanical Work: Ductwork above suspension system shall be complete, and permanent heating and cooling systems operating.
 - 3. Electrical Work: Installation of conduit above the CADRE ® and QUADRA ™ system shall be complete before installation of suspension system.

ACOUSTICAL CEILING

- B. Protection:
 - 1. Personnel: Follow good safety and industrial hygiene practices during handling and installing 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.
 - 2. Existing Completed Work: Protect completed work above suspension system from damage during installation of CADRE ® and QUADRA ™ system components.

1.9 SYSTEM DESCRIPTION

- A. Suspended ceiling system consisting of main tees and cross tees connected together to form a modular installation for CADRE ® and QUADRA ™ , acoustical materials, light fixtures, and air diffusers.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. CADRE Ceiling Systems and DONN ® (DX ®) (DXT) (FINELINE ®) (FINELINE 1/8) suspension systems as manufactured by USG Interiors, Inc., Chicago, Illinois, U.S.A., or accepted substitute.
 - 1. Basis of Design: USG Cadre Executive. (Layout as indicated on Drawings.)
- B. Acoustical material shall be USG Interiors AURATONE ® , ACOUSTONE ® , or ECLIPSE ™ ceiling panels or other, depending upon performance required (acoustical panels may not be required).

2.2 MATERIALS

- A. CADRE Ceiling Panels:
 - 1. Manufactured from Glass Reinforced Gypsum (GRG) and formed into 24"x24" or 48"x48" lay-in panels. Panels are to be produced using Omni-directional glass reinforcement (chopper spray). No hand lay-up will be allowed.
 - 2. Accessories:
 - a. M9 wall molding: 15/16"x9/16"x12' -long angle shape of prepainted steel.
 - b. Panels with Cutouts: For incandescent light, sprinklers, or speakers with integral trim to conceal the edge of the panel cutout (specify hole sizes and locations for each type), sized to fit the QUADRA top opening.
 - 3. Panel Types; See Drawings for layout of panel types:
 - a. Corner 4' x 4' CD210.
 - b. Executive 2' x 2' CD680.
 - c. Field Pattern 2' x 2' CD212.
 - d. Border 2' x 2' CD211.
- B. Suspension System Components:
 - 1. General: DONN (DX) (DXT) (FINELINE) (FINELINE 1/8): ASTM C635, (Intermediate) (Heavy Duty) classification, commercial quality cold-rolled steel; exposed surfaces pre-finished in manufacturer's standard color.
- C. Air Distribution Components:

ACOUSTICAL CEILING

1. DONN Air Diffusers: Extruded aluminum frame with flat white vanes (24"x24") in (one) (two) (three) (four) slot configurations with four-directional throw. Finish to coordinate with CADRE panels.
2. Plenum: 28-gauge galvanized steel insulated with 1/2" fiberglass insulation, ____ DIA. top inlet collar. In lieu of using schedule at the end of Part 3, delete paragraph below and insert product characteristics.

2.3 PERFORMANCE

- A. Suspension System: Heavy Duty classification designed to support ceiling assembly as indicated on project drawing with maximum deflection of 1/360.
- B. Acoustical performance values are approximately the rating of the acoustical drop-in panels on all QUADRA.
- C. Surface burning: Class A finished GRG surfaces shall have flame spread/smoke developed values of less than 0/15.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive materials for conditions that will adversely affect installation.
- B. Do not start work until unsatisfactory conditions are corrected.
- C. Work to be concealed: Verify work above ceiling system is complete and installed in manner that will not affect layout and installation of system components.

3.2 PREPARATION

- A. Field Dimensions: Installer must verify actual field dimensions prior to installation.

3.3 INSTALLATION

- A. Standard Reference: Install in accordance with ASTM C636, CISCA recommendations and local building codes.
- B. Manufacturer's Reference: Install in accordance with manufacturer's current printed recommendations.
- C. Drawing Reference: Install in accordance with approved shop drawings.
- D. Hanger Wires:
 1. Spacing: Space hanger wires on main tees a maximum of 48" o.c. attaching hangers directly to structure above.
 2. Limitations: Do not support wires from mechanical and/or electrical equipment, piping, or other equipment occurring above ceiling.
- E. Accessories: Install accessories as applicable to meet requirements.
- F. Allowance Tolerances: Per ASTM C636.

ACOUSTICAL CEILING

3.4 CLEANING

- A. Maintenance: Perform any necessary cleaning maintenance with nonsolvent-based commercial cleaner on painted panels or suspension components.
- B. Immediately remove any corrosive substances or chemicals that may attack finishes (e.g., wallpaper paste).
- C. Removal of Debris: Remove all debris resulting from work of this section.

END OF SECTION

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide resilient base and accessories in locations indicated on the Drawings and as herein specified.

1.2 SUBMITTALS

- A. Samples: Submit 2 samples of each type and color of resilient base and trim accessory. Provide 2-1/2" long samples for each accessory.
- B. Submit product preparation instructions and recommendations, storage and handling requirements and installation methods.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Provide each type of resilient base and accessory as produced by a single manufacturer, including recommended adhesives.

1.4 PROJECT/SITE CONDITIONS

- A. Maintain materials and areas of work at temperatures between 70°F and 90°F for not less than 48 hours before, during, and 48 hours after the material installation.
- B. Install resilient base and accessories after other finishing operations, including painting and installation of built-in casework have been completed.

PART 2 - PRODUCTS

2.1 ACCESSORY MATERIALS

- A. Rubber Base: ASTM F1861 Type TS, Group 1, thermoset vulcanized SBR rubber, continuous roll, 1/8-inch gauge, 4-inch top-set, coved toe at hard floor finishes, straight base at carpet.
 - 1. Manufacturers: Johnsonite, Roppe, Flexco, Burke/Mercer, Nora, or accepted substitute.
 - 2. Color: Match Johnsonite 63 Burnt Umber.

PART 3 - EXECUTION

3.1 INSTALLATION OF ACCESSORIES

- A. Apply wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required.
 - 1. Install base in lengths as long as practicable with corners fabricated from base materials, mitered, or coped inside corners.
 - 2. Tightly bond base to substrate throughout length of each piece with continuous contact at horizontal and vertical surfaces.

3.2 EXTRA STOCK

- A. Deliver stock of maintenance materials to the Owner's Project Manager. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.

RESILIENT BASE AND ACCESSORIES

- B. Base Materials: Salvage left over materials to the Owner.

END OF SECTION

TILE CARPETING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide carpet tile as indicated on the Drawings and as specified herein.

1.2 QUALITY ASSURANCE

- A. Installers: Employ carpet tile installers with minimum of 3 years experience in installing commercial carpet tile products.
- B. Carpet Tile Quality: Carpet tile to be manufacturer's standard commercial quality material, no seconds or imperfections will be accepted.

1.3 SUBMITTALS

- A. Office Samples: Submit three full tile size samples for each color and texture to the Architect for review of color, texture and pattern only.
- B. Shop Drawings: Submit 3 opaque prints of floor plan, showing area of carpet tiles, edge strips, tile installation grid, and related installation details. Do not install carpeting until shop drawings have been reviewed by the Architect.
- C. Product Data:
 - 1. Submit 3 copies of the manufacturer's specifications covering carpet tile construction and recommended installation and maintenance procedures.
- D. Certification: Submit 3 copies of the carpet tile manufacturer's written certification that the carpet tile delivered has been manufactured in accordance with these specifications.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver carpet tile to site with original registration numbers attached.
- B. Storage and Distribution: Coordinate storage location with the Architect. Do not exceed the design live load of the structure during distribution of the carpet tiles.

1.5 SCHEDULING

- A. Installation Schedule: Install carpet tile after painting and cabinet installations have been completed in each work area.

1.6 WARRANTY

- A. Provide carpet tile manufacturer's standard 10 year limited replacement wear warranty.
- B. Provide carpet tile manufacturer's standard backing system lifetime limited warranty.

TILE CARPETING

1.7 INDOOR AIR QUALITY

- A. Do not use carpet products or adhesives that exceed the maximum VOC limits of the Carpet and Rug Institute Green Label Indoor Air Quality Test Program or other testing programs demonstrating equivalence. Do not use sealers that exceed the maximum VOC and chemical component limits of Green Seal requirements, www.greenseal.org/standard/paints.htm.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Manufacturer: Shaw.
- B. Style: Charisma .
- C. Color: 61750 Aristocrat.
- D. Product Type: Carpet tile.
- E. Style Number: 59561.
- F. Construction: Graphic Loop.
- G. Fiber: Eco Solution Q Nylon.
- H. Dye Method: 74% solution dyed / 26% yarn dyed.
- I. Primary Backing: Synthetic.
- J. Secondary Backing: EcoWorx Tile.
- K. Protective Treatments: SSP Shaw Soil Protection.
- L. Product Size: 24.0 x 24.0 inches (61.0 x 61.0 cm).
- M. Gauge: 5/64 inch (50.4 per 10 cm).
- N. Stitches: 8.5 per inch (33 per 10 cm).
- O. Finished Pile Thickness: 0.107 inches (2.72 mm).
- P. Average Density: 7402 per cu. yd. (0.274 g/cm3).
- Q. Kilotex: 10.10 kilotex.
- R. Total Thickness: 0.26 inches (6.60 mm).
- S. Tufted Weight: 22.0 oz/yd2 (746 gms/sqm).
- T. Pattern Repeat: None.
- U. GSA Approved Product: True.
- V. Installation Method: Quarterturn.

TILE CARPETING

- W. Performance and Testing:
1. Antimicrobial Assessment: Passes AATCC-174 when installed using Shaw 5036 adhesive.
 2. Pill Test: Pass.
 3. Radiant Panel: Class I.
 4. NBS Smoke: Less than 450.
 5. Electrostatic Propensity: Less than 3.5 kV.
 6. CRI Greenable Plus: USA (GLP9968).
 7. ADA Compliance: This product meets the guidelines as set forth in the Americans with Disabilities Act for minimum static coefficient of friction of 0.6 for accessible routes.

2.2 CARPET TILE ACCESSORIES

- A. Carpet Tile Adhesive: Carpet manufacturer's approved adhesive for tile removal and replacement.
1. Shaw 5036 Adhesive.
- B. Concrete Sealer: As selected by Installer and compatible with adhesive.
- C. Mastic Underlayments:
1. Zero Thickness to 1/2": Armstrong Latex Underlayment or accepted substitute.
 2. 1/2" Thickness and Greater: Polyvinyl acetate resin mixed with concrete.
- D. Carpet Edge Strip: Provide at the following locations:
1. At Transition to Stone Tile: Schluter "Reno Ramp".
 2. At Transition to Existing Entry Mat: Schluter "Schiene".
 3. At Transition to Existing Marmoleum: Schluter "Schiene".

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine substrates and conditions under which carpet tile is to be installed.
- B. Correct conditions detrimental to proper and timely completion of work.
- C. Do not proceed until unsatisfactory conditions have been corrected. Starting work constitutes acceptance of existing conditions.

3.2 INSTALLATION

- A. Inspect carpet tiles before laying for "streaking" shading spots and soil, tears, pull tufts, or other defects. Do not install defective carpet tile, but replace with undamaged carpet tile.
- B. Conform strictly to carpet tile manufacturer's gluing instructions and specifications for installation methods and materials for adhesive installation using only recommended adhesives and primers. Cut edges shall be trued and properly treated.
1. Measurements: Measure area to be carpeted to determine best starting positions. Chalk 2 lines that intersect these positions at right angles. Proper planning should avoid trimming perimeter tiles more than 1/2 their width (9" for 18" x 18" tiles).
 2. Fully Adhesive Application: Apply pressure-sensitive adhesive along chalk lines in starting quadrant and at perimeter. This will eliminate tile movement and keep the tiles straight during the initial installation. A full adhesive system is to be used for the installation of the tiles.

TILE CARPETING

3. Tile Placement: Starting in corner of 1 quadrant, install tiles in a pyramid fashion using control grids to keep tiles straight. Install tiles by butting edges together evenly, being careful not to compress modules too tightly (this can cause peaked edges). Arrows are embossed on the module backings to show pile direction. Always lay tiles with arrows in same direction.

3.3 ADJUSTING AND CLEANING

- A. Replace or reinstall carpet tile which is not smooth and even, free of discoloration, soil, sag, or buckle.
- B. After installation, remove debris and clean carpet with spot remover where required. Remove thread with sharp scissors and vacuum clean.
- C. Remove scraps from the Site that have not been retained by the Owner.
- D. Protection of the carpet tiles after the completion of the installation is specified as general work and is made a part of the work of all trades doing work in areas after the carpet tile material installation.

3.4 EXTRA STOCK

- A. Overrun Stock and Scraps:
 1. Furnish 5% of the total carpet tile area of each color to the Owner for maintenance materials.
 2. Deliver overrun stock the Owner-selected scraps of carpet tiles to the Owner's storage area.

END OF SECTION

PAINTING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Interior Painting:
 - 1. Field finish:
 - a. Exposed concrete.
 - b. Masonry.
 - c. Plaster.
 - d. Primed and galvanized steel.
 - e. Gypsum.
 - f. Unfinished and primed wood.
 - 1) Includes wood paneling and trim.
 - 2) Includes wood doors and frame.
 - 2. Field paint exposed fire protection, plumbing, HVAC, and electrical equipment not factory finished which is installed in areas scheduled for field finishing.
 - 3. Field paint all exposed factory finished HVAC ceiling and wall grilles to match the surrounding paint color and as indicated by the Architect.
- B. Do Not Paint:
 - 1. Prefinished items, such as light fixtures, plumbing fixtures and finished door hardware.
 - 2. Finished metal such as anodized aluminum, stainless steel, finished brass or bronze.
 - 3. Moving parts of operating units, equipment identification, performance rating, name plates or code-required labels.
 - 4. Brick masonry.

1.2 REFERENCES

- A. Oregon Administrative Rules (OAR), Department of Human Services, Public Health Division: Chapter 333, Division 70 Renovation, Repair and Painting Activities Involving Lead-Based Paint.
- B. Code of Federal Regulations: 40 CFR: Protection of the Environment.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's literature on each coating proposed for this Project. Obtain approval of coatings prior to ordering. Include the manufacturer's recommended minimum dry film thickness for each coating system. Indicate where the material is to be used.
- B. Office Samples:
 - 1. Submit Samples: For the Architect's review of color and gloss.
 - 2. Resubmit Samples: As requested until required color and gloss is achieved.
 - 3. Opaque Finish: Provide three 8" x 8" minimum size samples of each color and gloss.
 - 4. Transparent Finish: On actual wood surfaces provide three 4" x 8" minimum size samples for natural and stained wood finish.

1.4 QUALITY ASSURANCE

- A. Painter: Provide local subcontractor experienced in painting commercial buildings. Painting subcontractor must have 5 years experience in projects of similar size.

PAINTING

- B. Field Samples:
 - 1. On actual building components, duplicate finishes on acceptable office samples.
 - 2. Provide wall and ceiling colors and finishes on minimum 50 square feet of in-place surfaces.
 - 3. Provide trim and equipment colors and finishes on minimum 10 lineal feet of in-place surfaces.
 - 4. The Architect will approve for color, texture and sheen only.
- C. Fire Protection: Provide sufficient fire extinguishers of a type suitable for the control of fire originating in paint materials. Remove and dispose of, or safely store, all waste, empty containers and oily cloths off of the premises daily.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to each site in new, original and unopened containers bearing manufacturer's name, trade name, and label analysis.
- B. Storage: Store coatings in ventilated spaces with containers closed.
- C. Handling: Keep dust and open flame from coating materials while mixing and painting.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Benjamin Moore, Premium Architectural Products. Devco, a Division of PPG Industries.
- B. Miller Paint Co. (Specification Standard)
- C. PPG.
- D. Rodda Paint Co.
- E. Rust-oleum Corporation.
- F. Sherwin Williams Co., Professional Coatings Division.
- G. Glidden Professional, a Division of PPG Industries.
- H. Watco-Dennis Corporation (Products by Rust-oleum Corporation).
- I. Kelly Moore. (Hillsboro standard)
- J. Or accepted substitute.

2.2 INTERIOR MATERIALS

- A. Products listed below are approved for use in the Project. Other products may be used when approved by the Architect in writing.
- B. Painted Wood and Trim - New and Existing:
 - 1. Primer: Miller No. 270-0-11 Miller-Prime Acrylic Enamel Undercoat
 - 2. Second and Third Coats: Miller No. 320-5-XX Acrinamel Acrylic Semi-Gloss Enamel.

PAINTING

- C. Ferrous Metal:
 - 1. Primer: Miller No. 310-2-10 Acrimetal DTM.
 - 2. Second and Third Coats: Miller No. 320-5-XX Acrimetal DTM Semi Gloss.
- D. Non Ferrous Metal:
 - 1. Primer: Miller No. 310-2-10 Acrimetal DTM.
 - 2. Second and Third Coats: Miller No. 320-5-XX Acrimetal DTM Semi Gloss.
- E. Gypsum Drywall - Walls (Paint):
 - 1. Primer: Miller No. 220-0-11 P.V.A. Primer.
 - 2. Second and Third Coats: Miller No. 120-4-XX Premium Satin.;
- F. Gypsum Drywall and Plaster - Ceilings:
 - 1. Primer: Miller No. 620-0-11 Kril Primer Sealer.
 - 2. First and Second Coats: Miller No. 120-4-XX Premium Satin; roller application for light eggshell finish.
- G. Stained and Sealed Wood:
 - 1. Primer: Watco Toner Stain to match existing and Old Master's Water Based Sanding Sealer (7520X).
 - 2. Second and Third Coats: Miller No. 710-4-45 Acriclear Satin Waterborne Polyurethane. Sand paper or synthetic steel wool between coats.
- H. Semi Transparent Wood Stain:
 - 1. First and Second Coats: Old Master's Wiping and Penetrating Stain.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examination of Surfaces: Examine areas and conditions under which painting work is to be applied. Correct conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Contaminated Surfaces: Do not paint over dirt, rust, blistered paint, grease, wet substrates, or surface conditions detrimental to the formation of a durable paint film.
- C. Work Start: Start of painting work will be interpreted as the Applicator's acceptance of surfaces and conditions within any particular area.

3.2 PREPARATION

- A. Cleaning: Comply with coating the manufacturer's instructions for preparation and cleaning of each substrate.
- B. Protection:
 - 1. Cover and protect adjacent finished surfaces.
 - 2. Remove hardware, machined surfaces, cover plates, lighting fixtures and prefinished items in place and not scheduled for field finishing, or provide surface applied protection. Reinstall removed items after finishing adjacent surfaces.

PAINTING

- C. Priming:
 - 1. Seal wood required to be job painted. Prime edges, ends, face, undersides and backsides of millwork and exterior painted wood.
 - 2. Provide finish coats that are compatible with prime paints used. Provide barrier coats over incompatible primers where required. Notify the Architect in writing of anticipated problems using specified coatings with substrates primed by others.
 - 3. Apply prime coat or first coat to material that is scheduled or required to be painted or finished.
 - 4. Touch up shop primed surfaces scratched or chipped prior to field finishing.
 - 5. The primer applied under Section 09 29 00, Gypsum Board, under the wall texture is not to be considered as a prime coat for paint.
- D. Existing Lead Base Paint: For renovations, repairs and painting (RRP) in "Child-Occupied Facilities" (where kids under the age of 6 regularly spend time and built before 1978), the General Contractor shall follow all Federal, State and local rules (including OSHA and US EPA rules and Oregon Administrative Rules Chapter 333, Division 70) associated with lead-based paints (LBP).
 - 1. The Contractor is responsible for the identification of LBP hazards and providing engineering controls for trigger activities that disturb LBP.
 - 2. Any time painted surfaces are disturbed, the work must be performed by a certified firm with a trained and certified "renovator" in accordance with *40 CFR (including Part 745.82 Lead)*.
 - 3. Post the areas of the building that will be affected with appropriate signage warning of the potential hazard.

3.3 APPLICATION

- A. Methods and Coverage:
 - 1. Apply painting and finishing materials in accordance with the manufacturer's directions. Use techniques best suited for the material and surfaces to which applied.
 - 2. For opaque finishes, apply additional coats when undercoats, stains or other conditions show through final paint coat, until paint film is of uniform finish, color and appearance.
 - 3. Where recommended by manufacturer, sand lightly between succeeding enamel or clear coats.
 - 4. Apply each material at not less than the manufacturer's recommended spreading rate, to provide a total dry film thickness of not less than amount recommended by coating manufacturer.
 - 5. Match approved office and field samples for color, texture and sheen.
 - 6. Paint exposed surfaces behind movable equipment and furniture same as adjacent surfaces.
 - 7. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.
- B. Equipment Surfaces:
 - 1. Paint interior surfaces of ducts where visible through registers or grilles, flat black.
 - 2. Except where accent colors are scheduled, paint mechanical and electrical work in finished areas including exposed ducts, piping, conduit, louvers, and grilles to match adjacent surfaces except when factory finished to color matching adjacent surface.
 - 3. Paint exterior exposed equipment where noted on the Drawings.
- C. Existing Surfaces: Existing walls to be repainted are to be cleaned, removing all scaled and loose paint. Wall areas that have been patched are to be primed and painted as specified for new work. The existing painted surfaces, after cleaning and spot priming as necessary, are to receive 2 finish coats of paint.

PAINTING

- D. Workmanship: Tint undercoats slightly darker than finish coat to aid Inspector in verifying coverage of each coat. Assume all responsibility for paint coats applied over surfaces and undercoats that have not been inspected and approved by Architect. Apply any additional coats of paint, as directed by Architect where surface preparation and undercoats have not been approved before painting. Make finished work match approved samples.
- E. Drywall and Plaster Surfaces: Paint shall not be applied to any surface until it is thoroughly dry and cured. Prime surfaces that show hot spots or alkali in order to prevent such blemishes from showing through the paint. Brush off all loose particles or crystals that may have formed.
- F. Colors: Refer to the Color Schedule included at the end of this Section. Colors have been selected from color chips in the Architect's office. Match the colors to these chips. Job mixing and tinting will not be allowed.

3.4 ADJUSTING AND CLEANING

- A. Remove, refinish or repaint work not in compliance with specified requirements. Recoat work not meeting minimum dry film thickness.
- B. Correct any painting related damage by cleaning, repairing or replacing and refinishing as directed.
- C. Repaint lines between accent colors as directed to obtain clean straight lines.
- D. Remove paint splatters from plastic laminate, resilient flooring, anodized aluminum, glass and similar finished surfaced.
- E. Touch up factory finished surfaces damaged during construction.

3.5 EXTRA STOCK

- A. Deliver extra stock of finish paint equal to 10% (to the nearest gallon) of each color and gloss used. Do not exceed 5 gallons of each color and gloss.
- B. Deliver extra stock in 1 or 5 gallon unopened containers.
- C. Keep list of stock delivered to Owner and submit with Closeout Manuals.

3.6 INTERIOR COLOR SCHEDULE

- A. Paint Color P1 - General: Match Benjamin Moore AC-1 "Coastal Fog".
- B. Paint Color P5: Match Rodda 0535 "Zen Retreat".
 - a. Use at Interior Hollow Metal Frames.
- C. Wood Doors (Door No. 143B and Door No. 143C), Wood Paneling, and Wood Trim: Clear finish to match existing.
- D. Wood Veneer Casework: Clear finish to match existing.
- E. Sheens: Confirm sheens with Owner's Project Manager.

END OF SECTION

SIGNAGE

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install plaques and hardware necessary to install metal plaques shown on Drawings as herein specified.

1.2 SUBMITTALS

- A. Manufacturer's illustrated product literature and specifications.
- B. Shop Drawings.
- C. Installation Instructions.
- D. Cleaning Recommendations.

1.3 QUALITY ASSURANCE

- A. Manufacturer to have a minimum of 10 years experience in manufacturing plaques.
- B. All plaques to be manufactured by one manufacturer.

1.4 WARRANTY

- A. Plaques shall be guaranteed for the life of the business against defects.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Gemini Incorporated
103 Mensing Way
Cannon Falls, MN 55009
Phone: 877-877-2922 or 507-263-3957
Fax: 800-627-8547 or 507-263-4887
Email: plaques@geminisignproducts.com
Web: www.geminisignproducts.com
- B. Or accepted substitute.

2.2 MATERIALS

- A. Copper (Alloy C11000).

2.3 PROCESS

- A. Plaque Thickness: 1/16", 1/8", 3/16" or 1/4" thick.

SIGNAGE

- B. Edges: Polished, Square Edge is standard; 41 degree Bevel Edge optional (1/8"-1/4"thick).
- C. Copy: Recessed copy and graphics.
- D. Polished as standard with manufacturer.
- E. Plaques are clear-coated and oven-baked with a two-part hardened seal of clear acrylic polyurethane.
- F. Sign Mounting Panel: Plaques to be mounted to sign panel as detailed on Drawings. Sign Mounting Panel: 1/4" thick plastic laminate faced and edged MDF; size as indicated on Drawings.
 - 1. Plastic Laminate: Match Formica "Black MiroDot Finish" 909-MC.

2.4 MOUNTING HARDWARE

- A. Hardware and instructions are provided for several mounting methods, including Blind Mount, Stud Boss Mount, Double Face Tape and Screw Mount. Etched Plaques 1/4" or thicker can be drilled and tapped for a stud mount. Thinner plaques can have corner holes drilled for mounting.
 - 1. See Drawings for mounting spacers, fasteners, and caps required to mount sign plaque to sign mounting panel and to mount sign mounting panel to wall.

2.5 MANUFACTURE

- A. Plaques shall be made of Copper (Alloy C11000).
- B. Plaques shall use Copperplate Gothic Bold (Extra Bold) letterstyle. Verify letter height, as indicated on the Drawings.
- C. Mounting shall be as indicated on Drawings.

2.6 INTERIOR SIGNAGE

- A. Provide as indicated on Drawings and as further specified in this Section.
 - 1. Background: Plastic laminate faced MDF sign mounting panel. 32 inches wide x 24" (verify) high x thickness indicated on Drawings.
 - a. Plastic Laminate Face and Edges: Match Formica "Black MicroDot Finish - 909-MC".
 - 2. Front Plate: 1/4" thick brushed or antique copper. Oval shaped, as indicated on Drawings.
 - 3. Recessed Image and Copy: As indicated on Drawings.
 - a. Font: Copperplate Gothic Bold (Extra Bold).
 - b. Text (Upper and Lower Case as indicated):
Thomas E. Withycombe Library
 - d. Text Color: Black.

SIGNAGE

PART 3 - EXECUTION

3.1 INSPECTION

- A. The installer shall examine the substrates and conditions under which the specialty signs are to be installed and notify the Contractor and the Owner's Project Manager in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.2 INSTALLATION

- A. Sign Location: As indicated on Drawings.
- B. A qualified installer shall install plaques. Additional structural support may be required for larger/heavier plaques.
- C. Install signage per manufacturer's instructions, templates, and shop drawings.
- D. Install sign units and components at the locations shown or scheduled, securely mounted with concealed theft-resistant fasteners, unless otherwise indicated. Attach signs to substrates in accordance with the manufacturer's instructions, unless otherwise shown.
- E. Install level, plumb, and at proper height. Cooperate with other trades for installation of sign units to finish surfaces.

3.3 ADJUSTING AND CLEANING

- A. Relocate misplaced signs.
- B. Replace or replace defective or damaged signs as directed by the Architect.
- C. Clean substrate and sign prior to Substantial Completion.
- D. Clean plaques per manufacturer's recommendations.

END OF SECTION

FIRE SUPPRESSION BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 DESIGN-BUILD SUMMARY OF WORK

- A. Work included in 21 00 00 applies to Division 21, Fire Suppression work to provide materials, labor, tools, permits and incidentals to make fire suppression systems ready for Owner's use for proposed project.

1.2 DESIGN-BUILD INSTRUCTIONS

- A. This document is issued to give Bidders a basis for preparing a proposal to design and install a complete Fire Suppression system for this project.
- B. Alternates to this Document may be offered as a separate proposal.

1.3 DESIGN-BUILD DESIGN APPROACH

- A. Use this Specification as a guide for design/engineering requirements, workmanship and materials or construction. Utilize design-build concept throughout construction phase of project.
- B. Investigate and be apprised of applicable codes, rules, and regulations as enforced by AHJ.
- C. Visit the Site of the proposed construction. Verify and inspect the existing site to determine conditions that affect this work.

1.4 DESIGN-BUILD DESIGN CRITERIA/CALCULATIONS

- A. Related Work Specified Elsewhere:
 - 1. Contents of Section apply to Division 21, Fire Suppression Specifications.
 - 2. Requirements of Section are a minimum for Division 21, Fire Suppression Sections, unless otherwise stated in each Section, in which case that Section's requirements take precedence.
- B. Fire Suppression Design Criteria: Refer to individual Division 21, Fire Suppression Sections for fire suppression system design criteria.
- C. Fire Suppression Equipment: Refer to individual Division 21, Fire Suppression Sections for fire suppression equipment requirements.

1.5 SECTION INCLUDES

- A. Work included in 21 00 00, Fire Suppression Basic Requirements applies to Division 21, Fire Suppression work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of fire protection systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.
 - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.

FIRE SUPPRESSION BASIC REQUIREMENTS

3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete Item of work furnished.
4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent," substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted Item.
5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.6 RELATED SECTIONS

- A. Content of Section applies to Division 21, Fire Suppression Contract Documents.
- B. Related Work:
 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits

1.7 REFERENCES AND STANDARDS

- A. References and Standards per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 21, Fire Suppression Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
 1. State of Oregon:
 - a. OAR - Oregon Administrative Rules
 - b. OESC - Oregon Electrical Specialty Code
 - c. OFC - Oregon Fire Code
 - d. OMSC - Oregon Mechanical Specialty Code
 - e. OPSC - Oregon Plumbing Specialty Code
 - f. OSSC - Oregon Structural Specialty Code
 - g. OEESC - Oregon Energy Efficiency Specialty Code
 - h. Oregon Elevator Specialty Code
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 1. ABA - Architectural Barriers Act
 2. ADA - Americans with Disabilities Act
 3. AHRI - Air-Conditioning Heating & Refrigeration Institute
 4. ANSI - American National Standards Institute
 5. ASCE - American Society of Civil Engineers
 6. ASCE-7 Minimum Design Loads for Buildings and Other Structures

FIRE SUPPRESSION BASIC REQUIREMENTS

7. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
8. ASHRAE Guideline 0, the Commissioning Process
9. ASME - American Society of Mechanical Engineers
10. ASPE - American Society of Plumbing Engineers
11. ASSE - American Society of Sanitary Engineering
12. ASTM - ASTM International
13. AWWA - American Water Works Association
14. CFR - Code of Federal Regulations
15. EPA - Environmental Protection Agency
16. ETL - Electrical Testing Laboratories
17. FCC - Federal Communications Commission
18. FM - FM Global
19. FM Global - FM Global Approval Guide
20. IAPMO - International Association of Plumbing and Mechanical Officials
21. ICC - International Code Council
22. IEC - International Electrotechnical Commission
23. ICC-ESR - International Code Council Evaluation Service Reports
24. HI - Hydraulic Institute Standards
25. ISO - International Organization for Standardization
26. MSS - Manufacturers Standardization Society
27. NEC - National Electric Code
28. NEMA - National Electrical Manufacturers Association
29. NFPA - National Fire Protection Association:
 - a. NFPA 13 - Standard for the Installation of Sprinkler Systems
 - b. NFPA 25 - Standard for Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
 - c. NFPA 70 - National Electrical Code
 - d. NFPA 72 - National Fire Alarm and Signaling Code
30. NRCA - National Roofing Contractors Association
31. NSF - National Sanitation Foundation
32. OSHA - Occupational Safety and Health Administration
33. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
34. TIMA - Thermal Insulation Manufacturers Association
35. UL - Underwriters Laboratories Inc.

- D. See Division 21, Fire Suppression individual Sections for additional references.

1.8 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 21, Fire Suppression sections.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.

FIRE SUPPRESSION BASIC REQUIREMENTS

- D. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via posted to ftp site. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.
- E. Submit shop drawings, calculations and product data sheets as one complete stand-alone package to AHJ, Owner's insurance underwriter and Engineer.
- F. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 21, Fire Suppression Sections.
- G. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
 - 1. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed Item. Highlight connections by/to other trades.
 - 2. Include technical data, installation instructions and dimensioned drawings for products, equipment and devices installed, furnished or provided. Reference Division 21, Fire Suppression specification Sections for specific Item required in product data submittal outside of these requirements.
 - 3. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
 - 4. For vibration isolation of equipment, list make and model selected with operating load and deflection. Indicate frame type where required. Submit manufacturer's product data.
 - 5. See Division 21, Fire Suppression Sections for additional submittal requirements outside of these requirements.
- H. Maximum of two reviews provided of complete submittal package. Arrange for additional reviews and/or early review of long-lead Item; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
- I. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
- J. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
- K. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 21, Fire Suppression coordination documents. For equipment with electrical connections, furnish copy of approved

FIRE SUPPRESSION BASIC REQUIREMENTS

submittal for inclusion in Division 26, Electrical and Division 28, Electronic Safety and Security submittals.

- L. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
- M. Substitutions and Variation from Basis of Design:
 - 1. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 - 2. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
- N. Shop Drawings:
 - 1. Provide coordinated Shop Drawings which include physical characteristics of all systems, equipment and piping layout, pipe layout, hanger layout, sway brace layout, seismic restraints, sway brace calculations, drains, location of drain discharge, risers, valves, details, water test information, physical device layout plans, and control wiring diagrams. Reference individual Division 21, Fire Suppression Sections for additional requirements for shop drawings outside of these requirements.
 - 2. Shop Drawings and hydraulics calculations, sway brace calculations, trapeze hanger calculations, and the like, to be prepared under the direct supervision and control of a Professional Engineer competent to do such work and licensed in the state of Oregon. Drawings and calculations to bear the seal and wet signature of the professional Engineer.
 - 3. Provide Shop Drawings which indicate information required by NFPA 13. Include room names and fire sprinkler occupancy hazard classifications.
 - 4. Provide Shop Drawings illustrating information for Hydraulic Information Sign for each hydraulic remote area calculated.
 - 5. Utilizing the Reflected Ceiling backgrounds, provide Shop Drawings illustrating locations of fire sprinklers and piping.
 - 6. Utilizing the Structural backgrounds, provide Shop Drawings illustrating locations and types of hangers and sway braces.
 - 7. Provide Shop Drawings illustrating each type of hanger, including fasteners to structure.
 - 8. Provide Shop Drawings illustrating each type of branchline restraint and sway brace, including length of sway brace member, sway brace fittings, minimum and maximum angles from vertical of sway brace member, method of attachment to structure, size, length and embedment of attachment to structure and size and type of structural member to which sway brace will be attached. Number each type of restraint and sway brace. Indicate on Drawings locations of each type of numbered restraint and sway brace.

FIRE SUPPRESSION BASIC REQUIREMENTS

9. Provide details for any hanger, attachment, or sway brace to be attached to any I-joist, structural insulated panels (SIPs), cross laminated timber, and similar engineered structural products according to the specifications of the engineered product manufacturer.
 10. Provide Shop Drawings illustrating information for Sprinkler System General Information Sign.
 11. Shop Drawings to include a cross-sectional view that shows the sprinkler heads and piping in relation to the building's architectural and structural information. View to be chosen based on a location that will display the most information.
 12. When required, provide Coordination Drawings.
 13. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
 14. Provide details of hanger, sway bracing and branch line restraint attachments to structure and to piping. Include details on the size and load capacities of fasteners. Provide verification of the structural capacity to withstand seismic load.
 15. Provide sway bracing calculations on drawings showing horizontal seismic design load and requirements, with indication of zone of influence for each bracing location.
 16. Provide a schedule of sway bracing type, size, and design criteria, including length, angle from vertical, and load capacities.
 17. Clearly indicate the elevation of the highest sprinkler in relation to the elevation of the flow test pressure gauge monitor hydrant.
 18. Provide details of flexible sprinkler hose fitting per manufacturer's schedule of equivalent feet used in hydraulic calculations, showing device length, maximum number of 90-degree bends and expected radius of bends.
 19. Provide a schedule of signage to be installed at each flexible sprinkler hose fitting.
 20. On the drawings, provide a list of number, model, temperature, sprinkler Identification number, manufacturer, orifice, deflector type, thermal sensitivity and pressure rating, quantity of each type to be contained in the spare sprinkler cabinet and the issue date or revision date of the list."
 21. Spare sprinkler head cabinet size indicating the number of spare sprinkler head to be contained therein.
- O. Samples: Provide samples when requested by individual Sections.
- P. Resubmission Requirements:
1. Make any corrections or change in submittals when required. Provide submittals as specified. The Engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Clearly indicate changes on Drawings and cloud changes in the submittals.
 2. Resubmit for review until review indicates no exceptions taken or make "corrections as noted".
- Q. Operation and Maintenance Manuals/Owner's Instructions:
1. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or Item requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
 - a. Include copies of certificates of code authority acceptance, code-required acceptance tests; test reports and certificates.

FIRE SUPPRESSION BASIC REQUIREMENTS

- b. Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Sections.
 - c. Catalog description of each Item of equipment actually installed on job.
 - d. Instructions for operation and maintenance of fire suppression systems composed of operating instructions, maintenance instructions and manufacturer's literature as follows:
 - 1) Testing and Maintenance Schedule Chart: Provide an 8-1/2- by 11-inch typewritten list of each item of installed equipment requiring testing inspection , lubrication or service, describing and scheduling performance of maintenance.
 - 2) Manufacturer's Literature: Provide copies of manufacturer's instructions for operation and maintenance of fire suppression equipment, including replacement parts list with name and address of nearest distributor. Mark each copy with equipment identification label as listed in equipment schedule, i.e. F-5 etc.
 - e. Include product certificates of warranties and guarantees.
 - f. Include Record Drawings,
 - g. Include copy of water supply flow test used as basis for hydraulic calculations.
 - h. Include hydraulic calculations and sway brace calculations.
 - i. Include Contractor's Material and Test Certificates for Aboveground Piping.
 - j. Include a copy of NFPA 25.
 - k. Include a copy of valve charts and whether normally open or normally closed.
 - l. Include a copy of drain, auxiliary, and low point drains charts.
 - m. Include a copy of the list to be included in the spare sprinkler head box.
 - n. Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - o. Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, and quantities relevant to each piece of equipment: i.e. belts, motors, lubricants, and filters.
 - p. Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub-assemblies.
 - q. Include copy of startup and test reports specific to each piece of equipment.
 - r. Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
- 2. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 21 00 00, Fire Suppression Basic Requirements, Article titled "Demonstration".
 - 3. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
- R. Record Drawings:

FIRE SUPPRESSION BASIC REQUIREMENTS

1. Maintain at site at least one set of Drawings for recording "As-constructed" conditions. Indicate on Drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical Item. Include items changed by field orders, supplemental instructions, and constructed conditions.
 2. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
 3. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.
 4. Invert elevations and dimensioned locations for water services and drainage piping below grade extending to 5-feet outside building line.
 5. Record Drawings to include site information or reference site information for complete understanding of the fire protection system between the building and the point of connection to the water supply and location of flow test pressure hydrants.
 6. See Division 21, Fire Suppression individual Sections for additional items to include in Record Drawings.
- S. Calculations: Submit hydraulic and sway brace and the like calculations.
1. Hydraulic Calculations:
 - a. Include friction losses between the hydraulically most remote design area and the hydrant flow test pressure hydrant.
 - b. Hydraulic calculations to be performed on a nationally recognized fire sprinkler hydraulic calculation computer program, with cover sheets in the format required by the latest edition of NFPA 13. Hydraulic calculations performed "by hand" or not on a nationally recognized fire sprinkler hydraulic calculations computer program will be returned without review by engineer.
 - c. Provide one or more hydraulic calculations for each hydraulically most remote area.
 - d. Where it is not obvious which area is most hydraulically remote, perform and submit for review additional hydraulic calculations proving the hydraulically most remote area.
 - e. For grid systems, either provide "peaked" hydraulic calculations, or provide two additional sets of hydraulic calculations for each hydraulically most remote area.
 - f. Include pressure losses between the highest sprinkler and the elevation of the pressure gauge monitor hydrant of the flow test.
 - g. Include friction loss for flexible branch line connectors per manufacturer's schedule of equivalent feet for device length, maximum number of bends and expected radius of bends.
 - h. When flexible sprinkler hose fittings are added to an existing system, provide hydraulic calculations verifying the design flow rate will be achieved."
 - i. For Future Tenant Improvement Spaces: Include in hydraulic calculations friction loss allowances for future installation of flexible sprinkler head connectors so that flexible connectors may be installed in the future without revisions to the overhead system.
 2. Sway Brace Calculations:
 - a. Sway brace calculations utilizing a proprietary computer calculation program only used for the sway brace components supported by that manufacturer. For example, only "manufacturer X" sway brace components, and not those of another manufacturer, may be calculated on a "manufacturer X" sway brace computer calculation program.

FIRE SUPPRESSION BASIC REQUIREMENTS

- b. Provide seismic calculations for any sway brace to be attached to any I-joist, structural insulated panels (SIPs), cross laminated timber, and similar engineered structural products according to the specifications of the I-joist manufacturer.

1.9 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every Item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.
- G. Piping Insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.10 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.11 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, fire alarm, plumbing, cable trays, lights, and electrical services with architectural and structural requirements, and other trades

FIRE SUPPRESSION BASIC REQUIREMENTS

(including fire alarm ceiling suspension and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, and finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.

- B. Advise Architect in the event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- C. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation.
- D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to sprinkler heads, pipe, fittings, hangers and bracing materials.

2.2 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL, ETL, FM, and ICC-ES approved for their intended fire protection function or have adequate approval or be acceptable by State, County, and City authorities.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
 - 1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
 - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

2.3 ACCESS PANELS

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.
- B. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 21, Fire Suppression Sections. In absence of specific requirements, comply with the following:
 - 1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
 - a. Ceiling access panels to be minimum of 24-inch by 24-inch required and approved size.
 - b. Wall access panels to be minimum of 12-inch by 12-inch required and approved size.

FIRE SUPPRESSION BASIC REQUIREMENTS

- c. Provide screwdriver operated catch.
- d. Manufacturers and Models:
 - 1) Drywall: Karp KDW.
 - 2) Plaster: Karp DSC-214PL.
 - 3) Masonry: Karp DSC-214M.
 - 4) 2 hour rated: Karp KPF-350FR.
 - 5) Manufacturers: Karp, Milcor, Elmdor, Acudor or approved equivalent.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- B. Install equipment requiring access (i.e. drains, control operators, valves, motors, engines, pumps, controllers, air compressors, gauges, fill cups, tanks, cleanouts and the like) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.
- D. Firestopping:
 - 1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection.
 - 2. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM International E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- E. Pipe Installation:
 - 1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating coordinating installation of piping systems.
 - 2. Include provisions for servicing and removal of equipment without dismantling piping.
- F. Plenums: Provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

FIRE SUPPRESSION BASIC REQUIREMENTS

3.2 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 21, Fire Suppression Sections.
- B. Provide fire suppression equipment and piping, both hanging and base mounted, with mounting connection points of sufficient strength to resist lateral seismic forces equal to lateral seismic forces as determined by building code and NFPA 13 calculations, whichever is more demanding.
- C. See Structural Drawings for seismic design criteria for sway bracing and seismic restraint.
- D. Earthquake resistant designs for Fire Protection (Division 21) equipment and distribution, i.e. fire sprinkler systems, fire standpipe systems, fire pumps, fire pump controllers, fire tanks, clean agent fire suppression systems, etc. to conform to regulations of jurisdiction having authority.
- E. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
- F. Provide stamped Shop Drawings from licensed Engineer of seismic bracing and seismic movement assemblies for piping, equipment, tanks, pumps controllers and the like. Submit shop drawings along with equipment submittals.
- G. Provide stamped Shop Drawings from licensed Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details.
- H. Provide details of flexible drops for sprinklers in conformance with Building Code and ASCE 7 requirements of ceilings. Coordinate with Architectural and Structural Drawings and Specifications.
- I. Piping: Per NFPA 13, ASCE-7 and local requirements.
- J. Equipment:
 - 1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA, ASCE 7 and local requirements.
 - 2. Provide means to prohibit excessive motion of fire protection equipment during an earthquake.

3.3 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- B. Notify Architect or Engineer, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 - 1. Prior to covering walls.
 - 2. Prior to ceiling cover/installation.
 - 3. When main systems, or portions of, are being tested and ready for inspection by AHJ.

FIRE SUPPRESSION BASIC REQUIREMENTS

4. When mains or branchlines are to be permanently concealed by construction or insulation systems.
 5. When fire suppression systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Bear responsibility and cost to make piping accessible, to expose concealed lines, or to demonstrate acceptability of the system. If Contractor fails to notify Architect at times prescribed above, costs incurred by removal of such work are the responsibility of the Contractor.
- D. Final Punch: Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:
1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
 2. Prior to changing over to new service, verify that every Item is thoroughly prepared. Install new piping, and wiring to point of connection.
 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference at a minimum. If overtime is required, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 4. During entire time system, or part thereof, is not operational, provide a firewatch per Fire Code, including a watchperson whose sole duty is to watch for and report fires.
 5. Organize work to minimize duration of power interruption.

3.5 CUTTING AND PATCHING

- A. Confirm Cutting and Patching requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:
1. Cutting and patching performed under Division 21, Fire Suppression includes, but is not limited to:
 - a. Cutting and patching of plaster or partitions.
 - b. Cutting and patching of finished ceilings.
 2. Perform cutting and patching by skilled craftsmen in trade of work to be performed. Fill holes which are cut oversized for completed work. Match refinished areas with existing adjacent finish in a manner acceptable to Architect.
 3. When masonry to concrete construction must be penetrated, provide a steel pipe sleeve in opening and grout in place in a neat manner. Leave grout surface to match existing finish. Provide escutcheons. If sleeves are not provided, core drill penetrations.
 4. Locate concealed utilities to eliminate possible service interruption or damage.
 5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.
 6. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project

FIRE SUPPRESSION BASIC REQUIREMENTS

Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).

7. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
8. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
9. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, landscaping, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
10. Repair mutilation of building around pipes, equipment, hangers, and braces.

3.6 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing at no additional cost to Owner.

3.7 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage and deterioration. Store materials in original containers which identify manufacturer, name, brand and model numbers on site inside building or protected from weather, sun, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.
 2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 3. Protect bright finished shafts, bearing housings and similar Item until in service.

3.8 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

FIRE SUPPRESSION BASIC REQUIREMENTS

- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.
- D. Prior to acceptance of work and during time designated by Architect, provide necessary qualified personnel to operate system for a period of two hours.
- E. Instruct the Owner in the operation of the sprinkler system, including main valve position (open or closed) recognition, system drainage, system testing, dry pipe valve reset and the relation to the fire alarm system.
- F. Upon completion of work and adjustment of equipment, test systems to demonstrate to Owner's Authorized Representative and Architect that equipment is furnished and installed or connected under provisions of these Specifications.

3.9 CLEANING

- A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- B. Upon completion of installation, except for sprinklers, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.
- C. Sprinklers may not be cleaned except for vacuuming in a manner in which no part of the sprinkler is touched by the vacuuming equipment. Replace sprinklers which bear traces of foreign substances with sprinklers of same model, temperature, K-factor, orifice, finish, style, orientation, and the like.

3.10 INSTALLATION

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- B. Install equipment in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start-up equipment, in accordance with manufacturer's start-up instructions, in the presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment. Provide pump impellers to obtain Basis of Design design capacities.
- D. Provide miscellaneous supports/metals required for installation of equipment and piping.

3.11 PAINTING

- A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:

FIRE SUPPRESSION BASIC REQUIREMENTS

1. Ferrous Metal: After completion of fire protection work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
2. After acceptance by Authority Having Jurisdiction (AHJ), in a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
3. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
4. Piping: Clean, primer coat and paint exposed piping on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
5. Covers: Covers such as vault covers and the like will be furnished with finishes which resist corrosion and rust.

3.12 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:
 1. Coordinate locations/sizes of access panels with Architect prior to work. Label access panels with engraved nameplates indicating function of panel.

3.13 DEMOLITION

- A. Confirm Demolition requirements in Division 01, General Requirements and Division 02, Existing Conditions. In absence of specific requirements, comply with individual Sections in Division 21, Fire Suppression and the following:
 1. Scope:
 - a. It is the intent of these documents to provide necessary information and adjustments to fire protection system required to meet code, and accommodate installation of new work.
 - b. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
 - c. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve underground utilities. Replace damaged Item with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
 2. Equipment and Piping: Unless otherwise directed, equipment, piping, or fittings being removed as part of demolition process are Owner's property. Remove other Item not scheduled to be reused or relocated from job site as directed by Owner.
 3. Unless specifically indicated on Drawings, remove exposed, unused piping to behind finished surfaces (floor, walls, ceilings, etc.). Cap piping and patch surfaces to match surrounding finish.
 4. Unless specifically indicated on Drawings, remove unused equipment, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).
 5. Coordinate demolition of existing fire suppression systems with Contractor. Where applicable or possible, portions of fire suppression demolition work may be performed by Contractor. Verify with local AHJ as to limitations of demolition by others and not fire suppression trades. Coordinate extent of demolition of fire suppression work to be

FIRE SUPPRESSION BASIC REQUIREMENTS

done by others and supervise this work. No extra costs will be approved by replacement of systems due to improper or excessive demolition.

3.14 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Sections in Division 21, Fire Suppression and the following:
 - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Testing reports including Contractor's Material and Test Certificate for Aboveground Piping and the like.
 - b. Cleaning
 - c. Operation and Maintenance Manuals
 - d. Training of Operating Personnel
 - e. Record Drawings
 - f. Warranty and Guaranty Certificates
 - g. Start-up/Test Document and Commissioning Reports
 - h. Letter of Conformance

3.15 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- B. Upon completion of installation of equipment, sprinklers, hose valves and piping and after units are water pressurized, test system to demonstrate capability and compliance with requirements. When possible, correct malfunctioning Item at site, then retest to demonstrate compliance; otherwise remove and replace with new Item and proceed with retesting.
- C. Inspect each installed Item for damage to finish. If feasible, restore and match finish to original, except fire sprinklers, at site; otherwise, remove Item and replace with new Item. Feasibility and match to be judged by Architect. Remove cracked or dented Item and replace with new Item.
- D. Fire sprinklers may not be reused, or cleaned, except for dusting. Replace damaged, field painted, oversprayed, overcoated or field coated sprinklers with new sprinklers of same manufacturer, model, finish, K-factor and performance characteristics. Where identical replacement sprinklers are not available, provide sprinklers of similar finish, style, K-factor and performance characteristics.

3.16 ELECTRICAL INTERLOCKS

- A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize fire protection equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

FIRE SUPPRESSION BASIC REQUIREMENTS

3.17 CONNECTIONS TO EXISTING

- A. Prior to connection of piping to existing piping or utilities, field verify existing conditions and exact sizes and locations of existing piping. Provide additional offsets, transitions, joints, cut-ins, and replace portions of existing as required to facilitate connections of new.

END OF SECTION

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Aboveground Black Steel Pipe and Fittings
 - 2. Wall and Floor Penetrations and Sleeves
 - 3. Hangers and Supports
 - 4. Struts and Strut Clamps
 - 5. Sway Braces and Restraints
 - 6. Anchors and Attachments
 - 7. Pipe Stands
 - 8. Valves
 - 9. Pipe, Valve, and Fire Protection Equipment Identification
 - 10. Signs
 - 11. Drains

1.2 RELATED SECTIONS

- A. Contents of Division 21, Fire Suppression and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Division 22, Plumbing
 - 2. Division 23, Heating, Ventilating and Air Conditioning
 - 3. Division 26, Electrical
 - 4. Division 28, Electronic Safety and Security
 - 5. Section 21 00 00, Fire Suppression Basic Requirements
 - 6. Section 21 13 00, Fire Suppression Sprinkler Systems
 - 7. Section 21 13 19, Fire Suppression Preaction Sprinkler Systems

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.
- B. Meet requirements of ASCE 7, Minimum Design Loads for Buildings and Other Structures, by American Society of Civil Engineers, latest adopted edition.

1.4 SUBMITTALS

- A. Submittals as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Material and Equipment: Listed for its intended fire protection use in current UL Fire Protection Equipment Directory, or UL Online Certifications Directory for Fire

COMMON WORK RESULTS FOR FIRE SUPPRESSION

Protection, International Code Council Evaluation Service Reports, or FM Global Approval Guide. All material and equipment to be new and from a current manufacturer.

2. Provide per AHJ requirements.
3. References to product Specifications for materials are listed according to accepted ANSI, ASTM, ASME, AWWA and other base standards. Materials to meet latest approved versions of these standards.
4. Fire Suppression Screw-Thread Connections: Comply with local fire department/fire marshal regulations for sizes, threading and arrangement of connections for fire department equipment to fire department connections.
5. Manufacturers: Unless an item is marked "No substitutions", submit substitution request for materials of other than named manufacturers.
6. Noise and Vibration:
 - a. Install vibration isolators and measures required to prevent noise and vibration from being transmitted to occupied areas. Select equipment to operate within noise coefficient (NC) design level for particular type of installation in relation to its location.
 - b. After installation, make proper adjustments to reduce noise and vibration to acceptable levels as defined by Architect.
 - c. In acoustically sensitive areas, design system in a manner that minimizes the number of wall penetrations.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.7 FLOW TEST

- A. If flow test information provided below has been conducted greater than 12 months prior to working plan submittal, the information provided is advisory only and not to be used for design. Provide materials and labor for a new water supply test on the closest nearby fire hydrants per NFPA 13 and NFPA 291. Utilize new flow test results for design of NFPA 13 fire sprinkler and NFPA 14 standpipe systems.
- B. Flow Test:
 1. Flow: 1634 GPM at a residual pressure of 57 PSI.
 2. Static Pressure: 64 PSI.
 3. Location: Site hydrant NW of building.
 4. Date: 01/22/2016, 9:30 AM.
 5. Information Provided By: Viking Sprinkler.

1.8 SYSTEM IMPAIRMENT

- A. When returning a water-based fire protection system to service after impairment or control valve closure, verify the system is in working order by performing a main drain test per NFPA 25.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Aboveground Black Steel Pipe and Fittings:
 1. Pipe:
 - a. Bull Moose Tube
 - b. Wheatland Tube Company

COMMON WORK RESULTS FOR FIRE SUPPRESSION

- c. Youngstown Tube Company
 - d. Tex-Tube Company
 - e. State Pipe and Supply, Incorporated
 - f. Or approved equivalent
 - 2. Fittings, Mechanical and Grooved Couplings:
 - a. Victaulic
 - b. Gruvlok
 - c. Shurjoint Piping Products Incorporated
 - d. Smith-Cooper International
 - e. Tyco Fire & Building Products
 - f. Viking Corporation
 - g. Allied Rubber and Gasket Company Incorporated, dba ARGCO
 - h. Anvil International
 - i. Dixon Valve & Coupling
 - j. Or approved equivalent.
 - 3. Fittings, Threaded:
 - a. Ward Manufacturing
 - b. Anvil International
 - c. Smith-Cooper International
 - d. Aegis Technologies
 - e. Or approved equivalent.
 - 4. Fittings, Rubber Gasketed:
 - a. Victaulic
 - b. Anvil International
 - c. AnvilStar
 - d. EBAA Iron, Incorporated
 - e. Shurjoint Piping Products, Incorporated
 - f. Smith-Cooper International
 - g. Tyco Fire & Building Products
 - h. Viking Corporation
 - i. Ward Manufacturing
 - j. Allied Rubber and Gasket Company Incorporated, dba ARGCO
 - k. Dixon Valve & Coupling
 - l. Or approved equivalent.
 - 5. Fittings, Welded:
 - a. Anvil International
 - b. Shurjoint Piping Products Incorporated
 - c. Smith-Cooper International
 - d. State Pipe & Supply, Incorporated
 - e. Or approved equivalent.
 - 6. Fittings, Flanged:
 - a. Victaulic; Groove/Flange Adapter.
 - b. United Brand Fittings
 - c. U.S. Pipe
 - d. Anvil S.P.F.
 - e. Iowa Fittings Company
 - f. Tyco Fire Products; Grinnell Groove/Flange Adapter
 - g. Or approved equivalent.
- B. Wall and Floor Penetrations and Sleeves:

COMMON WORK RESULTS FOR FIRE SUPPRESSION

1. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
 2. Fire Protection Products Incorporated (FPPI)
 3. Or approved equivalent.
- C. Hangers and Supports:
1. Cooper B-Line Tolco:
 - a. Ring Hangers: Figure 200.
 - b. U-Bolts: Model B3188.
 - c. Straps:
 - 1) Figure 22.
 - 2) Figure 22L2.
 - 3) Figure 23.
 - 4) Figure 24.
 - 5) Figure 28.
 - 6) Figure 29.
 - 7) Model B3184.
 - d. Riser Clamps: Model B3373.
 - e. Pipe Clamps: Model B3140, Figure 4B.
 2. Anvil International
 3. ITW Buildex Sammys
 4. Erico International
 5. PHD Manufacturing Incorporated
 6. Or approved equivalent.
- D. Struts and Strut Clamps:
1. Struts:
 - a. Cooper B-Line Tolco
 - b. Or approved equivalent.
 2. Strut Clamps:
 - a. Cooper B-Line Tolco; Model B2400.
 - b. Or approved equivalent.
- E. Sway Braces and Restraints:
1. Cooper B-Line Tolco:
 - a. Fig. 75
 - b. Fig. 4A
 - c. Fig. 4L
 - d. Fig. 4LA
 - e. Fig. 800
 - f. Fig. 825
 - g. Fig. 825A
 - h. Fig. 828
 - i. Fig. 906
 - j. Fig. 910
 - k. Fig. 975
 - l. Fig. 980
 - m. Fig. 1000
 - n. Fig. 1001
 - o. Fig. 2002
 2. Anvil International

COMMON WORK RESULTS FOR FIRE SUPPRESSION

3. Erico International
 4. PHD Manufacturing Incorporated
 5. Or approved equivalent.
- F. Anchors and Attachments:
1. Concrete:
 - a. Cast-In Place Anchors for Hangers:
 - 1) Cooper B-Line Tolco; Models 109, 109AF, B2500 with N2500 nut, or B3014 with B3014N nut.
 - 2) Erico International
 - 3) Or approved equivalent.
 - b. Cast-In Place Anchors for Braces:
 - 1) Cooper B-Line Tolco; Models B2500 with N2500 nut, or B3014 with B3014N nut.
 - 2) Anvil International; Figure 282 with nut.
 - 3) Erico International
 - 4) Or approved equivalent.
 - c. Attachments as specified or described by structural. If not specified or described by structural, then as follows:
 - 1) Hilti; Model Kwikbolt TZ
 - 2) Powers; Models Snake+, Power Stud+ SD2, or Powers Wedge-Bolt.
 - 3) Simpson Strong-Tie
 - 4) DeWalt; Mini-Undercut+, internally threaded undercut anchor.
 - 5) Or approved equivalent.
 2. Wood:
 - a. Cooper B-Line Tolco:
 - 1) Fig. 50
 - 2) Fig. 51
 - 3) Fig. 56
 - 4) Fig. 58
 - 5) Fig. 78
 - 6) Fig. 120
 - 7) Fig. 130
 - b. Anvil International
 - c. Elco Construction Products, Hangermate
 - d. Erico International
 - e. ITW Buildex Sammys
 - f. Or approved equivalent.
 3. Steel:
 - a. Cooper B-Line Tolco:
 - 1) Model B3037
 - 2) Model B3033
 - 3) Model B3034
 - 4) Fig. 65
 - 5) Fig. 66
 - 6) Fig. 67
 - 7) Fig. 68
 - 8) Fig. 69
 - 9) Model B3042T
 - 10) Fig. 22L2

COMMON WORK RESULTS FOR FIRE SUPPRESSION

- 11) Fig. 23
 - 12) Fig. 24
 - 13) Fig. 28
 - 14) Fig. 78
 - b. Anvil International
 - c. Elco Construction Products, Hangermate
 - d. Erico International
 - e. ITW Buildex Sammys
 - f. Or approved equivalent.
- G. Pipe Stands:
 - 1. Cooper B-Line Tolco; Fig B3092 with Fig. B3088ST.
 - 2. Anvil International; Figure 259 with Figure 62 or 63.
 - 3. Or approved equivalent.
- H. Valves:
 - 1. OS&Y Gate:
 - a. 175 PSI:
 - 1) Nibco; Model F-607-0.
 - 2) Mueller; Model R-2360-6.
 - 3) Or approved equivalent.
 - b. 250 PSI:
 - 1) Victaulic; Model 771.
 - 2) Or approved equivalent.
 - c. 350 PSI:
 - 1) Nibco; Model F697-0.
 - 2) Or approved equivalent.
 - d. 2-inches and Smaller:
 - 1) Nibco; Model T-104.
 - 2) Or approved equivalent.
 - 2. Swing Check:
 - a. Victaulic; Model 717.
 - b. Nibco; Model F-908-W.
 - c. Mueller; Model A-2122-6.
 - d. Viking Easy Riser Swing Check.
 - e. Tyco; Model CV-1F.
 - f. AnvilStar; Series 78FP.
 - g. Reliable; Model G.
 - h. Or approved equivalent.
 - 3. Wafer Check:
 - a. Nibco; Model W-900-W.
 - b. Mueller; Model A2102.
 - c. Viking
 - d. Tyco
 - e. Or approved equivalent.
 - 4. Butterfly Valves:
 - a. Victaulic; Series 705, Series 707, Series 765, Series 766.
 - b. Nibco; Model WD3510-8.
 - c. Tyco; Model BFV-N.
 - d. Use lug body next to pumps; Nibco; Model LD-3510-6.

COMMON WORK RESULTS FOR FIRE SUPPRESSION

- e. Reliable; Model REL-BFG-300-I.
 - f. Or approved equivalent.
 - 5. Automatic Air Release Valve:
 - a. Potter Electric Signal Company
 - b. Or approved equivalent.
 - 6. Ball Valve:
 - a. Victaulic; Series 728.
 - b. Apollo Valves; 64 Series, 1/4-inch through 2-inches.
 - c. Fire Protection Products Incorporated (FPPI)
 - d. Nibco; Models KX-505-W-8, KT-580-70-UL, or KT-585-70-UL.
 - e. Or approved equivalent.
 - I. Pipe, Valve, and Fire Protection Equipment Identification:
 - 1. Fire Protection Products, Incorporated (FPPI)
 - 2. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
 - 3. Or approved equivalent.
 - J. Signs:
 - 1. Tyco Fire Products
 - 2. Reliable Automatic Sprinkler
 - 3. Viking Corporation
 - 4. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
 - 5. Or approved equivalent.
 - K. Drains:
 - 1. Reference Aboveground Black Steel Pipe and Fittings.
 - 2. AGF
 - 3. Victaulic
 - 4. Or approved equivalent.
- 2.2 ABOVEGROUND BLACK STEEL PIPE AND FITTINGS
 - A. Wet Pipe Systems:
 - 1. Pipe Size 2-inch Diameter and Smaller: ASTM A53, ASTM A135, or ASTM A795; minimum Corrosion Resistance Ratio (CRR) of 1.00 per UL Listing or FM Global Approval.
 - 2. Pipe Size 2-1/2-inch Diameter and Larger: ASTM A53, ASTM A135, or ASTM A795; minimum of Schedule 10 or minimum CRR of 1.00 per UL Listing or FM Global approval. Wall thickness greater than Schedule 5. Schedule 5 not approved.
 - 3. Exposed pipe 8-feet or less above finished floor: A minimum of Schedule 40.
 - B. Dry Pipe Systems:
 - 1. Pipe Size 2-inch Diameter and Smaller: ASTM A53, ASTM A135, or ASTM A795; Schedule 40 only, shop welded, or threaded or cut grooved.
 - 2. Pipe Size 2-1/2-inch Diameter and Larger: ASTM A53, ASTM A135, or ASTM A795; minimum of Schedule 10.
 - 3. Exposed pipe 8-feet or less above finished floor: Minimum of Schedule 40.
 - C. Joints:
 - 1. Threaded, flanged or bevel welded.
 - 2. Piping installed in plenums or shafts to have welded joints.

COMMON WORK RESULTS FOR FIRE SUPPRESSION

- D. Fittings:
 - 1. Threaded:
 - a. Malleable Iron: Class 150 and Class 300, ANSI B16.3.
 - b. Cast Iron: Class 125 and 250, ANSI B16.3.
 - 2. Flanged:
 - a. Cast iron; Class 125 and 250, ASME B16.1.
 - b. Raised ground face, bolt holes spot faced.
 - 3. Welded:
 - a. Carbon Steel: Long radius, standard weight or extra strong.
 - b. Factory Wrought Steel Buttweld Fittings: ASME B16.9.
 - c. Buttwelding Ends for Pipe, Valves, Flanges and Fittings: ASME B16.25.
 - d. Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures: ASTM A234.
 - e. Steel Pipe Flanges and Flanged Fittings: ASME B16.5.
 - f. Forged Steel Fittings, Socket Welded and Threaded: ASME B16.11.
 - 4. Mechanical Fittings and Grooved Couplings:
 - a. Couplings: UL 213, AWWA C606, ASTM A536 ductile iron or ASTM A47 malleable iron, with enamel finish and grooves or shoulders designed to accept grooved couplings. Synthetic-rubber gasket with central-cavity, pressure-responsive design and ASTM A183 carbon-steel bolts and nuts.
 - b. FM Global approved.
 - E. Anti-Microbial Coating: Factory-applied coating to inhibit corrosion from microbiological organisms.
- 2.3 WALL AND FLOOR PENETRATIONS AND SLEEVES
- A. Below Grade and High Water Table Areas: Waterproof elastomeric compound.
- 2.4 HANGERS AND SUPPORTS
- A. General: Select size of hangers and supports to exactly fit pipe size for bare piping.
 - B. Hangers: Ferrous.
 - C. Hanger Rods: Zinc electroplated carbon steel.
 - D. Finishes: Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
 - E. Materials:
 - 1. Use carbon steel pipe hangers and supports, metal trapeze pipe hangers and attachments for general service applications.
 - 2. Use stainless steel hangers, rods and attachments for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries and the like.
 - F. Anti-Scratch Padding: Use padded hangers for piping subject to scratching.

COMMON WORK RESULTS FOR FIRE SUPPRESSION

2.5 STRUTS AND STRUT CLAMPS

- A. Electro-galvanized steel.
- B. Designed for supporting pipe runs from strut supports.
- C. Strut clamps UL listed for fire protection.
- D. Stainless steel for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries and the like.

2.6 SWAY BRACES AND RESTRAINTS

- A. Sway Bracing: From a single manufacturer and compatible with sway brace calculation program.
- B. Stainless steel for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries, and the like.

2.7 ANCHORS AND ATTACHMENTS

- A. General: Anchor supports to masonry, concrete and block walls per anchoring system manufacturer's recommendations, or as modified by project Structural Engineer.
- B. Materials:
 - 1. Ferrous.
 - 2. Stainless steel for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries, and the like.
- C. Cast in Place Anchors for Hangers: Verify listing is for hangers, braces, or both.
- D. Attachments in Concrete:
 - 1. Suitable for hanging and bracing fire protection systems in concrete which is subject to cracking in a seismic event.
 - 2. Seismic Design Areas C, D, E and F:
 - a. Compatible with International Code Council Evaluation Service Acceptance Criteria AC-193 and AC308 for expansion, screw and adhesive anchors. Meet requirements of ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary.
 - b. All models of Hilti HDI and ITW Red Head Multi-Set II anchors are not approved for attaching fire protection systems in Seismic Design Areas C, D, E and F. No Exceptions.
- E. ITW Buildex Sammys with FM Approval only are not allowed in certain seismic zones. Verify with FM that FM Approval is effective in project's seismic zone.

COMMON WORK RESULTS FOR FIRE SUPPRESSION

2.8 PIPE STANDS

- A. Adjustable Pipe Saddle Support with Yoke:
 - 1. Designed to support horizontal pipe from floor stanchion.
 - 2. U-bolt and hex nuts to hold pipe securely to saddle or pipe clamp type.
 - 3. ANSI/MSS SP-69; SP-58. Type 37.
 - 4. Steel pipe with steel saddle.
- B. Base Stand:
 - 1. Steel pipe welded to steel base plate.
 - 2. Meet requirements of 12X anchor diameter hole spacing for seismic applications.

2.9 VALVES

- A. OS&Y Gate:
 - 1. 2-1/2-inches and Larger: Iron body.
 - 2. 2-inches and Smaller: Bronze body.
- B. Swing Check: Iron body, rubber and bronze faced checks.
- C. Wafer Check: Iron body, rubber seat, spring actuated.
- D. Butterfly Valves: Ductile iron body with factory-installed tamper switches. Use lug body next to pumps.
- E. Pressure Relief: Bronze body, stainless steel spring.
- F. Automatic Air-Release Valve for Wet Systems:
 - 1. Rated to 175 psi.
 - 2. Automatic float-type with shutoff mounted in a water retention pan.
 - 3. Single set 24VAC@2A for electronic supervision.
 - 4. Ball valve switch with cover tamper.
- G. Ball Valves: Brass body, brass stem; forged brass ball disc.

2.10 PIPE, VALVE, AND FIRE PROTECTION EQUIPMENT IDENTIFICATION

- A. Engraved plastic laminate or corrosion resistant metal sign or plastic equipment marker.
- B. Corrosion-resistant chain or permanent adhesive.

2.11 SIGNS

- A. Engraved plastic laminate or corrosion resistant metal sign or plastic equipment marker.
- B. Corrosion-resistant chain or permanent adhesive.

2.12 DRAINS

- A. Reference Aboveground Black Steel Pipe and Fittings.

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install in conformance with UL Listing, FM Approval or ICC-ES requirements and restrictions.

3.2 ABOVEGROUND BLACK STEEL PIPE AND FITTINGS

A. Piping Routing:

1. Route piping, except as otherwise indicated, vertically and horizontally (sloped to drain). Avoid diagonal runs wherever possible. Orient horizontal routes parallel with walls and beam lines.
2. Install piping as shown or described by diagrams, details and notations on Drawings or, if not indicated, install piping to provide the shortest route which does not obstruct usable space or block access for servicing the building and its equipment.
3. Install piping in concealed spaces above finished ceilings. Prior to design and installation, obtain pre-approval by Architect for exposed piping.
4. In open-to-structure areas which are open to public view, route exposed piping to minimize visual impact. Obtain Architect's and Engineer's approval of exposed piping installation.
5. Coordinate installation with other trades. Route piping as required to avoid building structure, equipment, plumbing piping, HVAC piping, ductwork, lighting fixtures, electrical conduits and bus ducts and similar work. Final location of lighting will have priority over final sprinkler locations. Provide drains to trapped sections of system which result from such routing. Other trades take precedence for installation space.
6. Support piping adjacent to walls, overhead construction, columns and other structural and permanent enclosure elements of the building. Limit clearance to 2-inches wherever furring is indicated for concealment of piping. Allow for insulation thickness. Locate insulated piping to provide minimum 1-inch clearance outside insulation.
7. Wherever possible in finished and occupied spaces, conceal piping from view by locating within column or beam enclosures, hollow wall construction, or above suspended ceilings. Do not encase horizontal routes in solid partitions, except where approved.
8. General Electrical Equipment Clearances: Do not route piping through electrical rooms, transformer vaults, elevator equipment rooms and other electrical or electronic equipment spaces and enclosures. Do not route piping above electric power or lighting panel, switchgear, low voltage panel, or similar electric device.
9. Rooms Protected by Alternative Systems: Route water filled and dry system piping around rooms protected by pre-action systems, clean agent systems, gaseous suppression systems and other alternative fire suppression systems.
10. Install pipe runs to minimize obstruction to other work.
11. Pitch all dry and pre-action system piping 1/4-inch per 10-feet for mains and 1/2-inch per 10-feet for branch lines, including pipe passing through both warm and cold areas.

B. Couplings:

1. Install where indicated on Drawings and on each side of pieces of equipment to permit easy removal of equipment.
2. Deburr cut edges.

C. Pipe Penetrations: Wire pipe cutout coupon at point of pipe penetration.

D. Pipe and Pipe Fittings:

COMMON WORK RESULTS FOR FIRE SUPPRESSION

1. Expansion and Flexibility: Install work with due regard for expansion and contraction to prevent damage to the piping, equipment, building and its contents. Provide piping offsets, loops, approved type expansion joints, sway bracing, wire restraints, vertical restraints, flexible couplings or other means to control pipe movement and to minimize pipe forces.
2. Coordinate support of pipe 4-inches and larger with Structural Engineer.
3. Provide clearances around piping per NFPA 13.
4. Install dry and pre-action welded pipe with welds facing vertically up, or where this is not possible, as close as possible to vertical between 46 degrees and 234 degrees. Intent is to minimize corrosion caused by moisture in the bottom of pipes.

3.3 WALL AND FLOOR PENETRATIONS AND SLEEVES

- A. Escutcheons: Install on exposed pipes passing through walls or floors.
1. Pipe Sleeves: Lay out work in advance of pouring concrete and furnish and set sleeves necessary to complete work.
 2. Floor Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1-inch above finished floor. Caulk pipes passing through floor with nonshrinking fire and water resistant grout or approved equivalent caulking compound. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements.
 3. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with non-shrinking caulking compound. Caulk/seal piping passing through fire-rated building assemblies with UL Listed or FM Approved fire-rated firestopping compound. Provide fire-rated assemblies per local AHJ requirements.
 4. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Penetrations must be indicated on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.
 5. Penetrations in Fire-Rated Wall/Floor Assemblies:
 - a. Reference Division 07, Thermal and Moisture Protection.
 - b. Coordinate with Drawings location of fire rated walls, ceilings and floors. When these assemblies are penetrated, seal around piping and equipment with approved firestopping material.
 - c. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814 and NFPA.
 - d. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814.

3.4 HANGERS AND SUPPORTS

- A. Installation of pipe hangers, inserts and supports to conform to NFPA 13. Provide adjustable hangers, inserts, brackets, clamps, supplementary steel and other accessory materials required for proper support of pipe lines and equipment. Provide supplementary materials for proper support and attachment of hangers.

COMMON WORK RESULTS FOR FIRE SUPPRESSION

3.5 STRUTS AND STRUT CLAMPS

- A. Install per manufacturer's listed orientation.

3.6 SWAY BRACES AND RESTRAINTS

- A. Locate per orientation and spacing as required by sway brace calculations.
- B. Attach sway bracing directly to pipe or equipment being braced.
- C. Do not attach sway bracing to bottom of truss members.

3.7 ANCHORS AND ATTACHMENTS

- A. In post-tension construction, determine location of post-tension cables and install anchors to avoid contact or interference with post-tension cables. Coordinate with Structural.
- B. Do not use powder-driven attachments.
- C. Building Attachments and Inserts: Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves and flanges, for sizes NPS 2-1/2 and larger. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- D. Hanger and Support Attachments:
 - 1. Concrete:
 - a. Before Pouring: Prior to installation, coordinate locations of cast in place concrete inserts with other trades. Install in accordance with manufacturer's instructions.
 - b. After Pouring:
 - 1) Where supports in slabs are required after concrete has been poured, provide drilled-in threaded inserts (mechanical-expansion anchors), installed in accordance with manufacturer's recommendations.
 - 2) Install mechanical-expansion anchors after concrete is completely cured and in accordance with manufacturer's installation instructions.
 - 3) Where anchors are to be installed in post-tension construction, determine and avoid locations of post-tension cables prior to drilling.
 - 2. Metal Floor Deck: Support hangers per UL Listing or FM Approval for selected concrete insert before pouring of concrete topping, or from beam clamps fastened to structural steel.
 - 3. Steel Joists: Support hangers from beam clamps fastened to bar joists or to auxiliary steel between bar joists as required.
 - 4. C-Clamp Hangers: Do not attach to one side of double-angle bottom members.
 - 5. Locate and install hangers, supports and attachments connecting to I-joists, structural insulated panels (SIPs), cross laminated timber and similar engineered structural products according to the structural product manufacturer specifications.
- E. Make available to the Architect information required to verify the anchorage, sway bracing and restraint of fire protection systems.

3.8 PIPE STANDS

- A. Secure to floor.

COMMON WORK RESULTS FOR FIRE SUPPRESSION

- B. Install to maintain pipe level and plumb.
- C. Securely attach to supported pipe by u-bolt.

3.9 VALVES

- A. General:
 - 1. Provide post indicator on buried control valves.
 - 2. Inspect valves for leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.
- B. Installation:
 - 1. Install valves where required for proper operation, testing and drainage. Locate valves so as to be accessible and so that separate support can be provided when necessary. Install conveniently and accessibly located with reference to finished building for repairs, removal and service.
 - 2. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow.
 - 3. Wafer Check Valves: Install between two flanges in horizontal or vertical position, position for proper direction of flow.
- C. Pressure Relief Valves: Provide piping to permanent drain.
- D. Valve Sequencing:
 - 1. Provide fire-alarm-supervised sectional control/isolation valves so that areas of the sprinkler system can be left in operation while providing isolation in the demolition areas.
 - 2. Sequence demolition with installation of new supplies to future phasing. Provide temporary supplies where piping serving a later phase runs through an area of an earlier phase. Sequence with architectural and structural phasing plans.

3.10 PIPE, VALVE, AND FIRE PROTECTION EQUIPMENT IDENTIFICATION

- A. Install engraved plastic laminate or corrosion resistant metal sign or plastic equipment marker, secured with corrosion-resistant chain or permanent adhesive on or near each Item of fire suppression equipment and each operational device, as specified in this specification if not otherwise specified for each Item or device.
- B. Provide signs for the following general categories of equipment and operational devices: Valves, drains, pumps, standpipes, tanks and similar equipment.
- C. Each new piece of equipment to bear a permanently attached identification plate, listing manufacturer's name, capacities, sizes and characteristics.
- D. Piping to bear the manufacturer's name, schedule of thickness, size and ASTM identification number
- E. Provide valve tag on every valve, control device, main drain, auxiliary drain, and drum drip in each system. Exclude check valves and valves within factory fabricated equipment units. List each tagged valve in valve schedule for each piping system.
- F. List each tagged item and its location in valve schedule; identify on fire suppression drawings.

COMMON WORK RESULTS FOR FIRE SUPPRESSION

- G. Install framed, glass or rigid transparent plastic covered, mounted valve schedule and valve location drawing in main riser or fire pump room.
- H. Provide identification sign on ceiling tile below valve location.
- I. Provide permanent identification sign at pressure regulating valves stating required setting of pressure regulator.
- J. Adjusting: Relocate fire suppression identification device which has become visually blocked.
- K. Cleaning: Clean face of identification devices and glass frames of valve charts.

3.11 SIGNS

- A. General Information Signs: Provide a general information sign used to determine system design basis and information relevant to the inspection, testing and maintenance requirements required by NFPA 25, Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems. Such general information is to be provided with a permanently marked weatherproof metal or rigid plastic sign, secured with corrosion-resistant wire, chain, or other acceptable means. Such signs are to be placed at each system control rise loop and auxiliary system control valve. The sign is to include the following information:
 - 1. Name and Location of the Facility Protected
 - 2. Presence of High-Piled and/or Rack Storage
 - 3. Maximum Height of Storage Planned
 - 4. Flow Test Data
 - 5. Location of Auxiliary Drains and Low Point Drains
 - 6. Original Results of Main Drain Flow Test
 - 7. Name of Installing Contractor or Designer
 - 8. Indication of presence and location of other auxiliary systems.
- B. Dry Signs: At system riser supplying dry systems, provide the following information: volume in gallons contained in each system.

3.12 DRAINS

- A. Locate drain connections within 7-feet of floor. Provide piping capable of being fully drained.
- B. Provide a drain vent at top of vertical drains. Coordinate with Division 22, Plumbing.
- C. Coordinate location of auxiliary drains with Architect. Architect to approve location before drain is installed.
- D. Protect drains from tampering and accidental operation.
- E. Protect drain discharge at the exterior with a turned-down 45 degree elbow.

END OF SECTION

FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Sprinklers
 - 2. Flexible Sprinkler Hose Fitting Assembly - For fire sprinklers in suspended ceilings which are supplied by a wet pipe system.
 - 3. Oversized Sprinkler Escutcheons - For dry sprinklers in suspended ceilings which are supplied by a wet pipe or preaction sprinkler system.
 - 4. Sprinkler Guards
- B. This is a contractor designed system. Contact AHJ prior to bid to verify fire system requirements. Provide design compliant with codes as interpreted by AHJ.
- C. Scope:
 - 1. Revision and extension of existing system to new and remodeled areas.
 - 2. Dry-pipe sprinkler system and/or dry barrel sprinklers for areas subject to 40 degrees F or less.
 - 3. Provide at least one coordination meeting with Architect prior to shop drawing submittal to coordinate sprinkler, piping, drain and test connection locations, details and the like.
- D. Coordinate location and type of tamper, flow and pressure switches and fire alarm system.
- E. Provide electrical connections and wiring as required for a complete and operable system. Includes but is not limited to bells, air compressors, sump pumps, fire pumps, jockey pumps and pump controllers.

1.2 RELATED SECTIONS

- A. Contents of Division 21, Fire Suppression and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Division 22, Plumbing
 - 2. Division 23, Heating, Ventilating and Air-Conditioning
 - 3. Division 26, Electrical
 - 4. Division 28, Electronic Safety and Security
 - 5. Section 21 00 00, Fire Suppression Basic Requirements
 - 6. Section 21 05 00, Common Work Results for Fire Suppression
 - 7. Section 21 13 19, Fire Suppression Preacton Sprinkler Systems

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Hydraulic calculations.

FIRE SUPPRESSION SPRINKLER SYSTEMS

2. Sway brace calculations.
3. Details of sway bracing.
4. Details of interval and end of branch line restraints.
5. Details of flexible sprinkler hose fitting assembly, including number and radius of bends, corresponding to equivalent feet used in hydraulic calculations. Provide details of sign to be installed at each flexible sprinkler hose fitting assembly.
6. Details of oversized ceiling penetrations and oversized sprinkler escutcheons.
7. Trapeze hanger details and calculations, including size, length and material. Additionally, provide size, weight and number of pipes to be carried on the trapeze.
8. On submittal and As-Built drawings, provide text of sprinkler list to be installed in the spare sprinkler cabinet.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.7 SYSTEM DESCRIPTION

- A. Provide coverage for building areas as indicated. Field verify field conditions prior to submittal of bid. Adjust bid to provide protection features in accordance with applicable codes and interpretations by AHJ. Provide design and installation based on more stringent requirements if this specification and AHJ requirements differ from Code.
- B. Design Parameters: Assign sprinkler systems design requirements as defined in Code to areas and obtain approvals for these requirements from appropriate reviewing authority. These requirements include hazard classifications, sprinkler temperature ratings, density, sprinkler area and water supply requirements and availability. Provide fire pump with Code-required appurtenances and electrical requirements for complete and working water supply system if results of water supply test and hydraulic calculations indicate need for a booster pump. Provide design and installation based on more stringent requirement if AHJ requirements differ from Code.
- C. Sprinkler system design to include a 10 percent pressure and flow cushion between system demand point and available water supplies.
- D. Extend hydraulic calculations from hydraulically most remote design area back to location of pressure hydrant of flow test or effective point of water supply where characteristics of water supply are known.

1.8 EXTRA STOCK

- A. Provide extra sprinklers per code.
- B. Provide suitable wrenches for each sprinkler type and metal storage cabinet in riser room.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Sprinklers:

FIRE SUPPRESSION SPRINKLER SYSTEMS

1. Finished Areas: Viking, to match, as closely as possible newest existing sprinklers in building.
 2. Nonfinished Areas: Viking, to match, as closely as possible newest existing sprinklers in building.
 3. Dry Sprinklers: Viking, to match, as closely as possible newest existing sprinklers in building.
- B. Flexible Sprinkler Hose Fitting Assembly:
1. Victaulic; VicFlex.
 2. Flexhead Industries
 3. SprinkFLEX
 4. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
 5. Reliable Automatic Sprinkler Company
 6. Tyco Fire and Building Products
 7. Viking Corporation
 8. Or approved equivalent.
- C. Oversized Sprinkler Escutcheons:
1. Victaulic; FireLock Expansion Plates.
 2. Viking Corporation; Expansion Plate.
 3. Tyco Fire Protection Products; Wide Adapter Plates.
 4. Reliable Automatic Sprinkler; Extender Rings.
 5. Globe Fire Sprinkler Corporation; Seismic Escutcheons.
 6. Or approved equivalent.
- D. Sprinkler Guards:
1. Victaulic
 2. Viking
 3. Tyco
 4. Reliable
 5. Globe
 6. Senju
 7. Or approved equivalent.

2.2 SPRINKLERS

- A. Finished Areas:
1. Type: Glass-Bulb
 2. Style: Recessed; Reading Room 143: Concealed.
 3. Response: Quick-Response
 4. Finish:
 - a. Chrome
 - b. White Polyester
 5. Escutcheon:
 - a. Chrome
 - b. White Polyester
 6. Reading Room 143: Coverplate
 - a. Flat Plate
 - b. Chrome
- B. Nonfinished Areas:

FIRE SUPPRESSION SPRINKLER SYSTEMS

1. Type: Glass-Bulb
 2. Response: Quick-Response
 3. Finish: Brass
 - C. Dry Sprinklers:
 1. Type: Glass-Bulb
 2. Style: Recessed
 3. Response: Quick-Response
 4. Finish:
 - a. Chrome
 - b. White Polyester
 5. Escutcheon:
 - a. Chrome
 - b. White Polyester
 6. Dry Sprinkler Boot: Manufactured for use with the dry sprinkler it protects.
 - D. Pendent sprinklers supplied by dry or preaction piping: Dry pendent type.
- 2.3 FLEXIBLE SPRINKLER HOSE FITTING ASSEMBLY
- A. Fully welded non-mechanical fittings, stainless steel, braided, leak-tested with minimum 1-inch true-bore internal corrugated hose diameter. 175 psi.
 - B. Ceiling Bracket: Galvanized steel, direct attachment type, with integrated snap-on clip ends and removable flexible hose attachment with set screw. FM1637, UL 2443.
 - C. Affix permanent sign, label or decal at each flexible sprinkler hose fitting assembly anchoring component limiting the relocation of the sprinkler.
- 2.4 OVERSIZED SPRINKLER ESCUTCHEONS
- A. Metal.
 - B. Provide oversized ceiling penetrations and oversized sprinkler escutcheons for pendent sprinklers to comply with Building Code and ASCE-7 seismic requirements.
 - C. Same manufacturer as sprinklers.
- 2.5 SPRINKLER GUARDS
- A. Metal.
 - B. Listed for use with sprinkler model to which it is attached.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install per manufacturer's requirements and recommendations.

3.2 SPRINKLERS

- A. Center sprinklers in center or quarter points of suspended ceiling tile.

FIRE SUPPRESSION SPRINKLER SYSTEMS

B. Align sprinklers with architectural column lines, lighting, diffusers and other ceiling features. In unfinished ceilings, route piping to minimize visual impact. Sprinklers and piping not so aligned are to be removed and replaced at no additional cost to Owner.

C. Install dry sprinklers in a manner which does not trap water.

3.3 FLEXIBLE SPRINKLER HOSE FITTING ASSEMBLY

A. Install flexible sprinkler hose fitting assemblies where pendent sprinkler heads are located in acoustic ceiling tiles.

B. Install with no more bends than are included in equivalent footage used in hydraulic calculations.

C. Maintain manufacturer's recommended bending radius as included in equivalent footage used in hydraulic calculations.

D. Affix permanent sign, label or decal at each flexible sprinkler hose fitting assembly anchoring component limiting the relocation of the sprinkler.

3.4 OVERSIZED SPRINKLER ESCUTCHEONS

A. Coordinate oversized sprinkler escutcheons with ceiling construction and sprinkler style.

B. Provide for dry sprinkler penetrations in suspended ceilings.

3.5 SPRINKLER GUARDS

A. Install per manufacturer's instructions and recommendations.

END OF SECTION

FIRE SUPPRESSION PREACTION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Revision of existing preaction sprinkler system, including revision of existing aspirating type air sampling smoke detection system, in Library Ref. Desk/ Reading Room.
 - a. Pipe and Fittings
 - b. Oversized Sprinkler Escutcheons
 - c. Sprinklers
 - d. Initiating Devices
 - e. Notification Appliances
 - f. Miscellaneous
 - 2. In Library Ref Desk 143A:
 - a. Revise and extend existing preaction piping to accommodate building and ceiling revisions.
 - b. Revise existing air sampling smoke detection system in this area to accommodate new suspended ceiling.
 - 3. In Reading Room 143:
 - a. Detach existing preaction piping serving sprinklers in this area from the existing preaction system. Cap preaction system piping outside of this room. Resupply existing piping from the adjacent Exhibit Space wet pipe system. Revise piping and sprinklers to accommodate ceiling revisions as shown on architectural drawings. Verify quantity and locations. Provide concealed sprinklers with flat plate, chrome finish covers. Revise hanging, bracing and branch line restraints.
 - b. Remove and cap air sampling smoke detection system in this room. Provide addressable photoelectric smoke detectors connected to the building fire alarm system. Coordinate with Division 28, Electronic Safety.
- B. This is a contractor designed system. Contact AHJ prior to bid to verify additional preaction system requirements. Design preaction sprinkler system in compliance with NFPA 13, and NFPA 72 standards as interpreted by the AHJ, and the manufacturer's requirements.
- C. Provide electrical connections and wiring as required for a complete and operable system. Includes but is not limited to connection of initiating devices to fire alarm system, bells, control equipment, and power supplies.

1.2 RELATED SECTIONS

- A. Contents of Division 21, Fire Suppression and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Division 26, Electrical
 - 2. Division 28, Electronic Safety and Security
 - 3. Section 21 00 00, Fire Suppression Basic Requirements
 - 4. Section 21 05 00, Common Work Results for Fire Suppression
 - 5. Section 21 13 00, Fire Suppression Sprinkler Systems

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

FIRE SUPPRESSION PREACTION SPRINKLER SYSTEMS

1.4 SUBMITTALS

- A. Submittals as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.7 SYSTEM DESCRIPTION

- A. Field verify field conditions prior to submittal to bid. Adjust bid to provide protection features in accordance with applicable codes and interpretations by AHJ. Provide design and installation based on more stringent requirements if AHJ requirements differ from Code.
- B. Design Parameters:
 - 1. Building Area: Library Ref Desk.
 - a. Occupancy Classification: Light.
 - 2. Design parameters above are NFPA 13 minimums. Provide increased design densities, design areas, and hose allowances to meet requirements of AHJ.
- C. Sprinkler system design to include a 10 percent pressure and flow cushion between system demand point and available water supplies.
- D. Extend hydraulic calculations from hydraulically most remote design area back to location of pressure hydrant or flow test or effective point of water supply where characteristics of water supply are known. Indicate elevation of test hydrant and building finished floor on fire protection plans.
- E. Do not use quick response area reductions in Ordinary and Extra Hazard Occupancy areas.

1.8 EXTRA STOCK

- A. Provide extra sprinklers per code; provide suitable wrenches for each sprinkler type, and metal storage cabinet in riser room.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Pipe and Fittings:
 - 1. Wheatland Tube
 - 2. Or approved equivalent.
- B. Oversized Sprinkler Escutcheons:
 - 1. Viking Corporation
 - 2. Tyco Fire Protection Products
 - 3. Or approved equivalent

FIRE SUPPRESSION PREACTION SPRINKLER SYSTEMS

- C. Inspector's Test Connections:
 - 1. AGF TestAnDrain
 - 2. Or approved equivalent.
- D. Sprinklers:
 - 1. Nonfinished Areas:
 - a. Viking, to match, as closely as possible newest existing preaction system sprinklers in building.
 - 2. Dry Pendent:
 - a. Viking, to match, as closely as possible newest existing preaction system sprinklers in building.
- E. Air Sampling Smoke Detection:
 - 1. System Sensor
 - 2. Xtralis
 - 3. Or approved equivalent.
- F. Notification Appliances: Notification appliances must be compatible with control equipment.
 - 1. Same manufacturer as control equipment.
 - 2. Wheelock
 - 3. Gentex
 - 4. Federal Signal
 - 5. System Sensor
 - 6. Or approved equivalent.

2.2 GENERAL

- A. Reference Section 21 05 00, Common Work Results for Fire Suppression, for additional product information.

2.3 PIPE AND FITTINGS

- A. Pipe (black steel):
 - 1. 2-inch Diameter and Smaller: ASTM A53, ASTM A135, or ASTM A795; minimum of Schedule 40.
 - 2. 2-1/2-inch Diameter and Larger: ASTM A53, ASTM A135, or ASTM A795; Schedule 10.
 - 3. Exposed pipe 8-feet or less above finished floor: A minimum of Schedule 40.
- B. Joints:
 - 1. Threaded, flanged or bevel welded.
 - 2. Piping installed in plenums or shafts to have welded joints.
- C. Fittings:
 - 1. Threaded:
 - a. Malleable Iron: Class 150 and Class 300, ANSI B16.3.
 - b. Cast Iron: Class 125 and 250, ANSI B16.3.
 - 2. Flanged:
 - a. Cast Iron: Class 125 and 250, ASME B16.1, raised ground face, bolt holes spot faced.
 - 3. Welded:

FIRE SUPPRESSION PREACTION SPRINKLER SYSTEMS

- a. Carbon Steel: Long radius, standard weight or extra strong.
- b. Factory Wrought Steel Buttweld Fittings: ASME B16.9.
- c. Buttwelding Ends for Pipe, Valves, Flanges, and Fittings: ASME B16.25.
- d. Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures: ASTM A234.
- e. Steel Pipe Flanges and Flanged Fittings: ASME B16.5.
- f. Forged Steel Fittings, Socket Welded and Threaded: ASME B16.11.
- 4. Grooved Couplings:
 - a. UL 213, AWWA C606, ASTM A536 ductile iron or ASTM A47 malleable iron, with enamel finish and grooves or shoulders designed to accept grooved couplings. Synthetic-rubber gasket with central-cavity, pressure-responsive design, and ASTM A183 carbon-steel bolts and nuts.
 - b. FM Global approved.
- D. Anti-Microbial Coating: Factory-applied coating to inhibit corrosion from microbiological organisms.

2.4 **OVERSIZED SPRINKLER ESCUTCHEONS**

- A. Metal.
- B. Provide oversized ceiling penetrations and oversized sprinkler escutcheons for dry pendent sprinklers to comply with Building Code and ASCE-7 seismic requirements for suspended ceilings in seismic design categories D through F which use diagonal splay wires to achieve horizontal restraint of ceiling.

2.5 **SPRINKLERS**

- A. Pendent sprinklers supplied by preaction system piping to be of the dry pendent type. System to be designed so no water is trapped between the system branchline and the dry barrel of the dry pendent. Dry pendent barrel to extend to a fitting located on the branchline.
- B. Finished Areas:
 - 1. Type: Dry-Type Glass-Bulb
 - 2. Style: Concealed
 - 3. Response: Quick Response
 - 4. Finish: Chrome
 - 5. Coverplate: Chrome
- C. Nonfinished Areas:
 - 1. Type: Glass-Bulb
 - 2. Style:
 - a. Dry Pendent
 - b. Upright
 - 3. Response: Quick-Response
 - 4. Finish:
 - a. White Polyester
 - b. Brass

FIRE SUPPRESSION PREACTION SPRINKLER SYSTEMS

2.6 INITIATING DEVICES

- A. Air-Sampling Smoke Detector: Aspirating type, high-sensitivity smoke detector. Minimum programmable sensitivity range of 0.5 to 4 percent/foot obscuration. Minimum two alarm outputs and one trouble outputs to be monitored by preaction control panel.
- B. Revise sampling pipe network of CPVC or pipe for the air sampling system as required by the manufacturer and Code, as described in Summary.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate location of auxiliary drains with Architect. Architect to approve location before drain is installed. Protect valves from tampering or accidental operation. Coordinate with Division 22, Plumbing.
- B. Mount dry and preaction system drum drips a minimum of 5-feet above floor.

3.2 PIPE AND FITTINGS

- A. Install piping in concealed spaces above finished ceilings. Prior to design and installation obtain pre-approval by Architect and Engineer for exposed piping.
- B. Install piping as close as possible to ceiling to avoid conflicts with other trades.
- C. Install pipe runs to minimize obstruction to other work.
- D. Route piping for non-preaction areas around area protected by preaction system.
- E. Pitch preaction system piping located or passing through warm as well as cold areas.

3.3 OVERSIZED SPRINKLER ESCUTCHEONS

- A. Coordinate oversized sprinkler escutcheons with ceiling construction.

3.4 SPRINKLERS

- A. Center sprinklers in middle or quarter points of suspended ceiling tile.
- B. Align sprinklers with architectural column lines, lighting, diffusers, and other ceiling features. In unfinished ceilings, route piping to minimize visual impact. Sprinklers and piping not so aligned are to be removed and replaced at no additional cost to Owner.

3.5 INSTALLATION

- A. Obtain approval of system design from AHJ prior to installation. Do not begin installation without approval from AHJ and submittal review comments from Engineer.
- B. Install in accordance with applicable codes, NFPA 72, NFPA 70 and the Contract Documents.
- C. In accordance with manufacturer's instructions, provide storage containers, pipe, fittings, manual release station, nitrogen generation corrosion inhibiting system detection and control system, notification appliances, shutdowns, auxiliary system interfaces, signs, wiring, conduit and outlet

FIRE SUPPRESSION PREACTION SPRINKLER SYSTEMS

boxes, piping, bracing, hangers, etc., required for the erection of a complete system as described in these specifications, as shown on Drawings, and as required by AHJ.

- D. Provide wiring to meet the requirements of national, state and local electrical codes. Provide color coded wiring as recommended and specified by the pre-action detection system manufacturer.
- E. Conceal wiring, conduit, boxes, and supports where installed in finished areas.
- F. Provide complete conduit system for wiring.
- G. At junction boxes and termination points, provide identification tags on wires and cables.
- H. Route wiring and piping to avoid blocking access to equipment requiring service, access, or adjustment.
- I. Provide machine printed zone label or address on initiating devices. Labels to be visible from the floor without magnification.
- J. Obtain Owner's approval of locations of devices before installation.
- K. Install instruction placards in or adjacent to control panel.
- L. Install warning and advisory placards adjacent to manual release stations and notification appliances at the entrance to the protected space and in the protected space.

3.6 FIRE SAFETY SYSTEMS INTERFACES AND FUNCTIONS

- A. Division 26, Electrical provides power and control conduit, wiring, boxes and terminations to power devices and interface devices to pre-action system.
- B. Fire Alarm System: Provide alarm, supervisory and trouble relay output connections to the building fire alarm system.

3.7 INSPECTION AND TESTING FOR COMPLETION

- A. System inspection, testing and commissioning to be performed by a certified manufacturer's representative.
- B. Perform testing and inspection in accordance with NFPA 13. In addition, test the fire control and detection system in accordance with NFPA 72. Document each inspection and test.
- C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Provide tools, software, and supplies required to accomplish inspection and testing.
- E. Prepare for testing by ensuring that work is complete and correct; perform preliminary tests as required to test system.
- F. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
- G. Notify Owner 7 days prior to beginning completion inspections and tests.
- H. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

FIRE SUPPRESSION PREACTION SPRINKLER SYSTEMS

- I. Diagnostic Period: After successful completion of inspections and tests, operate system in normal mode for at least 14 days without any system or equipment malfunctions.
 - 1. Record system operations and malfunctions.
 - 2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
 - 3. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.
 - 4. At end of successful diagnostic period, submit completed test documentation.

3.8 CLOSEOUT

- A. Comply with all requirements of Division 01, General Requirements and Section 21 00 00, Fire Suppression Basic Requirements.
- B. Closeout Demonstration: Demonstrate proper operation of functions to Owner.
 - 1. Be prepared to conduct any of the required tests.
 - 2. Have at least one copy of operation and maintenance data, copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
 - 3. Have authorized technical representative of control unit manufacturer present during demonstration.
 - 4. Demonstration may be combined with inspection and testing required by AHJ. Notify AHJ in time to schedule demonstration.
 - 5. Repeat demonstration until successful.
- C. Substantial Completion of the project cannot be achieved until inspection and testing is successfully completed.
- D. Diagnostic Period:
 - 1. Specified diagnostic period without malfunction has been completed.
 - 2. Approved operating and maintenance data has been delivered.
 - 3. Aspects of operation have been demonstrated to Owner.
 - 4. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
 - 5. Occupancy permit has been granted.
 - 6. Specified pre-closeout instruction is complete.
 - 7. Perform post-occupancy instruction within 3 months after date of occupancy.

END OF SECTION

PLUMBING BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Work included in 22 00 00, Plumbing Basic Requirements applies to Division 22, Plumbing work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of plumbing systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.
 - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
 - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
 - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
 - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.2 RELATED SECTIONS

- A. Contents of Section applies to Division 22, Plumbing Contract Documents.
- B. Related Work:
 - 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits

1.3 REFERENCES AND STANDARDS

- A. References and Standards per Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, individual Division 22, Plumbing Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
 - 1. State of Oregon:

PLUMBING BASIC REQUIREMENTS

- a. OAR - Oregon Administrative Rules
 - b. OESC - Oregon Electrical Specialty Code
 - c. OFC - Oregon Fire Code
 - d. OMSC - Oregon Mechanical Specialty Code
 - e. OPSC - Oregon Plumbing Specialty Code
 - f. OSSC - Oregon Structural Specialty Code
 - g. OEESC - Oregon Energy Efficiency Specialty Code
 - h. Oregon Elevator Specialty Code
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
- 1. ABA - Architectural Barriers Act
 - 2. ADA - Americans with Disabilities Act
 - 3. AHRI - Air-Conditioning Heating & Refrigeration Institute
 - 4. ANSI - American National Standards Institute
 - 5. ASCE - American Society of Civil Engineers
 - 6. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
 - 7. ASHRAE Guideline 0, the Commissioning Process
 - 8. ASME - American Society of Mechanical Engineers
 - 9. ASPE - American Society of Plumbing Engineers
 - 10. ASSE - American Society of Sanitary Engineering
 - 11. ASTM - ASTM International
 - 12. AWWA - American Water Works Association
 - 13. CFR - Code of Federal Regulations
 - 14. CGA - Compressed Gas Association
 - 15. CISPI - Cast Iron Soil Pipe Institute
 - 16. ETL - Electrical Testing Laboratories
 - 17. EPA - Environmental Protection Agency
 - 18. FM - FM Global
 - 19. IAPMO - International Association of Plumbing and Mechanical Officials
 - 20. GAMA - Gas Appliance Manufacturers Association
 - 21. HI - Hydraulic Institute Standards
 - 22. ISO - International Organization for Standardization
 - 23. MSS - Manufacturers Standardization Society
 - 24. NEC - National Electric Code
 - 25. NEMA - National Electrical Manufacturers Association
 - 26. NFGC - National Fuel Gas Code
 - 27. NFPA - National Fire Protection Association
 - 28. NRCA - National Roofing Contractors Association
 - 29. NSF - National Sanitation Foundation
 - 30. OSHA - Occupational Safety and Health Administration
 - 31. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
 - 32. TEMA - Tubular Exchanger Manufacturers Association
 - 33. TIMA - Thermal Insulation Manufacturers Association
 - 34. UL - Underwriters Laboratories Inc.
- D. See Division 22, Plumbing individual Sections for additional references.
- 1.4 SUBMITTALS
- A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 22, Plumbing Sections.

PLUMBING BASIC REQUIREMENTS

- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
 - 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
 - 2. Provide product submittals and shop drawings in electronic format only. Electronic format must be posted to ftp site. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. At Contractor's option, two separate submittals may be provided, consisting of underground work and building work. Deviations will be returned without review.
 - 3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 22, Plumbing Sections.
 - 4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
 - a. Label submittal to match numbering/references as shown in Contract Documents and schedules. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
 - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference Division 22, Plumbing Sections for specific items required in product data submittal outside of these requirements.
 - c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
 - d. For vibration isolation of equipment, list make and model selected with operating load and deflection. Indicate frame type where required. Submit manufacturer's product data.
 - e. See Division 22, Plumbing Sections for additional submittal requirements outside of these requirements.
 - 5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
 - 6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.

PLUMBING BASIC REQUIREMENTS

7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 22, Plumbing Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.
9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
10. Substitutions and Variation from Basis of Design:
 - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
11. Shop Drawings: Provide coordinated Shop Drawings which include physical characteristics of all systems, equipment and piping layout plans, and control wiring diagrams. Reference individual Division 22, Plumbing Sections for additional requirements for Shop Drawings outside of these requirements.
 - a. Provide Shop Drawings indicating sanitary and storm cleanout locations and type to Architect for approval prior to installation.
 - b. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
12. Samples: Provide samples when requested by individual Sections.
13. Resubmission Requirements:
 - a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
 - 1) Resubmit for review until review indicates no exception taken or "make corrections as noted".
 - 2) When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.
14. Operation and Maintenance Manuals, Owner's Instructions:
 - a. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items

PLUMBING BASIC REQUIREMENTS

requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.

- 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.
 - 3) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
 - 4) Include copy of startup and test reports specific to each piece of equipment.
 - 5) Include copy of final water systems balancing log along with pump operating data.
 - 6) Include commissioning reports.
 - 7) Include copy of pressure, flow, leakage and purity test data and air and water systems test data, as applicable. Include copy of third-party and state and local jurisdiction inspection reports.
 - 8) Include copy of valve charts/schedules.
 - 9) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
 - 10) Include product certificates of warranties and guarantees.
 - 11) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
 - b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 22 00 00, Plumbing Basic Requirements article titled "Demonstration".
 - c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
15. Record Drawings:
- a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on Drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
 - b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
 - c. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in

PLUMBING BASIC REQUIREMENTS

version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.

- d. At completion of project, show changes and deviations from the Drawings in red on one set of black-line drawings. Include written Addendums, RFIs, and change order items. Make changes to Drawings in a neat, clean, and legible manner.
- e. Provide Invert elevations and dimensioned locations for water services, building waste, and storm drainage piping below grade extending to 5-feet outside building line.
- f. See Division 22, Plumbing individual Sections for additional items to include in record drawings.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturers equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.
- G. Piping Insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.
- H. All potable water system components, devices, material, or equipment containing a weighted average of greater than 0.25 percent lead are prohibited, and shall be certified in accordance with current editions of the Safe Drinking Water Act (SDWA), NSF 61 & NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61.
- I. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.

PLUMBING BASIC REQUIREMENTS

- J. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

1.6 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty in Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.7 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, plumbing, cable trays, lights, and electrical services with architectural and structural requirements, and other trades (including ceiling suspension, and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Advise Architect in the event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- C. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

1.8 WORK INCLUDED

- A. Furnish and install sleeves, inserts and anchorage required for the installation, which are embedded in work of other trades. Sleeve, wrap and seal piping in concrete.
- B. Electrical: For plumbing trim/devices/equipment, provide, from the line voltage connection by Division 26, the low voltage electrical connections and wiring as required for complete and operable system. Includes, but is not limited to: Low voltage electrical raceway, wiring and accessories, such as step-down transformers as necessary for function of sensors and automatic valve and faucet controls. Supply step-down transformers and size wiring as recommended by manufacturer of plumbing trim/faucets requiring electrical low voltage connection.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to fixtures, pumps, drains and equipment.

PLUMBING BASIC REQUIREMENTS

2.2 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL approved or have adequate approval or be acceptable by State, County, and City authorities.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
 - 1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
 - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Install equipment requiring access (i.e., drain pans, drains, control operators, valves, motors, cleanouts and water heaters) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.
- D. Earthwork:
 - 1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with the provisions of related earthwork Sections/divisions. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
- E. Firestopping:

PLUMBING BASIC REQUIREMENTS

1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Pipe Installation:
 1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.
 2. Include provisions for servicing and removal of equipment without dismantling piping.
- G. Plenums:
 1. Provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

3.2 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 22 Plumbing Sections.
- B. General:
 1. Earthquake resistant designs for Plumbing (Division 22) equipment and distribution, i.e. motors, plumbing systems, piping, equipment, water heaters, boilers, etc. to conform to regulations of jurisdiction having authority.
 2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
 3. Provide stamped Shop Drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for piping equipment and water heaters. Submit Shop Drawings along with equipment submittals.
 4. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details.
- C. Piping:
 1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.
- D. Provide means to prohibit excessive motion of plumbing equipment during earthquake.

PLUMBING BASIC REQUIREMENTS

3.3 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Notify Architect or Engineer, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 - 1. Underground piping installation prior to backfilling.
 - 2. Prior to covering walls.
 - 3. Prior to ceiling cover/installation.
 - 4. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Bear responsibility and cost to make piping accessible, to expose concealed lines, or to demonstrate acceptability of the system. If Contractor fails to notify Architect at times prescribed above, costs incurred by removal of such work are the responsibility of the Contractor.
- D. Final Punch:
 - 1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Plumbing Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the plumbing systems are ready for final punch.
 - 2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - 1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
 - 2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping, and wiring to point of connection.
 - 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
 - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 - 4. Organize work to minimize duration of power interruption.

3.5 CUTTING AND PATCHING

- A. Confirm Cutting and Patching requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - 1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project

PLUMBING BASIC REQUIREMENTS

Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).

2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing piping and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.6 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.7 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.
 2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 3. Protect bright finished shafts, bearing housings and similar items until in service.

3.8 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of

PLUMBING BASIC REQUIREMENTS

other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.9 CLEANING

- A. Confirm cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

- A. Confirm installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
 - 1. Do not place equipment in sustained operation prior to initial balancing of plumbing systems.
 - 2. Provide pump impellers to obtain Basis of Design design capacities.
- D. Provide miscellaneous supports/metals required for installation of equipment and piping.

3.11 PAINTING

- A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - 1. Ferrous Metal: After completion of plumbing work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt for exterior or black enamel for interior, suitable for hot surfaces.
 - 2. In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 3. See individual equipment Specifications for other painting.
 - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
 - 5. Piping: Clean, primer coat and paint exposed piping on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
 - 6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

PLUMBING BASIC REQUIREMENTS

3.12 DEMOLITION

- A. Confirm Demolition requirements in Division 01, General Requirements and Division 02, Existing Conditions. In absence of specific requirements, comply with individual Sections in Division 22, Plumbing and the following:
 - 1. Scope:
 - a. It is the intent of these documents to provide necessary information and adjustments to plumbing system required to meet code, and accommodate installation of new work.
 - b. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
 - c. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve underground utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
 - 2. Equipment: Unless otherwise directed, equipment, fixtures, or fittings being removed as part of demolition process are Owner's property. Remove other items not scheduled to be reused or relocated from job site as directed by Owner.
 - 3. Unless specifically indicated on Drawings, remove exposed, unused piping to behind finished surfaces (floor, walls, ceilings, etc.). Cap piping and patch surfaces to match surrounding finish.
 - 4. Unless specifically indicated on Drawings, remove unused equipment, fixtures, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).

3.13 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Sections in Division 22, Plumbing and the following:
 - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Testing and Balancing Reports
 - b. Cleaning
 - c. Operation and Maintenance Manuals
 - d. Training of Operating Personnel
 - e. Record Drawings
 - f. Warranty and Guaranty Certificates
 - g. Start-up/Test Document and Commissioning Reports

3.14 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Tests:
 - 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.

PLUMBING BASIC REQUIREMENTS

2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.15 ELECTRICAL INTERLOCKS

- A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize plumbing equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

END OF SECTION

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Pipe Hangers and Supports for Plumbing Piping and Equipment
 - 2. Building Attachments
 - 3. Miscellaneous Metal and Materials

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. ASCE 7-10, Minimum Design Loads for Buildings and Other Structures.
 - 2. Hanger spacing installation and attachment to meet all manufacturer's requirements and MSS SP-58.
 - 3. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
 - 4. Install piping per SMACNA's requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.7 PERFORMANCE REQUIREMENTS

- A. General - Provide pipe and equipment hangers and supports in accordance with the following:
 - 1. When supports, anchorages, and seismic restraints for equipment, and supports, anchorages, and seismic restraints for piping are not shown on the Drawings, the contractor is responsible for their design.
 - 2. Connections to structural framing are not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
- B. Engineered Support Systems:
 - 1. Support frames such as pipe racks or stanchions for piping and equipment which provide support from below.
 - 2. Equipment and piping support frame anchorage to supporting slab or structure.

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- C. Provide channel support systems, for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.
- D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.
- E. Provide seismic restraint hangers and supports for piping and equipment.
- F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Pipe Hangers and Supports for Plumbing Piping and Equipment:
 - 1. Pipe Hangers/Supports:
 - a. B-Line Systems, Inc.
 - b. Anvil International
 - c. HOLDRITE
 - d. Erico Co., Inc.
 - e. Snappitz Thermal Pipe Shield Manufacturing
 - f. Rilco Manufacturing Co. Inc.
 - g. Nelson-Olson Inc.
 - h. Or approved equivalent.
 - 2. Channel Support Systems:
 - a. B-Line Systems, Inc.
 - b. Anvil International, Anvit-Strut
 - c. Erico Hanger Co., Inc.; O-Strut Div.
 - d. Unistrut Corp.
 - e. HOLDRITE EZ-Strut Systems
 - f. Or approved equivalent.
 - 3. Thermal-Hanger Shield Inserts:
 - a. Erico Hanger Co., Inc.
 - b. Pipe Shields, Inc.
 - c. Rilco Manufacturing Co., Inc.
 - d. HOLDRITE Insulation Couplings
 - e. Or approved equivalent.
- B. Building Attachments:
 - 1. Anchor-It
 - 2. Gunnebo Fastening Corp.
 - 3. ITW Ramset/Red Head
 - 4. Masterset Fastening Systems, Inc.
 - 5. Or approved equivalent.
- C. Miscellaneous Metal and Materials:
 - 1. See Miscellaneous Metal and Materials article below.
 - 2. Powder-Actuated Fastener Systems:
 - a. Gunnebo Fastening Corp.
 - b. Hilti, Inc.

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- c. ITW Ramset/Red Head.
- d. Masterset Fastening Systems, Inc.
- e. Or approved equivalent.

2.2 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- A. Horizontal Piping Hangers and Supports - Horizontal and Vertical Piping, and Hanger Rod Attachments:
 - 1. Factory fabricated horizontal piping hangers and supports to suit piping systems in accordance manufacturer's published product information.
 - 2. Use only one type by one manufacturer for each piping service.
 - 3. Select size of hangers and supports to exactly fit pipe size for bare piping and to exactly fit around piping insulation with saddle or shield for insulated piping.
 - 4. Provide copper-plated hangers and supports for uninsulated copper piping systems.
 - 5. Provide padded pipe hangers, clamps and supports for thermoplastic piping system.
 - 6. Install no hub cast iron pipe and fittings per CISPI 301-09 Installation Procedures for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain Waste and Vent Piping Applications. Brace hubless cast iron pipe and fittings 5-inch and larger with HOLDRITE No Hub Pipe Restraints or approved equivalent.
- B. Pipe Hangers, Guides and Channel Systems:
 - 1. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.
 - 2. Hanger Rod Couplings: Malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.
 - 3. Pipe Rings for Hanger Rods: Pipe sizes 2-inch and smaller, MSS SP Type 6 or Type 10, or approved equivalent. Pipe sizes 2-1/2-inches and larger, clevis type hangers with adjustable nuts on rod. MSS SP Type 1. Pipe rings to have same finish as hanger rods.
 - 4. Pipe Slides: Type 35 reinforced Teflon slide material (3/32-inch minimum thickness) bonded to steel; highly finished steel or stainless steel contact surfaces to resists corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16-inch minimum thickness; attachment to pipe and framing by welding.
 - 5. Pipe Guides:
 - a. Furnish and install pipe guides on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides securely to pipe and structure. Any contact with chilled water pipe is not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.
 - b. Furnish and install guides approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Guides are not to be used as supports and are in addition to other pipe hangers and supports.
 - 6. Channel Type Pipe Hanging System: Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A570 GR33; one side of channel to have a continuous slot with in-turned lips; framing nut with grooves and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.
- C. Pipe Saddles and Shields:

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
 2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).
- D. Thermal-Hanger Shield Inserts: 100-PSI (690-kPa) minimum compressive strength insulation, encased in sheet metal shield.
1. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier.
 2. Material for Hot Piping: Water-repellent-treated ASTM C533, Type 1 calcium silicate.
 3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 4. For Clevis or Band Hanger: Insert and shield to cover lower 180 degrees of pipe.
 5. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.
 6. Thermal Hanger Shield Inserts should be provided at the hanger points and guide locations on pipes requiring insulation. The Inserts should consist of Polyisocyanurate (urethane or phenolic insulation) encircling the entire circumference of the pipe with a 360 degree PVC (1.524 mm thick) with a living hinge and J lock and installed during the installation of the piping system.
- E. Roller Hangers:
1. Adjustable roller hanger. Black steel yoke, cast iron roller. MSS Type 41.
- F. Concrete Inserts:
1. Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.
- G. Continuous Concrete Insert:
1. Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.
- H. Beam Clamps:
1. MSS Type 19 and 23, wide throat, with retaining clip.
 2. Universal Side Beam Clamp: MSS Type 20.
- I. Hangers for Pipe Size 2-inches and Smaller:
1. Adjustable swivel ring hanger, UL listed, Type 6 or Type 10.
- J. Plumbers Tape:
1. Not permitted as pipe hangers or pipe straps.

2.3 BUILDING ATTACHMENTS

- A. General: Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project Structural Engineer. Provide anchor bolts suitable for cracked concrete.
- B. Anchor Bolts:
1. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

2. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.
 3. Anchor (Adhesive) Bolts: Consisting of two-part adhesive cartridge and zinc-plated Type A307 steel anchor bolt rod assembly with ASTM A194 nut.
- C. Beam Clamps:
1. MSS Type 19 and 23, wide throat, with retaining clip.
 2. Universal Side Beam Clamp: MSS Type 20.
- D. Powder-Actuated Drive Pin Fasteners:
1. Powder-Actuated Drive-Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- E. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- F. Grout: ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 2. Properties: Nonstaining, noncorrosive, and non-gaseous.
 3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

2.4 MISCELLANEOUS METAL AND MATERIALS

- A. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings, that are necessary for completion of the project. The Contractor is responsible for their design.
1. Fabricate miscellaneous units to size, shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
- B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.
- C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
- D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
- E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.
- F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods and equipment required for fabrication.

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- G. Provide hot dipped galvanized components for items exposed to weather.
- H. Use straps, threshold rods and wire with sizes required by SMACNA to support piping.
- I. Grout: ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Nonstaining, noncorrosive, and non gaseous.
 - 3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Examination:
 - 1. Verify building materials to have hangers and attachments affixed in accordance with hangers to be used. Provide supporting calculations.
- B. Preparation:
 - 1. Examine Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall," "2-Hour Fire/Smoke Barrier," and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.
- C. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate with project structural engineer proper placement of inserts, anchors and other building structural attachments.

3.2 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- A. Hangers and Supports:
 - 1. Comply with MSS SP-58. Pipe Hanger and Support Installation: Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. For horizontally hung grooved-end piping, provide a minimum of 2 hangers per pipe section.
 - 2. Pipe Ring Diameters:
 - a. Uninsulated and Insulated Pipe, except where oversized pipe rings are specified: Ring inner diameter to suit pipe outer diameter.
 - b. Insulated Piping Where Oversized Pipe Rings are Specified and Vibration Isolating Sleeves: Ring inner diameter to suit outer diameter of insulation or sleeve.
 - 3. Oversize Pipe Rings: Provide oversize pipe rings of 2-inch and larger size.
 - 4. Pipe Support Brackets: Support pipe with pipe slides.
 - 5. Steel Backing in Walls: Provide steel backing in walls to support fixtures and piping hung from steel stud walls.
 - 6. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
 - a. Field assemble and install according to manufacturer's written instructions.
 - 7. Pipe Guides:
 - a. Install on continuous runs where pipe alignment must be maintained. Provide a minimum of two on each side of expansion joints, spaced per manufacturer's

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- recommendations for pipe size. Fasten guides to pipe structure. Any contact with chilled water pipe should not permit heat to be transferred in sufficient quantity to cause condensation on any surface.
- b. Install approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Do not use as supports. Provide in addition to other required pipe hangers and supports.
- 8. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field -fabricated, heavy-duty trapezes.
 - a. 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.
 - b. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1
 - 9. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers.
 - 10. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.
 - 11. Do not support piping from other piping.
 - 12. Fire protection piping will be supported independently of other piping.
 - 13. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.
 - 14. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.
 - 15. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchor, and to facilitate the action of expansion joints, expansion loops, expansion bends and similar units.
 - 16. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
 - 17. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping" is not exceeded.
 - 18. Insulated Piping: (comply with the following)
 - a. Attach clamps and spacers to piping.
 - 1) Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - 2) Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - 3) Do not exceed pipe stress limits according to ASME B31.9.
 - b. Install MSS SP-58, Type 39 protection saddles, if insulation without a vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
 - c. Install MSS SP-58, Type 40 protective shields on cold piping having a vapor barrier. Shields to span arc of 180 degrees.
 - 1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
 - d. Shield Dimensions for Pipe, not less than the following:

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- 1) NPS 1/4 to NPS 3-1/2 (DN8 to DN 90): 12-inches long and 0.048-inch thick.
 - 2) NPS 4 (DN100): 12-inches long and 0.06-inch thick.
 - 3) NPS 5 and NPS 6 (DN125 and DN150): 18-inches long and 0.06-inch thick.
 - 4) NPS 8 to NPS 14 (DN200 to DN350): 24-inches long and 0.075-inch thick.
 - 5) NPS 16 to NPS 24 (DN400 to DN600): 24-inches long and 0.105-inch thick.
 - e. Pipes NPS 8 (DN200) and Larger: Include wood inserts.
 - f. Insert Material: Length at least as long as protective shield.
 - g. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
 19. Equipment Clearances: Do not route equipment or piping through electrical rooms, transformer vaults, elevator equipment rooms, IT rooms, MPOE rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-feet lateral clearance from all sides of electric switchgear panels. Do not route piping or equipment above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact equipment or pipe routing to provide proper clearance with such items.
 20. Pipe supports and hanger spacing (pipe supported from structure or floor-supported) to meet the requirements of References and Standards Article in Part 1 above.
- B. Vertical Piping:
1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.
 2. Riser clamps to be directly under fitting or welded to pipe. Provide neoprene pads for all systems except natural gas.
 3. Riser to be supported at each floor penetration.
 4. Provide structural steel supports at the base of pipe risers. Size supports to carry forces exerted by piping system when in operation.
- C. Adjusting and Painting:
1. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping and equipment to proper level and elevations.
 2. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.

3.3 BUILDING ATTACHMENTS

- A. Install within concrete slabs or attach to structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints and at changes in direction of piping.
- B. Attachment to Wood Structure: Provide MSS Type 34 for attachment to wooden beam or approved attachment for a wood structure.
- C. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Install concrete inserts before concrete is placed; fasten insert secure to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- E. Install powder-actuated drive pin fasteners 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. Test powder-actuated insert attachments with a minimum load of 100 pounds.
- F. Bolting: Provide bored, drilled or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched or hand sawn holes will not be accepted.
- G. Anchor Bolts:
 - 1. Install anchor bolts for mechanical equipment and piping as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment and piping are hung.
 - 2. Anchor Bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.
- H. Pipe Anchors: Provide anchors to fasten piping which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.
- I. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor wall, and through equipment room walls and floors.
- J. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
 - 1. Install fabricated pipe sleeve.
 - 2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.
 - 3. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814 sealant.
- K. Piping Penetrations Through Fire-rated (1 to 3 hour) Assemblies:
 - 1. Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.
 - 2. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814. Use HOLDRITE HydroFlame or approved equivalent.
- L. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

3.4 MISCELLANEOUS METAL AND MATERIALS

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

connectors as required. Avoid cutting concrete reinforcing when drilling for inserts. Reference structural drawings and reinforcing shop drawings and determine locations of stirrups prior to drilling into concrete.

- C. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete masonry or similar construction.
- D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.
- E. Setting Loose Plates: Clean concrete and masonry bearing surfaces of any bond reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
 - 1. 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 edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
- F. Fabrication:
 - 1. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates and similar devices. Hot dip galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.
 - 2. Finishes:
 - a. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with 1 coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas with primer of same material before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
 - b. Metal in contact with Concrete, Masonry and Other Dissimilar Materials:
 - 1) Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
 - c. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- G. Metal Fabrication:
1. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
 2. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
 3. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of weld and methods used in correcting welding work, and with the following:
 - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - b. Obtain fusion without undercut or overlap.
 - c. Remove welding flux immediately.
 - d. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
 4. Provide hot dipped galvanized components for items exposed to weather.

END OF SECTION

PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Type 1, Glass Wool Pipe Insulation
 - 2. Accessories
 - 3. Pipe Fitting Insulation Covers

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Piping insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Installer qualifications.
 - 2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
 - 3. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.
 - 4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
 - 5. Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.
- B. In addition, meet the following:
 - 1. Formaldehyde Free: Should be third-party certified with UL Environment Validation.
 - 2. Recycled Content: A minimum of 40 percent post-consumer recycled glass content certified and UL validated.
 - 3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
 - 4. Installer to have minimum 5 years' experience in the business of installing insulation.

PLUMBING INSULATION

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.7 FIRE HAZARD CLASSIFICATION

- A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.
- B. Test pipe insulation in accordance with requirements of current edition of UL "Pipe and Equipment Coverings".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Type 1, Glass Wool Pipe Insulation:
 - 1. Owens-Corning
 - 2. Johns Manville
 - 3. Or approved equivalent.
- B. Accessories:
 - 1. ITW Insulation Systems
 - 2. Or approved equivalent.
- C. Pipe Fitting Insulation Covers:
 - 1. Zeston Johns Manville
 - 2. ITW Insulation Systems
 - 3. Or approved equivalent.

2.2 TYPE 1, GLASS WOOL PIPE INSULATION

- A. Glass Fiber: ASTM C547 Type I and IV; rigid molded, noncombustible.
 - 1. Thermal Conductivity Value: 0.27 BTU*in/(hr*sf°F) at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F to 1000 degrees F.
 - 3. Vapor Retarder Jacket: White Kraft paper reinforced with glass fiber and bonded to aluminum foil, with self-sealing longitudinal laps and butt strips or vapor barrier mastic.

2.3 ACCESSORIES

- A. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.
- B. Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories, i.e., adhesives, mastics, cements and tape to have same flame and smoke component ratings as insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide non-water soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

PLUMBING INSULATION

2.4 PIPE FITTING INSULATION COVERS

- A. PVC Plastic Fitting Covers: Schuller Zeston 2000, Knauf Proto Fitting or approved equivalent. One-piece molded type fitting covers and jacketing material, gloss white. Connections: Tacks; pressure sensitive color matching vinyl tape.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION INFORMATION

- A. Verification of Conditions:
1. Do not apply insulation until pressure testing and inspection of piping has been completed.
 2. Examine areas and conditions under which insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Preparation: Clean and dry surfaces to be insulated.
- C. Installation:
1. Insulation: Continuous through walls, floors and partitions except where noted otherwise.
 2. Piping and Equipment:
 - a. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.
- D. Provide accessories as required. See Part 2 Article "Accessories" above.
- E. Protection and Replacement: Protect installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- F. Labeling and Marking: Provide labels, arrows and color coding on piping. Attach labels and flow direction arrows to jacketing per Section 22 05 53, Identification for Plumbing Piping and Equipment.
- G. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 1-1/2-inches and larger (hot and cold piping).
- H. Piping Surfaces to be Insulated:

Item to be Insulated	System Insulation Type	Pipe Size	Insulation Thickness
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PLUMBING INSULATION

Cold Water Piping Above Grade	1	=<1-1/2-inch	1/2-inch
		>1-1/2-inch	1-inch
Condensate Drain Piping	1	All	1/2-inch

3.2 TYPE 1, GLASS WOOL PIPE INSULATION

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions for below grade installation.
- C. Lap seal insulation with waterproof adhesive. Do not use staples or other methods of attachment which would penetrate vapor barrier. Apply fitting covers with seated tacks and vapor barrier tape.
- D. Apply insulation to pipe and seal with self-sealing lap. Use self-sealing butt strips to seal butt joints. Insulate fittings, valves and unions with single or multiple layers of insulation and cover to match pipe or use preformed PVC molded insulation covers.
- E. Above Grade Roof Drain/Overflow Drain Piping: Cover all roof drain piping and overflow drain piping with sectional pipe covering.

3.3 ACCESSORIES

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions.
- C. Provide and install accessories for all insulation types listed in this Section.

3.4 PIPE FITTING INSULATION COVERS

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions.

END OF SECTION

PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Hot and Cold Domestic Water Above Grade

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NSF 61, Annex G.
 - 2. Steel pipe to conform to ASTM and ANSI Standards as specified in this Section.
 - 3. Copper piping to conform to ASTM B88, B306 and B208 and the standards of Copper Development Association (CDA), and American Welding Society, (AWS).
 - 4. Cast Iron Piping to conform to standards of ASTM A-74, CISPI 301 and FM 1680.
 - 5. Manufacturer's Standards Society (MSS) for valving and support reference standard.
 - 6. American Water Works Association (AWWA) for Valving Assembly Standards.
 - 7. American Society of Sanitation Engineers (ASSE) for Valving Standards.
 - 8. American National Standards Institute (ANSI) for Piping Standards.
 - 9. NFPA Standard 51B - "Fire Prevention in Use of Cutting and Welding Processes".
 - 10. Crosslinked polyethylene (PEX) pipe conforming to ASTM F876, F877 and CSA B1375, or DIN 16892 and 16893.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. See component manufacturers listed in individual articles below.
- B. Uponor
- C. Cerro

PLUMBING PIPING

- D. Tyler
- E. ADS
- F. Charlotte
- G. Elkhart
- H. Enfield
- I. Fusesseal
- J. Gruvlok
- K. Spears
- L. Nibco
- M. Orion
- N. American-USA
- O. Sioux Chief
- P. Viega
- Q. Mueller
- R. Or approved equivalent.
- S. Firestopping Penetrations in Fire Rated Wall Floor Assemblies:
 - 1. Hilti
 - 2. Proset
 - 3. Or approved equivalent.

2.2 GENERAL

- A. Provide pipe, tube and fittings of the same type, fitting requirements, grade, class and the size and weight indicated or required for each service, as indicated in other Division 22, Plumbing Specifications. Where type, grade, or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards.
- B. Manufactured materials delivered, new to the project site and stored in their original containers.
- C. Product Marking: Furnish each item with legible markings indicating name brand and manufacturer, manufacturing process, heat number and markings as required per ASTM and UL/FM Standards.

2.3 HOT AND COLD DOMESTIC WATER ABOVE GRADE

- A. Copper Tube: 2-1/2-inches and smaller. ASTM B88 (ASTM B88M), Type L (B), Drawn.
 - 1. Fittings: ASME B16.18 copper.
 - 2. Joints: ASTM B32, alloy Sn95 solder.

PLUMBING PIPING

- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), Drawn.
 - 1. Fittings: ASME B16.22, wrought copper.
 - 2. Joints: Roll grooved mechanical coupling. ASTM A536.
- C. Cross-Linked Polyethylene Tubing, Fittings and Accessories (except exposed locations).
 - 1. Tubing:
 - a. Cross-linked polyethylene (PEX) tubing complies with requirements of ASTM F876 and F877, and cross-linking method must be Type A (hot) method.
 - b. PEX tubing to have minimum working pressure of not less than 160 PSI for water at 73.4 degrees F, 100 PSI for water at 180 degrees F and 80 PSI for water at 200 degrees F determined in accordance with Plastic Pipe Institute Technical Report TR-3/92, and listed in Plastic Pipe Institute Technical Report TR-4/95.
 - 2. Fittings:
 - a. Fittings: Engineered Plastic Fittings for above grade applications. Engineered plastic fittings for below grade applications. Serrated type with reinforcement rings.
 - b. Reinforcement Rings: Manufactured using "Engel Method" to ensure that viscoelastic stress regenerative properties are sufficient to produce pressure tight seal.
 - c. Fitting Insert: Of such dimension in that tubing must be expanded in order to facilitate insertion of fitting into tube.
 - d. Accomplish expansion of tubing and ring by an expansion tool designed expressly for that purpose.
 - e. Fittings complies with requirements of ASTM F877.
 - 3. Manifolds: Provide premanufactured copper manifolds of same manufacturer as piping.
 - 4. Stubout Ells and Stubout Brackets: Provide premanufactured Type L copper stubout ell and copper stubout brackets.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. General Installation:
 - 1. Work performed by experienced journeyman plumbers. No exceptions.
 - 2. Provide access panels for concealed valves, shock arrestors, trap primers and the like.
 - 3. Install pipes and pipe fittings in accordance with recognized industry practices and manufacturer's recommendations.
 - 4. Align piping accurately at connections, within 3/32-inch misalignment tolerance. Comply with ANSI B31 Code for Pressure Piping.
 - 5. Locate piping runs, as indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2-inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1-inch clearance outside insulation. Whenever possible in finished and occupied spaces, conceal piping from view by locating it in column enclosures, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as indicated.

PLUMBING PIPING

- a. Do not run piping through transformer vaults, telephone, elevator, electrical or electronic equipment spaces or enclosures unless indicated on Drawings.
- b. Concealed Piping Above Suspended Ceiling: Plan and coordinate to avoid interferences; install to maintain suspended ceiling heights shown on Architectural Drawings. Allow sufficient space above removable ceiling panels for panel removal. Locate piping so that valves are visible and accessible within 24-inches horizontally and vertically from point of access to the ceiling space. Provide plenum rated materials for ceiling spaces which are being used as plenums.
- c. Exposed Work: Run pipes parallel to the closest wall unless otherwise shown on Drawings; maintain maximum headroom; avoid light fixtures.
- d. Insulation Space Allowance: In piping work, allow space for pipe insulation and jackets. If interferences occur, move the piping to accommodate insulation thickness specified.
- e. Pipe Lengths: Do not use short lengths or nipples at locations where a full length of pipe will fit.
- f. Alignment Prior to Supporting and Anchoring: Place piping in proper alignment and position prior to connection to anchors, expansion loops, and equipment. Furnish jacking devices, temporary steel structural members, and assembled structures as necessary. Remove temporary equipment and structures supplied by contractor at completion; such items to remain Contractor property.
- g. Valve and Equipment Connections: Piping not to place undue stress on flanged valves and equipment connections. Install mating flange faces true and parallel to each other and not requiring springing of piping for assembly. Pipe hangers and supports to carry the full weight of the pipe and fluid.
- h. Piping Leaks: Correct immediately; use new materials; leak-sealing compounds or peening not permitted.
- i. Pressure Ratings of Fittings, Valves, and Devices in Piping Systems: Pressure rating to be equal to, or greater than, the maximum working pressure of the system.
- j. Equipment Vents and Drains: Provide for coils and vessels which contain water. Provide isolation valves and outlet valves at piping high and low points to permit venting and draining of the vessel without venting and draining connected piping. Provide hose connections and caps on drain lines.
- k. Escutcheon Plates: Where exposed insulated and uninsulated piping passes through walls, floors or ceilings; provide spring clip type. Provide plates on both sides of wall or floor.

B. Testing:

1. General:

- a. Provide temporary equipment for testing, including pumps, compressors, tanks, and gauges, as required. Test piping systems before insulation (if any) is installed and remove or disengage control devices before testing. Where necessary, test sections of each piping system independently, but do not use piping valves to isolate sections where test pressures exceed local valve operating pressure rating. Fill each section with water, compressed air, or nitrogen and pressurize for the indicated pressure and time.
- b. Notify Architect and local Plumbing Inspector 2 days before tests.
- c. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop

PLUMBING PIPING

- greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- d. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
 - e. Send test results to Architect for review and approval and include in Operation and Maintenance Manual.
- 2. Testing of Pressurized Systems:
 - a. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
 - b. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
 - 3. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.
- C. Corrosive Soil Conditions:
- 1. Wrap steel, iron, copper or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per manufacturer's recommendations.
 - 2. Provide epoxy coated cast iron pipe and fittings for drainage systems.
 - 3. Obtain and review project soils report for verification of requirements concerning corrosive soils.
- D. Protection:
- 1. Keep pipe openings closed by means of plugs or caps to prevent entrance of foreign matter. Protect piping, ductwork, fixtures, equipment and apparatus against dirty water, chemical or mechanical damage both before and after installation. Restore to its original condition or replace fixtures, equipment or apparatus damaged prior to final acceptance of work.
- E. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
- 1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- F. Cut piping squarely, free of rough edges and reamed to full bore. Insert piping fully into fittings.
- G. Provide joints of type indicated in each piping system.
- H. Thread pipe in accordance with ANSI/ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Remove excess cutting oil from piping prior to assembly. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.
- I. Sleeves:
- 1. Pipe Sleeves:
 - a. Layout work in advance of pouring concrete, furnish, and set sleeves necessary to complete work.
 - b. Floor Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1-inch above finished floor. Caulk pipes passing through floor with non-shrinking grout or approved caulking compound (Except

PLUMBING PIPING

- DWV Piping penetrating a concrete slab set on finish grade), provide "Link-Seal" sleeve sealing system for concrete/slab penetrations which are below grade. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements
- c. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with non-shrinking caulking compound. Provide modular link sealing system for concrete penetrations which are below grade. Caulk/seal piping passing through fire-rated assemblies per local AHJ requirements.
 - d. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Indicate penetrations on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Plumbing Drawings are diagrammatic. Offset piping as required to meet these limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.
2. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
- a. Install fabricated pipe sleeve.
 - b. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification.
 - c. Seal each end airtight with a resilient nonhardening seal per code.
3. Piping penetrations through fire-rated (1 to 3 hour) assemblies:
- a. Select and install pre-engineered pipe penetration system in accordance with UL listing and manufacturer's recommendation.
 - b. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E84.

3.2 HOT AND COLD DOMESTIC WATER ABOVE GRADE

- A. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
- B. Testing of Pressurized Systems:
 - 1. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
 - 2. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
- C. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.
- D. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
 - 1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- E. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM Std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and Copper Development Association recommended procedures. Clean joints by other than chemical means prior to

PLUMBING PIPING

assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meeting CDA standard test method 1.0 and ASTM B813-91. Apply solder until a full fillet is present around the joint. Do not apply solder and flux in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.

- F. Braze copper tube and fitting socket with BCUP series filler metal without flux. Use listed brazing flux for joining of copper tube to brass or bronze fittings, meeting AWS FB3A or FB3C. "Shock" cooling is prohibited. A continuous fillet is to be visible around the completed joint. After cooling, thoroughly remove flux residue with warm water and a brush prior to testing. Do not use BCUP filler on copper alloys containing over 10 percent nickel. Cap or plug piping during construction to prevent entry of foreign material.
- G. Domestic Water:
1. "Piping" to include pipes, fittings, nipples, valves and accessories connected thereto.
 2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts, flues, conduits and work of other trades, and as close to ceiling or other construction as practical, free of unnecessary traps or bends.
 3. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.
 4. Use unions for piping connections to equipment.
 5. Provide sufficient elbows, swings and offsets to permit free expansion and contraction.
 6. Use reducers or increasers. Use no bushings.
 7. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageways.
 8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report on final water quality results.
 9. Install exposed connections to equipment with special care, showing no tool marks or threads at fittings and piping. No bowed or bent piping permitted.
 10. Make ferrous to non-ferrous connections with dielectric fittings.
 11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2-inches. Use no close nipples. Use only shoulder-type nipples.
 12. Through-Wall Pipes: Type 'L' copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-bolts to steel back-up plates or steel angles anchored in the wall. Provide wrought copper elbow which securely anchors ears in wall at through-wall pipes.
 13. Provide drain valves at base of risers and at low points on the system.
 14. Backflow Preventers: Pipe relief to nearest drain. Slope at 2 percent.
- H. Sterilization of Domestic Water System:
1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.
 2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. After retention, drain, reflush and return system to service.
 3. Certification: Provide copy of domestic water chlorination certificate in each operations and maintenance manual.

PLUMBING PIPING

4. Provide water line disinfections performed by a licensed contractor with training in potable water line disinfections.

END OF SECTION

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Work included in 23 00 00, HVAC Basic Requirements applies to Division 23, HVAC work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of heating, ventilating and air conditioning systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.
 - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
 - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work provided.
 - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
 - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.2 RELATED SECTIONS

- A. Contents of Section applies to Division 23, HVAC Contract Documents.
- B. Related Work:
 - 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits

1.3 REFERENCES AND STANDARDS

- A. References and Standards per Division 01, General Requirements, individual Division 23, HVAC Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
 - 1. State of Oregon:
 - a. OAR - Oregon Administrative Rules

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

- b. OESC - Oregon Electrical Specialty Code
 - c. OFC - Oregon Fire Code
 - d. OMSC - Oregon Mechanical Specialty Code
 - e. OPSC - Oregon Plumbing Specialty Code
 - f. OSSC - Oregon Structural Specialty Code
 - g. OEESC - Oregon Energy Efficiency Specialty Code
 - h. Oregon Elevator Specialty Code
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 - 1. ABA - Architectural Barriers Act
 - 2. ABMA - American Bearing Manufacturers Association
 - 3. ADA - Americans with Disabilities Act
 - 4. AHRI - Air-Conditioning Heating & Refrigeration Institute
 - 5. AMCA - Air Movement and Control Association
 - 6. ANSI - American National Standards Institute
 - 7. ASCE - American Society of Civil Engineers
 - 8. ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers
 - 9. ASHRAE Guideline 0, The Commissioning Process
 - 10. ASME - American Society of Mechanical Engineers
 - 11. ASPE - American Society of Plumbing Engineers
 - 12. ASSE - American Society of Sanitary Engineering
 - 13. ASTM - ASTM International
 - 14. AWWA - American Water Works Association
 - 15. CFR - Code of Federal Regulations
 - 16. CGA - Compressed Gas Association
 - 17. CISPI - Cast Iron Soil Pipe Institute
 - 18. EPA - Environmental Protection Agency
 - 19. ETL - Electrical Testing Laboratories
 - 20. FM - FM Global
 - 21. GAMA - Gas Appliance Manufacturers Association
 - 22. HI - Hydraulic Institute Standards
 - 23. IAPMO - International Association of Plumbing & Mechanical Officials
 - 24. IFGC - International Fuel Gas Code
 - 25. ISO - International Organization for Standardization
 - 26. MSS - Manufacturers Standardization Society
 - 27. NEC - National Electric Code
 - 28. NEMA - National Electrical Manufacturers Association
 - 29. NFPA - National Fire Protection Association
 - 30. NFGC - National Fuel Gas Code
 - 31. NRCA - National Roofing Contractors Association
 - 32. NSF - National Sanitation Foundation
 - 33. OSHA - Occupational Safety and Health Administration
 - 34. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
 - 35. TEMA - Tubular Exchanger Manufacturers Association
 - 36. TIMA - Thermal Insulation Manufacturers Association
 - 37. UL - Underwriters Laboratories, Inc.
- D. See Division 23, HVAC individual Sections for additional references.

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

1.4 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 23, HVAC Sections.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
 - 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
 - 2. Provide product submittals and shop drawings in electronic format only. Electronic format must be posted to ftp site. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. Deviations will be returned without review.
 - 3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 23, HVAC Sections.
 - 4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
 - a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
 - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 23, HVAC Specification Sections for specific items required in product data submittal outside of these requirements.
 - c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
 - d. For vibration isolation of equipment, list make and model selected with operating load and deflection.
 - e. See Division 23, HVAC individual Sections for additional submittal requirements outside of these requirements.
 - 5. Maximum of two reviews of submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
 - 6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

- individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
 8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required by Division 23, HVAC Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.
 9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
 10. Substitutions and Variation from Basis of Design:
 - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
 11. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, equipment, ductwork and piping layout plans, and control wiring diagrams. Reference individual Division 23, HVAC Specification Sections for additional requirements for shop drawings outside of these requirements.
 - a. Provide Shop Drawings indicating access panel locations for items that require Code or maintenance access, size and elevation for approval prior to installation.
 12. Samples: Provide samples when requested by individual Sections.
 13. Resubmission Requirements:
 - a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
 - 1) Resubmit for review until review indicates no exception taken or make "corrections as noted".
 - 2) When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.
 14. Operation and Maintenance Manuals, Owner's Instructions:

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

- a. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
 - 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.
 - 3) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Sections.
 - 4) Include product certificates of warranties and guarantees.
 - 5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
 - 6) Include copy of startup and test reports specific to each piece of equipment.
 - 7) Include copy of final air and water systems balancing log along with pump, fan and distribution system operating data.
 - 8) Include commissioning reports.
 - 9) Include copy of valve charts/schedules.
 - 10) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
 - b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 23 00 00, HVAC Basic Requirements Article titled "Demonstration".
 - c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
15. Record Drawings:
- a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
 - b. Record Drawings are to include equipment and fixture/connection schedules, control dampers, fire smoke dampers, fire dampers, valves, bottom of pipe, duct and equipment elevations and dimensioned locations for all distribution systems (hydronic and air). Invert elevations and dimensioned locations for underground systems below grade to 5-feet outside building that accurately reflect "as constructed or installed" for project.

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

- c. At completion of project, input changes to original project CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.
- d. See Division 23, HVAC individual Sections for additional items to include in record drawings.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.
- G. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.
- H. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.
- I. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

1.6 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.7 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, equipment, fire sprinklers, plumbing, cable trays, lights, and electrical services with architectural and structural requirements, and other trades (including ceiling suspension, and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Advise Architect in event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- C. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to pumps, fans, valves, control devices, air handlers, vibration isolation devices, etc.

2.2 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL approved or have adequate approval or be acceptable by State, County, and City authorities.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
 - 1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
 - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

2.3 ACCESS PANELS

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

- B. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 23, HVAC Sections. In absence of specific requirements in Division 01, General Requirements, comply with the following:
 - 1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
 - a. Ceiling access panels to be minimum 24-inch by 24-inch required and approved size.
 - b. Wall access panels to be minimum of 12-inch by 12-inch required and approved size.
 - c. Provide screwdriver operated catch.
 - d. Manufacturers and Models:
 - 1) Drywall: Karp KDW.
 - 2) Plaster: Karp DSC-214PL.
 - 3) Masonry: Karp DSC-214M.
 - 4) 2 hour rated: Karp KPF-350FR.
 - 5) Manufacturers: Milcor, Elmdor, Acudor or approved equivalent.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Install equipment having components requiring access (i.e., drain pans, drains, control operators, valves, motors and vibration isolation devices) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions including all appurtenances recommended in manufacturer's installation instructions, at no additional charge to Owner. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.
- D. Firestopping:
 - 1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- E. Pipe Installation:

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building, as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, seismic flexible joints, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.
 2. Include provisions for servicing and removal of equipment without dismantling piping.
- F. Plenums:
1. Plenums: Materials within plenums shall be noncombustible or shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723. Immediately notify Architect / Engineer of any discrepancy.
- 3.2 SEISMIC CONTROL
- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 23 HVAC Sections.
- B. General:
1. Earthquake resistant designs for HVAC (Division 23) equipment and distribution, i.e. motors, ductwork, piping, equipment, etc. to conform to regulations of jurisdiction having authority.
 2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
 3. Provide stamped Shop Drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for piping equipment and water heaters. Submit Shop Drawings along with equipment submittals.
 4. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details.
- C. Piping and Ductwork:
1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.
- D. Provide means to prohibit excessive motion of mechanical equipment during earthquake.
- 3.3 REVIEW AND OBSERVATION
- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Notify Architect and Engineer, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
1. Underground system installation prior to backfilling.

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

2. Prior to covering walls.
 3. Prior to ceiling cover/installation.
 4. After major equipment is installed.
 5. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Final Punch:
1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Mechanical Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the mechanical systems are ready for final punch.
 2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
 2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping and ductwork, and wiring to point of connection. Where existing systems are being utilized, clean existing distribution systems (ductwork, piping, fans, air handlers) prior to connecting new ductwork or piping.
 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
 - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 4. Organize work to minimize duration of power interruption.

3.5 CUTTING AND PATCHING

- A. Confirm Cutting and Patching requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
 3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.6 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.
- B. Maintain design intent where equipment other than as shown as Basis of Design in Contract Documents is provided. Where equipment requires ductwork or piping arrangement, controls/control diagrams, or sequencing different from that indicated in Contract Documents, provide at no additional cost to Owner.

3.7 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage to be replaced before installation.
 2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 3. Protect bright finished shafts, bearing housings and similar items until in service.

3.8 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

3.9 CLEANING

- A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
 - 1. Do not place equipment in sustained operation prior to initial balancing of HVAC systems.
- D. Provide miscellaneous supports/metals required for installation of equipment, piping and ductwork.

3.11 PAINTING

- A. Confirm Painting requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - 1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces in mechanical rooms, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
 - 2. After acceptance by Authority Having Jurisdiction (AHJ), In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 3. See individual equipment Specifications for other painting.
 - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
 - 5. Piping and Ductwork: Clean, primer coat and paint exposed piping and ductwork on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
 - 6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

3.12 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - 1. Coordinate locations/sizes of access panels with Architect prior to work.

3.13 DEMOLITION

- A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - 1. Scope:
 - a. It is the intent of these documents to provide necessary information and adjustments to the HVAC system required to meet code, and accommodate installation of new work.
 - b. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
 - c. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
 - 2. Equipment: Unless otherwise directed, equipment, fixtures, or fittings being removed as part of demolition process are Owner's property. Remove other items not scheduled to be reused or relocated from job site as directed by Owner.
 - 3. Unless specifically indicated on Drawings, remove exposed, unused ductwork and piping to behind finished surfaces (floor, walls, ceilings, etc.). Cap and patch surfaces to match surrounding finish.
 - 4. Unless specifically indicated on Drawings, remove unused equipment, fixtures, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).

3.14 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Testing and Balancing Reports
 - b. Cleaning
 - c. Operation and Maintenance Manuals
 - d. Training of Operating Personnel
 - e. Record Drawings
 - f. Warranty and Guaranty Certificates
 - g. Start-up/Test Document
 - h. Commissioning Reports

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

3.15 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Tests:
 - 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in Operation and Maintenance Manuals.
 - 2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.16 ELECTRICAL INTERLOCKS

- A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

3.17 TEMPORARY HEATING, COOLING AND HUMIDITY CONTROL

- A. Provide temporary heating, cooling, controls, humidification and dehumidification as required to facilitate the construction of the project. Size and select temporary system based on the requirements of the various trades during construction. This includes, but is not limited to, drywall, case work, wood flooring and wood finishes that are subject to warping. Size and install system to prevent mold growth. Coordinate the location of the temporary system. The house system can be used. Develop a procedure for how the house system will be used including a sketch depicting the house system, how filtration will be used to prevent construction debris from entering the system and how often the filters will be changed, how the ductwork will be cleaned after use to ensure a clean system is turned over to the Owner and how the units are sized. Submit this procedure to the Mechanical Engineer for review. Follow National Air Duct Cleaners Association (NADCA) duct cleaning procedures and guidelines. Warranties for the house system, if new, to commence when the Owner moves in if house system is used as the means to maintain the climate within the building during construction. Include this warranty requirement in the original bid or proposal amount. Coordinate and provide any temporary power, controls, ductwork, piping, plumbing anchorage, miscellaneous steel and structural supports required to support the temporary system. Installation of the system to comply with all applicable codes and be acceptable to the Authority Having Jurisdiction (AHJ).

END OF SECTION

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. General Requirements and Procedures
 - 2. Fundamental Air Systems Balancing Procedures
 - 3. Constant Volume Air Systems Balancing Procedures
 - 4. Final Reports:
 - a. Report Requirements
 - b. General Report Data
 - c. System Diagrams
 - d. Air Handling Units
 - e. Fans
 - f. Duct Traverses
 - g. Diffusers/Registers/Grilles
 - h. Instrument Calibration

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Quality-Assurance Submittals: Submit two copies of evidence that the Testing, Adjusting, and Balancing (TAB) Agent and this Project's TAB team members meet the qualifications specified in the "Quality Assurance" Article below.
 - 2. Pre-Construction Phase Report:
 - a. Provide a pre-construction phase TAB Plan at least two weeks prior to the commencement of TAB work. This report is to include:
 - 1) A complete set of report forms intended for use on the project, with data filled in except for the field readings. Forms to be Project-specific.
 - 2) Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.
 - 3) Identification of the type, manufacturer, and model of the actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certifications are to be included.
 - 4) A narrative of any project specific and/or non-standard TAB procedures to be used, and the equipment or systems they apply to.
 - 3. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit two copies of the Contract Documents review report as specified in Part 3 of this Section.

TESTING, ADJUSTING, AND BALANCING FOR HVAC

4. Strategies and Procedures Plan: Submit two copies of the TAB strategies and step-by-step procedures as specified in Part 3 below. Include a complete set of report forms intended for use on this Project.
5. Specify reports required because of editing procedures in Part 3 of this Section.
6. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by the TAB Agent.
7. Sample Report Forms: Submit two sets of sample TAB report forms.
8. Test Instrument Calibration: Submit proof of calibration within the last 6 months.
9. Final Report.
10. Provide additional submittals to commissioning authority as dictated in commissioning specifications.

1.5 QUALITY ASSURANCE

- A. Quality Assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 1. Acceptable Manufacturers:
 - a. Oregon:
 - 1) Air Introduction and Regulations Inc.
 - 2) Accurate Air Balance, Inc.
 - 3) Neudorfer Engineers
 - 4) Northwest Engineering Services
 - 5) Air Balancing Specialty Inc.
 - 6) Precision Test & Balance, Inc.
 - 7) Testcomm
 - 8) Pacific Coast Air Balance
 2. Acceptable Balance Firm:
 - a. General:
 - 1) Procure services of independent TAB agency to balance, adjust and test water circulating and air moving equipment and air distribution or exhaust systems. Minimum experience: 5 years.
 - b. Industry Standards: Testing and Balancing will conform to NEBB, American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), and American National Standards Institute (ANSI) as follows:
 - 1) NEBB: Comply with Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
 - 2) ASHRAE: Comply with recommendations pertaining to measurements, instruments, and TAB.
 - 3) ANSI:
 - (a) S1.4 Specifications for sound level meters.
 - (b) S1.11 Specifications for Octave-Band and Fractional-Octave-Band analog and digital filters.
 - (c) ANSI S1.13 Methods for the Measurement of Sound Pressure Levels.
 - c. Test Observation: If requested, conduct tests in the presence of the Architect or the Architect's representative.
 3. Provide proof of testing agency having successfully completed at least five projects of similar size and scope.

TESTING, ADJUSTING, AND BALANCING FOR HVAC

4. Code Compliance: Perform tests in the presence of the Authority Having Jurisdiction (AHJ) where required by the Authority Having Jurisdiction (AHJ).
5. Owner Witness: Perform tests in the presence of the Owners representative.
6. Engineer Witness: The engineer or engineer's representative reserves the right to observe tests or selected tests to assure compliance with the specifications.
7. Simultaneous Testing: Test observations by the AHJ, the Owner's Authorized Representative and the engineer's representative need not occur simultaneously.
8. Do not perform TAB work until heating, ventilating, and air conditioning equipment has been completely installed and is operating continuously as required.
9. Conduct air testing and balancing with clean filters in place. Clean strainers prior to performing hydronic testing and balancing.
10. Agent Qualifications: Engage a TAB agent certified by AABC or NEBB.
11. TAB Conference: Meet with the Owner's and the Architect's representatives on approval of the 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 Installer, and other support personnel. Provide 7 days advance notice of scheduled meeting time and location.
 - a. Agenda Items: Include at least the following:
 - 1) Submittal distribution requirements.
 - 2) Contract Documents examination report.
 - 3) TAB plan.
 - 4) Work schedule and Project site access requirements.
 - 5) Coordination and cooperation of trades and subcontractors.
 - 6) Coordination of documentation and communication flow.
12. Certification of TAB Reports: This certification includes the following:
 - a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - b. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
13. TAB Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing" and NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
14. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards and NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
15. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 1. TAB Agency provides warranty for a period of 90 days following submission of completed report, during which time, Owner may request a recheck of up to 10 percent of total number of terminals, or resetting of any outlet, coil, or device listed in the final TAB report.
 2. Guarantee: Meet the requirements of the following programs:
 - a. Provide a guarantee on AABC or NEBB forms stating that the agency will assist in completing the requirements of the Contract Documents if the TAB Agent

TESTING, ADJUSTING, AND BALANCING FOR HVAC

fails to comply with the Contract Documents. Guarantee includes the following provisions:

- 1) The certified Agent has tested, adjusted, and balanced systems according to the Contract Documents.
- 2) Systems are balanced to optimum performance capabilities within design and installation limits.

1.7 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and 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 design quantities.
- C. 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 persons skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.
- F. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- G. 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.
- H. TAB: Testing, Adjusting, and Balancing.
- I. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- J. Test: A procedure to determine quantitative performance of a system or equipment.
- K. Testing, Adjusting, and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.
- L. AABC: Associated Air Balance Council.
- M. AMCA: Air Movement and Control Association.
- N. NEBB: National Environmental Balancing Bureau.
- O. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.8 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.

TESTING, ADJUSTING, AND BALANCING FOR HVAC

- B. Notice: Provide 7 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.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS AND PROCEDURES

- A. Project Conditions:
 - 1. Non-Owner Occupancy: Complete balancing of building systems prior to Substantial Completion and owner occupancy.
- B. General Requirements:
 - 1. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and controls, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
 - 2. Perform TAB work with doors, closed windows, and ceilings installed etc., to obtain simulated or project operating conditions. Do not proceed until systems scheduled for TAB are clean and free from debris, dirt and discarded building materials.
 - 3. Where Owner occupies building during the testing period, cooperate with Owner to minimize conflicts with Owner's operations.
- C. Examination:
 - 1. Examine Contract Documents to become familiar with project requirements and existing building record documents (if available) to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - a. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - b. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, 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.
 - 2. Examine approved submittal data of HVAC systems and equipment.
 - 3. Examine project record documents described in Division 01, General Requirements.
 - 4. Examine Architect's and Engineer's design data, including Basis of Design, 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.
 - 5. 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 the 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.
 - 6. Coordinate requirements in system and equipment with this Section.

TESTING, ADJUSTING, AND BALANCING FOR HVAC

7. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
 8. Examine system and equipment test reports.
 9. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 10. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
 11. Examine equipment for installation and for properly operating safety interlocks and controls.
 12. Report deficiencies discovered before and during performance of TAB procedures.
 13. Beginning of work means acceptance of existing conditions.
- D. Preparation:
1. Prepare a TAB plan that includes strategies and step-by-step procedures.
 2. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - a. Permanent electrical power wiring is complete.
 - b. Hydronic systems are filled, clean, and free of air.
 - c. Automatic temperature-control systems are operational.
 - d. Equipment and duct access doors are securely closed.
 - e. Balance, smoke, and fire dampers are open.
 - f. Isolating and balancing valves are open and control valves are operational.
 - g. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - h. Windows, doors and other portions of the building envelope can be closed so design conditions for system operations can be met.
 3. Hold a pre-balancing meeting at least one week prior to starting TAB work.
 - a. Attendance is required by installers whose work will be tested, adjusted, or balanced.
 4. Provide instruments required for TAB operations. Make instruments available to Architect to facilitate spot checks during testing.
- E. General TAB Procedures:
1. Perform TAB procedures on each system according to the procedures contained in AABC national standards or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
 2. Cut insulation, ducts, pipes, 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 the insulation Specifications for this Project.
 3. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- F. Adjustment Tolerances:
1. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.

TESTING, ADJUSTING, AND BALANCING FOR HVAC

2. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
 3. Hydronic Systems: Adjust to within plus or minus 10 percent of design at coils and plus or minus 5 percent at system pumps and equipment.
 4. Adjust supply, return, and exhaust air quantities to maintain pressurization in spaces indicated on Drawings. Note and document room-to-room pressurization and maintain these relationships. Adjust pressure controlled spaces to within plus or minus 0.01 in WC.
- G. Recording and Adjusting:
1. Field Logs: Maintain written logs including:
 - a. Running log of events and issues.
 - b. Discrepancies, deficient or uncompleted work by others.
 - c. Contract interpretation requests.
 - d. Lists of completed tests.
 2. Ensure recorded data represents actual measured or observed conditions.
 3. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
 4. Mark on drawings locations where traverse and other critical measurements were taken and cross reference location in final report.
 5. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
 6. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.2 FUNDAMENTAL AIR SYSTEMS BALANCING PROCEDURES

- A. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- B. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- C. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- D. Prepare test reports for both fans and inlets and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross check the summation of required outlet volumes with required fan volumes.
- E. Prepare schematic diagrams of systems' "as-built" duct layouts.
- F. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- G. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- H. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- I. Verify that motor starters are equipped with thermal protection, sized for the connected load.
- J. Check dampers for proper position to achieve desired airflow path.
- K. Check for airflow blockages.

TESTING, ADJUSTING, AND BALANCING FOR HVAC

- L. Check that condensate drains are installed, trapped and primed and routed to drain.
- M. Check for readily observable leaks in air-handling unit components and ductwork.
- N. Use sheaves and pulleys to adjust the speed of belt drive fans to achieve design flow with motors running at 60 Hertz unless noted otherwise.

3.3 CONSTANT VOLUME AIR SYSTEMS BALANCING PROCEDURES

- A. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer. Adjust fans to deliver design airflow at the lowest possible speed.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each air-handling unit component under final balanced condition.
 - 3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Recommend corrective action to align design and actual conditions.
 - 4. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 5. Do not make fan-speed adjustments that result in motor loading greater than full load amps. Do not increase fan speed beyond fan class rating. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
 - 6. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.

3.4 FINAL REPORTS

- A. Report Requirements:
 - 1. General:
 - a. Computer printout in letter-quality font, on standard bond paper, in 3-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 TAB engineer.
 - 1) Include a list of the instruments used for procedures, along with proof of calibration.
 - c. Final Report Contents: In addition to the certified field report data, include the following:
 - 1) Fan Curves
 - 2) Manufacturers Test Data
 - 3) Field test reports prepared by system and equipment installers.

TESTING, ADJUSTING, AND BALANCING FOR HVAC

- 4) Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

B. General Report Data:

1. In addition to the form titles and entries, include the following data in the final report, as applicable:
 - a. Title Page
 - b. Name and Address of TAB Agent
 - c. Project Name
 - d. Project Location
 - e. Architect's Name and Address
 - f. Engineer's Name and Address
 - g. Contractor's Name and Address
 - h. Report Date
 - i. Signature of TAB Agent who Certifies the Report
 - j. Summary of Contents, Including the Following:
 - 1) Design versus Final Performance
 - 2) Notable Characteristics of Systems
 - 3) Description of System Operation Sequence if it varies from the Contract Documents
 - k. Nomenclature Sheets for Each Item of Equipment
 - l. Data for Terminal Units, including Manufacturer, Type Size, and Fittings
 - m. Notes to explain why certain final data in the body of reports vary from design values.
 - n. Test Conditions for Fans and Pump Performance Forms, Including the Following:
 - 1) Settings for Outside-, Return-, and Exhaust-air Dampers
 - 2) Conditions of Filters
 - 3) Cooling Coil, Wet- and Dry-bulb Conditions
 - 4) Face and Bypass Damper Settings at Coils
 - 5) Fan Drive Settings, including Settings and Percentage of Maximum Pitch Diameter
 - 6) Inlet Vane Settings for Variable-Air-Volume Systems
 - 7) Settings for Supply-air, Static-pressure Controller
 - 8) Other System Operating Conditions that affect Performance

C. System Diagrams:

1. Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
 - a. Quantities of Outside, Supply, Return, and Exhaust Airflows
 - b. Water and Steam Flow Rates
 - c. Duct, Outlet, and Inlet Sizes
 - d. Pipe and Valve Sizes and Locations
 - e. Terminal Units
 - f. Balancing Stations

D. Air Handling Units:

1. For air-handling units, split systems, fan coils, pumps, and evaporator units with coils, include the following:
 - a. Unit Data: Include the following:
 - 1) Unit Identification

TESTING, ADJUSTING, AND BALANCING FOR HVAC

- 2) Location
 - 3) Make and Type
 - 4) Model Number and Unit Size
 - 5) Manufacturer's Serial Number
 - 6) Unit Arrangement and Class
 - 7) Discharge Arrangement
 - 8) Sheave Make, Size in inches, and Bore
 - 9) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
 - 10) Number of Belts, Make, and Size
 - 11) Number of Filters, Type, and Size
 - b. Motor Data: Include the following:
 - 1) Make and Frame Type and Size
 - 2) Horsepower and rpm
 - 3) Volts, Phase, and Hertz
 - 4) Full-load Amperage and Service Factor
 - 5) Sheave Make, Size in Inches, and Bore
 - 6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
 - c. Test Data: Include design and actual values for the following:
 - 1) Total Airflow Rate in cfm (L/s)
 - 2) Total System Static Pressure in Inches wg (Pa)
 - 3) Fan rpm
 - 4) Discharge Static Pressure in Inches wg (Pa)
 - 5) Filter Static-pressure Differential in Inches wg (Pa)
 - 6) Preheat Coil Static-pressure Differential in Inches wg (Pa)
 - 7) Cooling Coil Static-pressure Differential in Inches wg (Pa)
 - 8) Heating Coil Static-pressure Differential in Inches wg (Pa)
 - 9) Outside Airflow in cfm (L/s)
 - 10) Return Airflow in cfm (L/s)
 - 11) Outside-air Damper Position
 - 12) Return-air Damper Position
 - 13) Vortex Damper Position
- E. Fans:
1. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - a. Fan Data: Include the following:
 - 1) System Identification
 - 2) Location
 - 3) Make and Type
 - 4) Model Number and Size
 - 5) Manufacturer's Serial Number
 - 6) Arrangement and Class
 - 7) Sheave Make, Size in Inches, and Bore
 - 8) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches.
 - b. Motor Data: Include the following:
 - 1) Make and Frame Type and Size
 - 2) Horsepower and rpm
 - 3) Volts, Phase, and Hertz

TESTING, ADJUSTING, AND BALANCING FOR HVAC

- 4) Full-load Amperage and Service Factor
 - 5) Sheave Make, Size in Inches, and Bore
 - 6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
 - 7) Number of Belts, Make, and Size
 - c. Test Data: Include design and actual values for the following:
 - 1) Total Airflow Rate in cfm
 - 2) Total System Static Pressure in Inches wg
 - 3) Fan rpm
 - 4) Discharge Static Pressure in Inches wg
 - 5) Suction Static Pressure in Inches wg
- F. Duct Traverses:
 - 1. Include a diagram with a grid representing the duct cross-section and record the following:
 - a. Report Data: Include the following:
 - 1) System and Air-handling Unit Number
 - 2) Location and Zone
 - 3) Traverse Air Temperature in Degrees F
 - 4) Duct Static Pressure in Inches wg
 - 5) Duct Size in Inches
 - 6) Duct Area in SF
 - 7) Design Airflow Rate in cfm
 - 8) Design Velocity in fpm
 - 9) Actual Airflow Rate in cfm
 - 10) Actual Average Velocity in fpm
 - 11) Barometric Pressure in PSIG
- G. Diffusers/Registers/Grilles:
 - 1. For diffusers, registers and grilles, include the following:
 - a. Unit Data: Include the following:
 - 1) System and Air-handling Unit Identification
 - 2) Location and Zone
 - 3) Test Apparatus Used
 - 4) Area Served
 - 5) Air-terminal-device Make
 - 6) Air-terminal-device Number from System Diagram
 - 7) Air-terminal-device Type and Model Number
 - 8) Air-terminal-device Size
 - 9) Air-terminal-device Effective Area in SF
 - b. Test Data: Include design and actual values for the following:
 - 1) Airflow Rate in cfm
 - 2) Air Velocity in fpm
 - 3) Preliminary Airflow Rate as Needed in cfm
 - 4) Preliminary Velocity as Needed in fpm
 - 5) Final Airflow Rate in cfm
 - 6) Final Velocity in fpm
 - 7) Space Temperature in Degrees F
- H. Instrument Calibration:

TESTING, ADJUSTING, AND BALANCING FOR HVAC

1. For instrument calibration, include the following:
 - a. Report Data: Include the following:
 - 1) Instrument Type and Make
 - 2) Serial Number
 - 3) Application.
 - 4) Dates of Use
 - b. Dates of Calibration.

END OF SECTION

HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Ductwork, Joints and Fittings
 - 2. Insulated Flexible Duct
 - 3. Ductwork Joint Sealers and Sealants

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 23 05 29, Hangers and Supports for HVAC Piping, Ductwork and Equipment.
 - 2. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Welding Certificates
 - 2. Field Quality Control Reports

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NFPA Compliance:
 - a. NFPA 90A Installation of Air Conditioning and Ventilating Systems.
 - b. NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
 - 2. Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Provide sheet metal materials free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Duct design is generally diagrammatic

HVAC DUCTS AND CASINGS

and is not meant to be scaled. Major changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Ductwork, Joints, and Fittings:
 - 1. Ductmate
 - 2. Lindab Inc
 - 3. Nexus Inc
 - 4. SEMCO
 - 5. United McGill Corporation
 - 6. Ward Industries
 - 7. Or approved equivalent
- B. Insulated Flexible Duct:
 - 1. ATCO
 - 2. Flexmaster
 - 3. J.P. Lamborn Co.
 - 4. Hart and Cooley
 - 5. Or approved equivalent
- C. Ductwork Joint Sealers and Sealants
 - 1. Ductmate
 - 2. Durodyne
 - 3. Hardcast
 - 4. United McGill Corporation
 - 5. Vulkem
 - 6. Foster
 - 7. Childer
 - 8. Or approved equivalent

2.2 DUCTWORK, JOINTS AND FITTINGS

- A. Materials:
 - 1. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, lock-forming quality, ASTM A 653/A 653M FS Type B, with G90/Z275 coating. Ducts to have mill phosphatized finish for surfaces exposed to view.
- B. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 - 2. Deflection: Duct systems not-to-exceed deflection limits according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
 - 3. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

HVAC DUCTS AND CASINGS

- C. Formed-On Flanges: construct according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Figure 1-4, using corner, bolt, cleat, and gasket details.
 - 1. Duct Size: Maximum 30-inches wide and up to 2-inch wg pressure class.
 - 2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
 - 3. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19-inches and larger and 0.0359-inch thick or less, with more than 10 SF of nonbraced panel area unless ducts are lined.
- D. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of material specified in this Section according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
 - 1. Ducts up to 20-inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 - 2. Ducts Larger than 72-inches in Diameter: Companion angle flanged joints per SMACNA HVAC Duct Construction Standards-Metal and Flexible, Figure 3-2.
 - 3. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
- E. 90-Degree Tees and laterals and Conical Tees: Fabricate to comply with SMACNA's HVAC Duct Construction Standards-Metal and Flexible, with metal thicknesses specified for longitudinal-seam straight ducts.
- F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows to be 1.5 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
 - 1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's HVAC Duct Construction Standards-Metal and flexible, unless otherwise indicated.
 - 2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):
 - a. Ducts 3- to 36-inches in Diameter: 0.034-inch .
 - 3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
 - a. Ducts 3- to 26-inches in Diameter: 0.034-inch.
 - 4. 90-Degree, Two-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
 - 5. Round Elbows
 - a. 8-inches and Less in Diameter: Fabricate die-formed elbows for 45 and 90-degree elbows and pleated elbows for 30, 45, 60 and 90 degrees only. Fabricate nonstandard bend-angle configurations or non-standard diameter elbows with gored construction.
 - b. 9 through 14-inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60 and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 - c. Larger than 14-inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.

HVAC DUCTS AND CASINGS

6. Die-Formed Elbows for Sizes through 8-inches in Diameter and Pressures 0.040-inch thick with two-piece welded construction.
7. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
8. Pleated Elbows for Sizes through 14-inches in Diameter and Pressures through 10-inch wg (2500 Pa): 0.022-inch.
9. Not acceptable:
 - a. Corrugated or flexible metal duct.
 - b. Adjustable elbows.

2.3 INSULATED FLEXIBLE DUCT

- A. Construction: Standard factory fabricated product. Inner wall: Impervious vinyl or chlorinated polyethylene, permanently bonded to a vinyl or zinc-coated spring steel helix.
- B. Insulation: Fiberglass blanket insulation covered by an outer wall of vinyl or fiberglass-reinforced metalized vapor barrier.
- C. Listing: UL 181 listed Class 1 flexible air duct material. Overall thermal transmission: No more than 0.25 BTU/in or hr/sq. degrees F at 75 degrees F differential, per ASTM C335.
- D. Vapor transmission value no more than 0.10 perm, per ASTM E96
- E. Pressure Rating: 4-inch wg positive pressure and 1-inch wg negative pressure.
- F. Performance Air Friction Correction Factor: 1.3 maximum at 95 percent extension. Working air velocity: Minimum 2000 FPM.
- G. Flame Spread Rating: No more than 25.
- H. Smoke Development Rating: No more than 50 as tested per ASTM E84.
- I. Insertion Loss: Minimum attenuation of 29 DB for 10-foot straight length at 8-inch diameter at 500 Hz.

2.4 DUCTWORK JOINT SEALERS AND SEALANTS

- A. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
- B. Low Emitting Materials Requirement: Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.
- C. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure and leakage class of ducts.
- D. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E 84.
- E. Water Based Sealant for Brush-On Application: Flexible, adhesive sealant, resistant to UV light, UL-181A, and UL-181-B listed, complying with NFPA requirements for Class 1 ducts. Min. 69 percent solids, nonflammable. Hardcast Versa-Grip 181; Childers CP-146; Foster 32-19 for SMACNA 1/2, 1, 2, 3, 4, 6, and 10-inch WG duct classes, and SMACNA Seal Class A, B, or C.
- F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.

HVAC DUCTS AND CASINGS

- G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.
- H. Polyurethane Sealant: General-purpose, exterior use, non-brittle sealant for gunned application. Vulkem 616 or equal.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. General: Use the following pressure seal, and leakage class(es) in design of ductwork specified in this section unless otherwise noted on Drawings.

SYSTEM	PRESSURE CLASS (Inches of Water)	SEAL CLASS	LEAKAGE CLASS ROUND DUCTS	LEAKAGE CLASS RECTANGULAR DUCTS
Low pressure	+ 1-inch	A	3	6
Return main (>24-inch)	0.5-inch more negative than return/exhaust fan pressure or -2-inch pressure class, whichever is more negative.	A	3	6
Return branch (<24-inch)	0.5-inch more negative than return/exhaust fan pressure or -2-inch pressure class, whichever is more negative.	A	3	6
General exhaust	0.5-inch more negative than return/exhaust fan pressure or -2-inch pressure class, whichever is more negative.	A	3	6

- B. Ductwork Installation:
 1. General: Install entire duct system in accordance with drawings, Specifications, and latest issues of local Mechanical Code, NFPA 90A, and SMACNA Duct Construction Manual. At Contractor's option, rectangular ductwork may be resized to maintain an equivalent air velocity and friction rate, while maintaining a maximum aspect ratio of 3. Remove markings and tagging from ductwork exterior surface in mechanical rooms and other locations where ductwork is exposed.
 2. The duct layout shown on the Contract Drawings is diagrammatic in nature. Coordinate the ductwork routing and layout, and make alterations to the ductwork routing and layout to eliminate physical interferences. Where deviations in the ductwork routing as shown in the Contract Drawings are required, alterations may be made so as not to compromise the air flow, pressure drop, and sound characteristics of the duct fitting or duct run as shown on the Contract Drawings. In the event Architect determines that the installed ductwork is inconsistent with the above mentioned criteria, remove and replace at no additional cost to the Owner.
 3. Install ducts with fewest possible joints.
 4. Install fabricated fittings for changes in directions, size, shape, and for connections.
 5. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12-inches, with a minimum of 3 screws in each coupling.

HVAC DUCTS AND CASINGS

6. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
 7. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
 8. Install ducts with a clearance of 1-inch, plus allowance for insulation thickness. Allow for easy removal of ceiling tile.
 9. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
 10. Coordinate layout with suspended ceiling, air duct accessories, lighting layouts, and similar finish work.
 11. Electrical and IT Equipment Spaces: route ducts to avoid passing through transformer vaults, electrical equipment spaces, IDF/MPOE rooms, and enclosures.
 12. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2-inches.
 13. Fire- and Smoke-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire, smoke or combination fire and smoke dampers as governed by Building Code and AHJ, including sleeves, and firestopping sealant.
 14. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Reference SMACNA's Seismic Restraint Manual: Guidelines for Mechanical Systems, Mason Seismic Restraint and Support Systems.
 15. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's Duct Cleanliness for New Construction Advanced Level.
 16. Paint interiors of metal ducts, that do not have duct liner, for 24-inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible duct material.
 17. Install ductwork in the location and manner shown and detailed. Review deviations required by job conditions with Architect prior to any fabrication. Provide fittings for construction per SMACNA.
- C. Flanged Take-Offs:
1. Install at branch takeoffs to outlets using round or flex duct.
 2. Flanged take-offs secured with minimum 8-inch screw spacing (three screws minimum).
 3. Provide ductwork taps and branches off of main ducts at 45 degrees whether shown on Drawings or not (drawings are diagrammatic).
- D. Cleaning:
1. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.
 2. Grille and Exposed Duct Cleaning:
 - a. After completion of ductwork installation, operate each fan system (excluding exhaust fans) for a minimum of 30 minutes prior to installation of ceiling grilles and diffusers. After grilles and diffusers are installed, clean out accumulation of particles from grilles and diffusers prior to acceptance.
 - b. Clean exterior surface of ducts exposed to public view of chalk, pencil and pen marks, labels, sizing tags, dirt, dust, etc., so that upon completion of installation, ducts are left in clean and unblemished manufactured conditions.

HVAC DUCTS AND CASINGS

- c. Exposed duct and grilles to remain free of dust entrained streaks due to leakage at joints and grille connections during warranty period. Clean leaks, seal and refinish to match existing if visible streaks develop.

3.2 DUCTWORK, JOINTS AND FITTINGS INSTALLATION

A. Duct Materials - Applied Locations:

1. General: Use the following materials in design of ductwork specified in this Section unless otherwise noted on the Drawings.

Location or Application	Material
Supply, Return, Transfer, and Exhaust - Low Pressure	Single Wall, Galvanized Steel

B. Ductwork Installation:

1. Fabricate radius elbows with centerline radius not less than 1-1/2 duct diameters.
2. Do not install duct size transition pitch angles which exceed 30 degrees for reductions in duct size in the direction of airflow, and 15 degrees for expansions in duct size in the direction of airflow.
3. Install fixed turning vanes in square throat rectangular elbows and in tees.
4. Fabricate duct turns with the inside (smallest) radius at least equal to the duct width (supply ducts) and 1.5 times radius (return and exhaust ducts). Where necessary, square elbows may be used, with maximum available inside radius and with fixed turning vanes. In healthcare settings such as hospitals and medical office buildings, square elbows and turning vanes allowed on supply ductwork only.

3.3 INSULATED FLEXIBLE DUCT INSTALLATION

- A. Provide sheet metal plenum or rigid elbow and connect to diffusers and grilles with ductwork connections. Refer to Drawings for more information. Provide straight section of flexible duct with minimum length of 2-feet and maximum length of 5-feet and connect to sheet metal plenums and rigid elbows connected to diffusers and grilles, unless noted otherwise.
1. Provide round neck grilles/diffusers or square-to-round transitions. Flexible duct connections directly to diffuser and grilles is not allowed.
 2. Flexible duct allowed in concealed spaces above lay-in ceilings only.

3.4 DUCTWORK JOINT SEALERS AND SEALANTS INSTALLATION

A. Joints and Seam Joint Sealing:

1. Seal duct seams and joints according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, for duct pressure class indicated.
2. Seal transverse joints, longitudinal seams and duct wall penetrations including screw, fastener, pipe, rod, and wire.
3. Seal ducts before external insulation is applied.
4. Fasteners such as sheet-metal screws, machine screws or rivets to be cadmium plated.
5. Rectangular Ductwork: Where intermediate joint reinforcement is required for duct of negative pressure class, pre-drill stiffening flange and provide fastener maximum 8-inches on center. Where retaining flanges are welded to duct wall, paint welds with zinc coating.
6. Single Wall Round Ductwork: Joint to incorporate beaded slip collar with minimum #8 sheet metal screws 8-inches on center. Seal ductwork as specified in this Section.

HVAC DUCTS AND CASINGS

7. Seal joints and seams. Apply sealant to make end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
8. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
9. Provide openings in ductwork where required to accommodate thermometers and control devices. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
10. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities as well as Code required clearances.

END OF SECTION

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Sheet Metal Materials
 - 2. Dampers
 - 3. Duct Test Holes

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Manufacturer's catalog data and fabrication/installation drawings for each factory fabricated duct accessory. Include leakage, pressure drop and maximum back pressure data.
 - 2. Shop Drawings: Indicate air duct accessories.
 - 3. Manufacturer's installation instructions: Provide instructions for each factory fabricated duct accessory.
 - 4. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - a. See Division 01, General Requirements, Product Requirements for additional provisions.
 - b. Extra Fusible Links: One of each type and size.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this Section, with minimum five years of documented experience.
 - 2. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
 - 3. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
 - 4. AMCA 511 - Certified Ratings Program for Air Control Devices.
 - 5. AMCA 611, latest edition - Certified Ratings Program - Product Rating Manual for Airflow Measurement Stations.
 - 6. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

AIR DUCT ACCESSORIES

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Dampers:
 - 1. Greenheck
 - 2. Nailor
 - 3. Ruskin
- B. Duct Test Holes:
 - 1. Ventlok
 - 2. Or approved equivalent.

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M. Galvanizing: 1-1/4 ounces per square foot total both sides; ducts to have mill-phosphatized finish for surfaces exposed to view.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36-inches or less; 3/8-inch minimum diameter for lengths longer than 36-inches.

2.3 DAMPERS

- A. Basis-of-Design: Ruskin MD 35.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 - 1. Pressure Classes of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- C. Rectangular Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design with linkage concealed in frame and suitable for horizontal or vertical applications.
 - 1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum 16 gauge thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - a. Roll-Formed Steel Blades: 16 gauge thick, galvanized sheet steel.
 - b. Aluminum Frames: Hat-shaped, 10 gauge thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

AIR DUCT ACCESSORIES

- c. Roll-Formed Aluminum Blades: 10 gauge thick aluminum sheet.
 - d. Extruded-Aluminum Blades: 16 gauge thick extruded aluminum.
 - e. Blade Axles: Minimum 1/2-inch diameter, plated steel, hex shaped, mechanically attached to blade.
 - f. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.
 - g. Tie Bars and Brackets: Galvanized steel.
 - h. Mill galvanized.
 - i. Capacity:
 - 1) Closed Position: Maximum pressure of 3-inches wg.
 - 2) Open Position: Maximum air velocity of 1,500-feet per minute across 24-inch by 24-inch damper.
- D. Round Volume Dampers: Single-blade suitable for horizontal or vertical applications.
 - 1. Steel Frames: Galvanized, roll formed, minimum of 20 gauge thick with beads at each end.
 - 2. Blades: Minimum 20 gauge thick, galvanized sheet steel, round, single-piece.
 - 3. Aluminum Frames: Minimum 10 gauge thick aluminum sheet.
 - 4. Aluminum Blades: Minimum 10 gauge thick aluminum sheet.
 - 5. Extruded-Aluminum Blades: Minimum 16 gauge thick extruded aluminum.
 - 6. Blade Axles: Minimum 3/8-inch square, plated steel, mechanically attached to blade.
 - 7. Bearings: Molded synthetic sleeve, turning in hole in frame.
 - 8. Finish: Mill galvanized.
 - 9. Capacity:
 - a. Closed Position: Maximum pressure of 3-inches wg
 - b. Open Position: Maximum air velocity of 1,500-feet per minute.
 - 10. Leakage: Maximum 40 cfm at 1-inch wg for 20-inches diameter damper.
 - 11. Pressure Drop: Maximum 0.02-inch wg at 1,500-feet per minute through 20-inch diameter dampers.
- E. Jackshaft: 1-inch diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
 - 2. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include 2-inch elevated platform for insulated duct mounting.

2.4 DUCT TEST HOLES

- A. Temporary Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.

PART 3 - EXECUTION

3.1 DUCT ACCESSORIES GENERAL INSTALLATION

- A. Inspect areas to receive air duct accessories. Notify Engineer of conditions that would adversely affect the installation of the dampers. Do not proceed until conditions are corrected.
- B. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.

AIR DUCT ACCESSORIES

- C. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- D. Do not compress or stretch damper frames into duct or opening.
- E. Handle dampers using sleeve or frame. Do not lift dampers using blades, actuators, or jack shafts.
- F. Adjust duct accessories for proper settings.

3.2 SHEET METAL MATERIALS INSTALLATION

- A. Install bracing for multiple sections to support assembly weights and hold against system pressure. Install bracing as needed.

3.3 DAMPERS INSTALLATION

- A. Where installing volume dampers in ducts with liner, avoid damage to and erosion of duct liner.
- B. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts for air balancing. Install at a minimum of two duct widths from each branch takeoff. Provide balancing dampers for all air inlets and outlets.
- C. Install dampers square and free from racking with blade running horizontally.

3.4 DUCT TEST HOLES INSTALLATION

- A. Provide test holes at fan inlets and outlets where indicated and where required for air testing and balancing.

END OF SECTION

AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Grilles, Registers, Diffusers

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size and accessories furnished.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Air Distribution Diffuser, Register, and Grille Schedule lists Basis of Design, with any specialty accessories, construction, finish or other criteria noted on schedule. Submitted air distribution must match criteria of Basis of Design:
 - a. Construction materials and appearance.
 - b. Frame/installation method.
 - c. Isothermal throw plus or minus 5 percent at design flows shown on drawings.
 - d. Noise Criteria: NC value plus or minus 1 at design flows shown on drawings.
 - e. Accessories: Equal to Basis of Design.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

AIR OUTLETS AND INLETS

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23, HVAC sections, where more than a single type is specified for the application, provide single selection for each product category.
- B. Grilles, Registers, Diffusers:
 - 1. Anemostat
 - 2. Carnes
 - 3. Environmental Air Products
 - 4. Kruger
 - 5. Metalaire
 - 6. Nailor
 - 7. Price Co.
 - 8. Shoemaker
 - 9. Titus
 - 10. Tuttle & Bailey
 - 11. Seiho
 - 12. Or approved equivalent.

2.2 GRILLES, REGISTERS, DIFFUSERS

- A. Diffuser, Register and Grille Schedule lists Basis of Design, with specialty accessories, construction, finish or other criteria noted on schedule. Submitted air distribution must match criteria of Basis of Design, including accessories and finish:
 - 1. Matching construction materials and appearance. Equal installation method/frame.
 - 2. Pressure drop equal to or less than Basis of Design at CFM on Drawings.
 - 3. Throw: Isothermal jet throw plus or minus 5 percent of Basis of Design at CFM listed on Drawings.
 - 4. Noise Criteria: Plus or minus 1 NC of Basis of Design at CFM listed on Drawings. If Basis of Design NC is below registered level, submitted must match. NC rating with 10 dB room factor or less.
- B. Provide 1-, 2-, 3-, or 4-way deflection as indicated on Drawings.
- C. Provide pattern controllers for linear supply air diffusers.
- D. Register Dampers: Dampers utilized with grilles. Opposed blade dampers utilizing a side operated worm drive which provides external duct operation. Slot the end of the shaft to receive a screwdriver. Factory assembled side operator. Construct of the same material as the grille. Manufacturer same as grilles/diffuser.
- E. Coordinate mounting frames with ceiling construction type. Verify per reflected ceiling plans.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Install in accordance with manufacturer's instructions. Provide seismic supports, clips, and bracing per local code. Coordinate installation of framing. Provide complete coverage of rough openings by integral device flanges or auxiliary frames. Where above ceiling location is unconditioned

AIR OUTLETS AND INLETS

space, caulk rough openings; repair and re-paint locations where dust entrainment streaks develop due to unsealed openings.

- B. Damp locations, such as lockers, restrooms, showers, natatoriums, whirlpool/spas, to have aluminum construction even if scheduled otherwise; mounting hardware to be stainless steel.
- C. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- D. Unless otherwise shown on drawings, for ceiling mounted air outlets with adjustable airflow pattern controllers mounted at a height of 12 feet or less, adjust the air outlets for horizontal air distribution, and adjust to vertical air distribution for ceiling height above 12 feet.
- E. Exterior color of grilles per Architect. White finish if not otherwise scheduled or noted by Architect. Paint ductwork visible behind air outlets and inlets matte black.
- F. Ceiling Membrane: Protect ceiling membrane per code. Fire caulk around openings. Provide listed radiation damper in rated roof/ceiling or floor/ceiling assemblies as required per code.
- G. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

3.2 GRILLES, REGISTERS AND DIFFUSERS INSTALLATION

- A. Coordinate with Architectural Reflected Ceiling Plan(s). Reflected ceiling plans determine final locations.
- B. Install diffusers to ductwork with air tight connection. 18-inch straight duct section or acoustic plenum at connection. Provide square to round adapters where required for connection to round ducts.
- C. Provide integral balancing dampers for diffusers, and grilles and registers where duct manual balancing dampers are not shown or specified.

END OF SECTION

ELECTRICAL BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Work included in 26 00 00, Electrical Basic Requirements applies to Division 26, Electrical work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of electrical systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.
 - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
 - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
 - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
 - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.2 RELATED SECTIONS

- A. Contents of Section applies to Division 26, Electrical Contract Documents.
- B. Related Work:
 - 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits

1.3 REFERENCES AND STANDARDS

- A. References and Standards per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 26, Electrical Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
 - 1. State of Oregon:

ELECTRICAL BASIC REQUIREMENTS

- a. OAR - Oregon Administrative Rules
 - b. OESC - Oregon Electrical Specialty Code
 - c. OFC - Oregon Fire Code
 - d. OMSC - Oregon Mechanical Specialty Code
 - e. OPSC - Oregon Plumbing Specialty Code
 - f. OSSC - Oregon Structural Specialty Code
 - g. OEESC - Oregon Energy Efficiency Specialty Code
 - C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 - 1. ABA - Architectural Barriers Act
 - 2. ADA - Americans with Disabilities Act
 - 3. ANSI - American National Standards Institute
 - 4. APWA - American Public Works Association
 - 5. ASCE - American Society of Civil Engineers
 - 6. ASHRAE Guideline 0, the Commissioning Process
 - 7. ASTM - ASTM International
 - 8. CFR - Code of Federal Regulations
 - 9. EPA - Environmental Protection Agency
 - 10. ETL - Electrical Testing Laboratories
 - 11. FCC - Federal Communications Commission
 - 12. FM - FM Global
 - 13. IBC - International Building Code
 - 14. IEC - International Electrotechnical Commission
 - 15. IEEE - Institute of Electrical and Electronics Engineers
 - 16. IES - Illuminating Engineering Society
 - 17. ISO - International Organization for Standardization
 - 18. MSS - Manufacturers Standardization Society
 - 19. NEC - National Electric Code
 - 20. NECA - National Electrical Contractors Association
 - 21. NEMA - National Electrical Manufacturers Association
 - 22. NETA - National Electrical Testing Association
 - 23. NFPA - National Fire Protection Association
 - 24. OSHA - Occupational Safety and Health Administration
 - 25. UL - Underwriters Laboratories Inc.
 - D. See Division 26, Electrical individual Sections for additional references.
- 1.4 SUBMITTALS
- A. See Division 01, General Requirements for Submittal Procedures as well as individual Division 26, Electrical Sections.
 - B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
 - C. In addition:
 - 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction,

ELECTRICAL BASIC REQUIREMENTS

- coordination of the work with that of all other trades, and the satisfactory performance of the work.
2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via posted to ftp site. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. Provide separate submittals for lighting control cutsheets, and for lighting control shop drawings. Deviations will be returned without review.
 3. Product Data: Provide manufacturer's descriptive literature for products specified in Division 26, Electrical Sections.
 4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the specifications and drawings.
 - a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
 - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 26, Electrical specification Sections for specific items required in product data submittal outside of these requirements.
 - c. See Division 26, Electrical individual Sections for additional submittal requirements outside of these requirements.
 5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
 6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
 7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
 8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 26, Electrical Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals. Electric motors are supplied and installed by Division 23 unless otherwise specified. During shop drawing stage of the project, verify correct disconnect sizes, conductor sizes, etc., and bring any discrepancies to the attention of the Mechanical trade. Be responsible for any modifications to electrical equipment or installations as a result of equipment incompatibility discovered after shop drawing review.
 9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.

ELECTRICAL BASIC REQUIREMENTS

10. Substitutions and Variation from Basis of Design:
 - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
11. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Reference individual Division 26, Electrical specification Sections for additional requirements for shop drawings outside of these requirements.
 - a. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
12. Samples: Provide samples when requested by individual Sections.
13. Resubmission Requirements:
 - a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
 - b. Resubmit for review until review indicates no exception taken or "make corrections as noted".
14. Operation and Maintenance Manuals, Owner's Instructions:
 - a. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
 - 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment.
 - 3) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00

ELECTRICAL BASIC REQUIREMENTS

- 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- 4) Include product certificates of warranties and guarantees.
 - 5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
 - 6) Include commissioning reports.
 - 7) Include copy of startup and test reports specific to each piece of equipment.
 - 8) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
- b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 26 00 00, Electrical Basic Requirements, Demonstration.
 - c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
15. Record Drawings:
- a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of conduit, and location of concealed electrical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
 - b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
 - c. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.
 - d. At completion of project, show changes and deviations from the Drawings in red on one set of black-line drawings. Include written Addendums, RFIs, and change order items. Make changes to Drawings in a neat, clean, and legible manner.
 - e. See Division 26, Electrical individual Sections for additional items to include in record drawings.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

ELECTRICAL BASIC REQUIREMENTS

- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e. distribution equipment, duct banks, light fixtures, etc.) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.

1.6 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.7 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, plumbing, lights, cable tray and electrical services with architectural and structural requirements, and other trades (including ceiling suspension and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Advise Architect in event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- C. Verify in field exact size, location, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.

ELECTRICAL BASIC REQUIREMENTS

2.2 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL approved or have adequate approval or be acceptable by state, county, and city authorities. Equipment/fixture supplier is responsible for obtaining State, County, and City acceptance on equipment/fixtures that are not UL or ETL approved or are not listed for installation.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
 - 1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
 - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

2.3 ACCESS PANELS

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.
- B. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 26, Electrical Sections. In the absence of specific requirements, comply with the following:
 - 1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
 - a. Ceiling access panels to be minimum of 24-inch by 24-inch.
 - b. Wall access panels to be minimum of 12-inch by 12-inch.
 - c. Provide screwdriver operated catch.
 - d. Manufacturers and Models:
 - 1) Drywall: Karp KDW.
 - 2) Plaster: Karp DSC-214PL.
 - 3) Masonry: Karp DSC-214M.
 - 4) 2 hour rated: Karp KPF-350FR.
 - 5) Manufacturers: Milcor, Elmdor, Acudor, or approved equivalent.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Install equipment requiring access (i.e., junction boxes, light fixtures, power supplies, motors, etc.) so that they may be serviced, reset, replaced or recalibrated by service people with normal

ELECTRICAL BASIC REQUIREMENTS

service tools and equipment. Do not install equipment in passageways, doorways, scuttles or crawlspaces which would impede or block the intended usage.

- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.
- D. Earthwork:
 - 1. Confirm Earthwork requirements in Contract Documents. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork Sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
- E. Firestopping:
 - 1. Confirm requirements in Division 07, Thermal and Moisture Protection. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Plenums:
 - 1. In plenums, provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.
- G. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- H. Provide miscellaneous supports/metals required for installation of equipment and conduit.

3.2 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 26 Electrical Sections.
- B. General:
 - 1. Earthquake resistant designs for Electrical (Division 26) equipment and distribution, i.e. power distribution equipment, generators, UPS, etc. to conform to regulations of jurisdiction having authority.

ELECTRICAL BASIC REQUIREMENTS

2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
3. Provide stamped shop drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for conduit and equipment. Submit shop drawings along with equipment submittals.
4. Provide stamped shop drawings from licensed Structural Engineer of seismic flexible joints for conduit crossing building expansion or seismic joints. Submit shop drawings along with seismic bracing details.
5. Provide means to prohibit excessive motion of electrical equipment during earthquake.

3.3 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Notify Architect or Engineer, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 1. Underground conduit installation prior to backfilling.
 2. Prior to covering walls.
 3. Prior to ceiling cover/installation.
 4. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Final Punch:
 1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Electrical Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the electrical systems are ready for final punch.
 2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
 1. During remodeling or addition to existing structure, while existing structure is occupied, present services to remain intact until new construction, facilities or equipment is installed.
 2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new wiring, and wiring to point of connection.
 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off-peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
 - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 4. No interruption of services to any part of existing facilities will be permitted without express permission in each instance from Owner. Requests for outages must state specific

ELECTRICAL BASIC REQUIREMENTS

dates, hours and maximum durations, with outages kept to these specific dates, hours and maximum durations. Obtain written permission from Owner for any interruption of power, lighting or signal circuits and systems.

- a. Organize work to minimize duration of power interruption.
- b. Coordinate utility service outages with utility company.

3.5 CUTTING AND PATCHING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
 1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
 3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
 4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and/or walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
 5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.6 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.7 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage and handling to be replaced before installation.
 2. Protect equipment to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 3. Protect bus duct and similar items until in service.

ELECTRICAL BASIC REQUIREMENTS

3.8 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, and individual Division 26, Electrical Sections.
- B. Upon completion of work and adjustment of equipment, test systems and demonstrate to Owner's Authorized Representative, Architect, and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.9 CLEANING

- A. Confirm Cleaning requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Upon completion of installation, thoroughly clean electrical equipment, removing dirt, debris, dust, temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- D. Provide miscellaneous supports/metals required for installation of equipment.

3.11 PAINTING

- A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - 1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces (i.e., hangers, hanger rods, equipment stands, etc.) with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.

ELECTRICAL BASIC REQUIREMENTS

2. In Electrical Room, on roof or other exposed areas, equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
3. See individual equipment Specifications for other painting.
4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
5. Conduit: Clean, primer coat and paint interior/exterior conduit exposed in public areas with two coats paint suitable for metallic surfaces. Color selected by Architect.
6. Covers: Covers such as manholes, vaults and the like will be furnished with finishes which resist corrosion and rust.

3.12 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
 1. Coordinate locations/sizes of access panels with Architect prior to work.

3.13 DEMOLITION

- A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 1. It is the intent of these documents to provide necessary information and adjustments to electrical system required to meet code, and accommodate installation of new work.
 2. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas. Owner will cooperate to best of their ability to assist in coordinated schedule, but will remain final authority as to time of work permitted.
 3. Examination:
 - a. Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to locate and preserve utilities. Replace damaged items with new material to match existing.
 - b. Verify that abandoned wiring and equipment serve only abandoned facilities.
 - c. Demolition drawings are based on casual field observation and existing record documents.
 - 1) Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish work.
 - 2) Verify location and number of electrical outlets, luminaires, panels, etc. in field.
 - d. Report discrepancies to Architect before disturbing existing installation.
 - 1) Promptly notify Owner if utilities are found which are not shown on Drawings.
 4. Execution:
 - a. Remove existing luminaires, switches, receptacles, and other electrical equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless shown as retained or relocated on Drawings.
 - b. Provide temporary wiring and connections to maintain electrical continuity of existing systems during construction. Remove or relocate electrical boxes, conduit, wiring, equipment, and luminaires, as encountered in removed or remodeled areas in existing construction affected by this work.

ELECTRICAL BASIC REQUIREMENTS

- c. Remove and restore wiring which serves usable existing outlets clear of construction or demolition.
- d. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, provide new conduit and wire to bypass inaccessible junction boxes and abandoned outlets.
- e. If existing conduits pass through partitions or ceiling which are being removed or remodeled, provide new conduit and wire to reroute clear of construction or demolition and maintain service to existing load.
- f. Extend circuiting and devices in existing walls to be furred out.
- g. Remove abandoned wiring to source of supply.
- h. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- i. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- j. Disconnect and remove abandoned panelboards and distribution equipment.
- k. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- l. Existing lighting which is to remain, leave luminaires in proper working order.
- m. Repair adjacent construction and finishes damaged during demolition work.
- n. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

3.14 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Cleaning
 - b. Operation and Maintenance Manuals
 - c. Training of Operating Personnel
 - d. Record Drawings
 - e. Warranty and Guaranty Certificates
 - f. Start-up/Test Document and Commissioning Reports

3.15 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Tests:
 - 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.
 - 2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

ELECTRICAL BASIC REQUIREMENTS

3.16 SALVAGED EQUIPMENT AND RECYCLED MATERIAL

- A. Salvage the following equipment not being reused and return to Owner:
 - 1. Luminaires
 - 2. Panelboards
 - 3. Breakers
 - 4. Transformers
- B. Electrical equipment that cannot be salvaged for reuse, sell/give to recycling company. Recycle following excess, removed, or demolished electrical material:
 - 1. Copper or aluminum conductors, buses, and motor/transformer windings.
 - 2. Steel and aluminum from raceways, boxes, enclosures, and housings.
 - 3. Acrylic and glass from luminaire lenses/refractors.
- C. Provide separate on-site storage space for recycled and salvaged material. Clearly label space.
- D. Confirm additional salvaged equipment and recycled materials in the Contract Documents.

END OF SECTION

EQUIPMENT WIRING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Equipment connections, whether furnished by Owner or other Divisions of the Contract.
 - 2. Equipment grounding.

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition:
 - 1. Verify mechanical and utilization equipment electrical characteristics with Drawings and equipment submittals prior to ordering equipment. Submit confirmation of this verification as a part of, or addendum to, the electrical product submittals.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements apply to this Section.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials and Equipment for Equipment Wiring: As specified in individual Sections.

2.2 GENERAL

- A. Unless otherwise noted, the following voltage and phase characteristics apply to motors:
 - 1. 3/4 HP and Under: 120 volt, 1 phase.
 - 2. 1 HP and Over: 208 volt, 3 phase.
- B. Safety Switches: Provide as required by OESC and as specified in Section 26 28 16, Enclosed Switches and Circuit Breakers.

EQUIPMENT WIRING

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to submittal of product data for electrical distribution equipment, obtain and examine product data and shop drawings for equipment furnished by the Owner and by other trades on the project. Update the schedule of equipment electrical connections accordingly, noting proper ratings for overcurrent devices, fuses, safety disconnect switches, conduit and wiring, and the like. As a minimum, this requirement applies to equipment furnished by Owner and equipment furnished under the following divisions of work under this contract:
 - 1. Division 8, Openings
 - 2. Division 11, Equipment
 - 3. Division 21, Fire Suppression
 - 4. Division 22, Plumbing
 - 5. Division 23, HVAC, Heating, Ventilating and Air Conditioning
 - 6. Division 27, Communications
 - 7. Division 28, Electronic Safety and Security

3.2 INSTALLATION

- A. Do not install unrelated electrical equipment or wiring on mechanical equipment without prior approval of Engineer.
- B. Provide moisture tight equipment wiring and switches in ducts or plenums used for environmental air.
- C. Connect motor and appliance/utilization equipment complete from panel to motor/equipment as required by code.
- D. Install motor starters and controllers for equipment furnished by others.
- E. Appliance/Utilization Equipment:
 - 1. Provide appropriate cable and cord cap for final connection unless equipment is provided with same. Provide receptacle configured to receive cord cap.
 - 2. Verify special purpose outlet NEMA configuration and ampere rating with equipment supplier prior to ordering wiring devices and coverplates.

3.3 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Division 01, General Requirements.

3.4 SYSTEMS STARTUP

- A. Provide field representative to prepare and start equipment.
 - 1. Test and correct for proper rotation of polyphase motors.
- B. Adjust for proper operation within manufacturer's published tolerances.
- C. Demonstrate proper operation of equipment to Owner's Authorized Representative.

END OF SECTION

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Lugs and Pads
 - 2. Wires and Cables
 - 3. Splices
 - 4. Connectors

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Cable insulation test reports in project closeout documentation.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Lugs and Pads:
 - 1. Anderson
 - 2. Ilsco
 - 3. Panduit
 - 4. Thomas & Betts
 - 5. 3M
 - 6. Or approved equivalent.
- B. Wires and Cables:
 - 1. General:
 - a. General Cable
 - b. Okonite
 - c. Southwire
 - d. Or approved equivalent.

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

2. Metal Clad Cable - Type MC:
 - a. Alflex
 - b. AFC
 - c. General Cable
 - d. Southwire
 - e. Or approved equivalent.
 - C. Splices:
 1. Branch Circuit Splices:
 - a. Ideal
 - b. 3M Scotchlok
 - c. Uraseal, Inc.
 - d. Or approved equivalent.
 2. Feeder Splices:
 - a. Not allowed.
 - D. Connectors:
 1. Anderson Power Products
 2. Burndy
 3. IlSCO
 4. 3M
 5. Thomas & Betts
 6. Or approved equivalent.
- 2.2 LUGS AND PADS
- A. Ampacity: Cross-sectional area of pad for multiple conductor terminations to match ampere rating of panelboard bus or equipment line terminals.
 - B. Copper Pads: Drilled and tapped for multiple conductor terminals.
 - C. Lugs: Compression type for use with stranded branch circuit or control conductors; mechanical lugs for use with solid branch and feeder circuit conductors.

2.3 WIRES AND CABLES

- A. Building Wires:
 1. Copper: Soft-drawn with conductivity of not less than 98 percent IACS at 20 degrees C (68 degrees F). 600 volt rated throughout. Conductors 12 AWG and 10 AWG, solid. Conductors 8 AWG and larger, stranded. 12 AWG minimum conductor size. Minimum insulation rating of 90 degrees C. Insulation Type: THHN/THWN-2.
 2. Aluminum conductors are not permitted unless written approval is received from the Engineer.
- B. Phase color to be consistent at feeder terminations; A-B-C, top to bottom, left to right, front to back.
- C. Color Code Conductors as Follows:

PHASE	208 VOLT WYE
A	Black
B	Red

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

C	Blue
Neutral	White
Ground	Green

- D. MC Cable:
1. Standard: High strength galvanized steel flexible armor. Full length minimum size No. 12 copper ground wire, copper dual rated THHN/THWNC, full length tape marker phase/circuit identification on cable armor. Short circuit throat insulators, mechanical compression termination.

- E. AC Cable (Armored Cable): Not allowed.

- F. NMB Cable: Not allowed.

2.4 SPLICES

- A. Branch Circuits: Twist on, high temperature, grounding type wing nuts.
1. Ideal Industries Wing-Nut Twist-On Connectors.
 2. 3M Scotchlok Twist-On Wire Connectors.

2.5 CONNECTORS

- A. Split bolt connectors not allowed.
- B. Conductor Branch Circuits: Wire nuts with integral spring connectors for conductors 12 AWG through 8 AWG. Push-in type connectors where conductors are not required to be twisted together are not acceptable.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install per manufacturer instructions and OSSC.
- B. Field Quality Control:
1. Test conductor insulation on feeders of 100 amp and greater for conformity with 1000 volt megohmmeter. Use Insulated Cable Engineers Association testing procedures. Minimum insulation resistance acceptable is 1 megohm for systems 600 volts and below. Notify Architect if insulation resistance is less than 1 megohm.
 2. Test Report: Prepare a typed tabular report indicating the testing instrument, the feeder tested, amperage rating of the feeder, insulation type, voltage, the approximate length of the feeder, conduit type, and the measured resistance of the megohmmeter test. Submit test reports with project closeout documents.
 3. Inspect and test in accordance with NETA Standard ATS, except Section 4.
 4. Perform inspections and tests listed in NETA Standard ATS, Section 7.3.2.

3.2 LUGS AND PADS

- A. Thoroughly clean surfaces to remove all dirt, oil, great or paint.
- B. Use torque wrench to tighten per manufacturer's directions.

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

3.3 WIRES AND CABLES

A. General:

1. Do not install or handle thermoplastic insulated wire and cable in temperatures below -10 degrees C (14 degrees F). Do not handle thermoset insulated wire and cable in temperatures below -40 degrees C (-40 degrees F).
2. Install conductors in raceways having adequate, code size cross-sectional area for wires indicated.
3. Install conductors with care to avoid damage to insulation.
4. Do not apply greater tension on conductors than recommended by manufacturer during installation.
5. Use of pulling compounds is permitted. Clean residue from exposed conductors and raceway entrances after conductor installation. Do not use pulling compounds for installation of conductors connected to GFCI circuit breakers or GFCI receptacles.
6. Additional Requirements for Aluminum Conductors (If Permitted):
 - a. Equipment connected to aluminum conductors to be specifically approved for the purpose, and marked as such. Pay particular attention to refrigeration and similar equipment. Do not use aluminum wire to make connections to mechanical equipment.
 - b. Make connection of aluminum conductors to wiring devices having wire-binding terminal screws, around which conductors can be looped under the head of the screw, by forming the conductor in a clockwise direction around the screw into three-fourths of a complete loop. Only one conductor connected to any one screw.
7. Conductor Size and Quantity:
 - a. Install no conductors smaller than 12 AWG unless otherwise shown.
 - b. Provide required conductors for a fully operable system.
 - c. Power Circuits: No. 12 AWG minimum, except as follows:
 - 1) No. 10 AWG for 15A, 120V circuits longer than 100 ft.
 - 2) No. 8 AWG for 15A, 120V circuits longer than 150 ft.
 - 3) No. 10 AWG for 20A, 120V circuits longer than 70 ft.
 - 4) No. 8 AWG for 20A, 120V circuits longer than 100 ft.
 - d. When exact run lengths are determined for all branch circuits, and prior to installation of the conductors, ensure that the maximum voltage drop, based on 80 percent of the circuit protective device, does not exceed 3 percent. Increase wire size from #12AWG, if necessary, to ensure that the 3 percent voltage drop is not exceeded.
8. Provide dedicated neutrals (one neutral conductor for each phase conductor) in all 120V circuits.

B. Conductors in Cabinets:

1. Cable and tree wires in panels and cabinets for power and control. Use plastic ties in panels and cabinets.
2. Tie and bundle feeder conductors in wireways of panelboards.
3. Hold conductors away from sharp metal edges.

C. Homeruns:

1. Do not change intent of branch circuit homeruns without approval. Homeruns for 20A branch circuits may be combined to a maximum of six current carrying conductors including neutral conductors in homeruns. Apply derating factors as required per NEC. Increase conductor size as needed.

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

2. MC cable homeruns are not allowed unless indicated on drawings.
- D. Identify wire and cable under the provisions of Section 26 05 53, Identification for Electrical Systems. Identify each conductor with its panel and circuit number as indicated.
- E. Exposed cable is not allowed.
- F. All cable must be run parallel or perpendicular to building lines and hidden from view when possible. Where installed in tray each power cable is to be identified with Lamacoid nametag engraved with identification of equipment being fed. Tag to be fastened to cable using tie-wraps. Provide nametag at each floor level.
- G. Do not install PVC jacketed cables in return air plenums, unless they are specially rated plenum cables.
- H. Use of MC Cable is limited to the following conditions. Installations that do not comply with the following conditions are to be removed and replaced with no additional expense to the Owner.
 1. 15 and 20 amp branch wiring where following conditions apply:
 - a. MC cable is allowed for branch circuits, including both lighting and power outlets, as allowed by code and restricted below.
 - b. Where there is a suspended ceiling with accessible space above (example: suspended acoustic ceiling tile).
 - c. Use MC cable for final flexible connections from junction or outlet boxes to recessed fixtures. Do not use MC cables to loop between fixtures, except where it is not practical to provide conduit connections between boxes or where existing inaccessible ceilings prevent installation of conduit runs. Each individual luminaire is to be serviced by an individual cable drop from the associated junction box in the ceiling space. Maximum length 6-feet of MC cable. Luminaire drops secured to, and supported by, the building structure with nylon tie wraps. The use of the ceiling suspension system for support of any type of cabling is not permitted.

3.4 **SPLICES**

- A. Make splices complete and promptly after wire installation. Provide single wire pigtails for luminaire and device connections. Wire nuts may be used for luminaire wire connections to single wire circuit conductor pigtails.
- B. Make splices for No. 8 and larger wires with mechanically applied pressure type connectors. Make all taped joints with Scotch 33+ or equal, applied in half-lap layers without stretching to deform. Uraseal splice kits are also acceptable through 250 KCMIL.
- C. Remove insulation with a stripping tool designed specifically for that purpose. A pocket knife is not an acceptable tool. Leave all conductors nick-free.

3.5 **CONNECTORS**

- A. Install to assure a solid and safe connection.
- B. Select hand twist connectors for wire size and install tightly on conductors.
- C. Install compression connectors using methods and tools recommended by the manufacturer.
- D. Do not install stranded conductors under screw terminals unless compression lugs are installed.

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- E. Do not connect wiring without UL listed connectors that are listed for the purposes.

END OF SECTION

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Connectors and Accessories
 - 2. Grounding Conductor

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Test reports of ground resistance for service and separately derived system grounds.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Comply with the requirements of ANSI/NFPA 70.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Connectors and Accessories:
 - 1. Burndy Hyground Compression System
 - 2. Erico/Cadweld
 - 3. Amp Ampact Grounding System
 - 4. Pipe Grounding Clamp:
 - a. Burndy GAR Series
 - b. O Z Gedney
 - c. Thomas & Betts
 - d. Or approved equivalent.
- B. Grounding Conductor
 - 1. General Cable
 - 2. Okonite

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

3. Southwire
4. Or approved equivalent

2.2 CONNECTORS AND ACCESSORIES

- A. Grounding Connectors: Hydraulic compression tool applied connectors or exothermic welding process connectors or powder actuated compression tool applied connectors.
- B. Pipe Grounding Clamp: Mechanical ground connector with cable parallel or perpendicular to pipe.

2.3 GROUNDING CONDUCTOR

- A. Grounding Electrode Conductor: Soft-draw bare stranded copper for wire sizes larger than #10 AWG Bare. Solid copper for wire sizes #10 AWG and smaller.
- B. Equipment Grounding Conductor: Green insulated, insulation type to match that of associated feeder or branch circuit wiring, size as indicated on drawings.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Verify site conditions prior to beginning work.
- B. Bond Sections of service equipment enclosure to service ground bus.
- C. Separately Derived Systems: Ground each separately derived system per NEC Article 250.
- D. Corrosion inhibitors: Apply a corrosion inhibitor to contact surfaces when making grounding and bonding connections. Use corrosion inhibitor appropriate for protecting a connection between metals used.
- E. Grounding system resistance to ground not to exceed 5 ohms. Make necessary modifications or additions to grounding electrode system for compliance. Submit final tests to assure that this requirement is met.
- F. Inspect and test in accordance with NETA Standard ATS, Except Section 4.
- G. Perform inspections and tests listed in NETA Standard AB, Section 7.13.

3.2 CONNECTORS AND ACCESSORIES INSTALLATION

- A. Install per manufacturer's instructions.

3.3 GROUNDING CONDUCTOR INSTALLATION

- A. Raceways:
 1. Ground metallic raceway systems. Bond to ground terminal with code size jumper except where code size or larger equipment grounding conductor is included with circuit, use grounding bushing with lay-in lug.
 2. Connect metal raceways, which terminate within an enclosure but without mechanical connection to enclosure, by grounding bushings and ground conductor to grounding bus.
 3. Where equipment supply conductors are in flexible metallic conduit, install stranded copper equipment grounding conductor from outlet box to equipment frame.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

4. Install equipment grounding conductor, code size minimum unless noted on drawings, in metallic and nonmetallic raceway systems.
- B. Feeders and Branch Circuits:
 1. Provide continuous green insulated copper equipment grounding conductors for feeders and branch circuits.
 2. Where installed in a continuous solid metallic raceway system and larger sizes are not detailed, provide insulated equipment grounding conductors for feeders and branch circuits sized in accordance with the latest adopted edition of NEC Article 250, Table 250-122.
- C. Bond boxes, cabinets, enclosures and panelboard equipment grounding conductors to enclosure with specified conductors and lugs. Install lugs only on thoroughly cleaned contact surfaces.
- D. Motors, Equipment and Appliances: Install code size equipment grounding conductor to (motor) equipment frame or manufacturer's designated ground terminal.
- E. Receptacles: Connect ground terminal of receptacle and associated outlet box to equipment grounding conductor. Self grounding nature of receptacle devices does not eliminate equipment grounding conductor bolted to outlet box.

END OF SECTION

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Anchors, Threaded Rod and Fasteners
 - 2. Support Channel, Hangers and Supports
 - 3. Rooftop Conduit Supports

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals not required for this Section.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems, whose products have been in satisfactory use in similar service for not less than 10 years.
 - 2. Support systems to be supplied by a single manufacturer.
 - 3. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, equipment hangers/supports, and seismic restraint by a qualified Structural Professional Engineer.
 - a. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.7 PERFORMANCE REQUIREMENTS

- A. General: Provide conduit and equipment hangers and supports in accordance with the following:
 - 1. When supports, anchorages, and seismic restraints for equipment and supports, anchorages and seismic restraints for conduit, cable tray and equipment are not shown on the Drawings, the Contractor is responsible for their design.

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

2. Connections to structural framing shall not introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
- B. Engineered Support Systems: The following support systems to be designed, detailed, and bear the seal of a professional engineer registered in the State of Oregon.
 1. Support frames such as conduit racks or stanchions for conduit and equipment which provide support from below.
 2. Equipment and piping support frame anchorage to supporting slab or structure.
- C. Provide channel support systems, for conduits to support multiple conduits capable of supporting combined weight of support systems and system contents.
- D. Provide heavy-duty steel trapezes for piping to support multiple conduit capable of supporting combined weight of supported systems and system contents.
- E. Provide seismic restraint hangers and supports for conduit and equipment.
- F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Anchors, Threaded Rod and Fasteners:
 1. Anchor It
 2. Epcon System
 3. Hilti-Hit System
 4. Power Fast System
 5. Or approved equivalent.
- B. Support Channel, Hangers and Supports:
 1. B-Line
 2. Kindorf
 3. Superstrut
 4. Unistrut
 5. Or approved equivalent.
- C. Rooftop Conduit Supports:
 1. Cooper B-Line Dura-Block Rooftop Support Base
 2. Or approved equivalent.

2.2 ANCHORS, THREADED ROD AND FASTENERS

- A. Anchors, Threaded Rod and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
- B. Concrete Inserts: Cast in concrete for support fasteners for loads up to 800 lbs.
- C. Anchors and Fasteners:
 1. Do not use powder-actuated anchors.
 2. Concrete Structural Elements: Use precast inserts.
 3. Steel Structural Elements: Use beam clamps.
 4. Concrete Surfaces: Use self-drilling anchors.

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

5. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts.
 6. Solid Masonry Walls: Use expansion anchors.
 7. Sheet Metal: Use sheet metal screws.
 8. Wood Elements: Use wood screws.
- D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
- E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.
- F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

2.3 **SUPPORT CHANNEL, HANGERS AND SUPPORTS**

- A. Hangers and Supports - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
1. Channel Material: Carbon steel.
 2. Coating: Hot dip galvanized.
- B. Pipe Straps: Two-hole galvanized or malleable iron.
- C. Luminaire Chain: 90 lb. test with steel hooks.
- D. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings that are necessary for completion of the project. The Contractor is responsible for their design.
1. Fabricate miscellaneous units to size shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
- E. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.
- F. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
- G. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

2.4 **ROOFTOP CONDUIT SUPPORTS**

- A. Curb base made of 100 percent recycled rubber and polyurethane prepolymer with a uniform load
- B. Capacity of 500 pounds per linear foot of support.
- C. UV resistant.

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

- D. Steel Frame: Steel, 14 gauge strut galvanized per ASTM A653 or 12 gauge strut galvanized per ASTM A653 for bridge series.
- E. Continuous block channel supports with 1-inch gaps to allow water flow, bridge channel supports, extendable height channel supports and elevated single conduit supports.
- F. Attaching Hardware: Zinc-plated threaded rod, nuts and attaching hardware per ASTM B633 fastened directly into rubber material with weather resistant Type 12 lag screws.
- G. Provide load distribution plates when required for heavy loads.
- H. Finish: Black with safety yellow striping.
- I. Provide hot dipped galvanized components for items exposed to weather.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Fabrication - Miscellaneous Metals
 - 1. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates, and similar devices. Hot dipped galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.
 - 2. Finishes:
 - a. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with one coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas in primer with same material, before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
 - b. Metal in contact with Concrete, Masonry and Other Dissimilar Materials: Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
 - c. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

3.2 ANCHORS, THREADED ROD AND FASTENERS INSTALLATION

- A. Safety factor of 4 required for every fastening device or support for equipment installed. Supports to withstand four times the weight of equipment it supports.

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

- B. Do not use other trade's fastening devices as supporting means for luminaires, equipment or materials.
- C. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- D. Do not use supports or fastening devices to support other than one particular item.
- E. Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from floor above or roof structure to prevent sagging and swaying.
- F. Provide seismic bracing per OSSC requirements.
- G. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- H. Use spring lock washers under fastener nuts for strut.
- I. Cutting and Drilling
 - 1. Do not drill or cut structural members without prior permission from Architect.

3.3 SUPPORT CHANNEL, HANGERS AND SUPPORTS INSTALLATION

- A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
- B. Safety factor of 4 required for every fastening device or support for equipment installed. Supports to withstand four times the weight of equipment it supports.
- C. Verify mounting height of luminaires prior to installation when heights are not detailed.
- D. Install vertical support members for equipment and luminaires, straight and parallel to building walls.
- E. Install horizontal support members straight and parallel to ceilings or finished floor unless otherwise noted.
- F. Provide independent supports to structural member for luminaires, materials, or equipment installed in or on ceiling, walls or in void spaces or over suspended ceilings.
- G. Do not use other trade's fastening devices as supporting means for luminaires, equipment or materials.
- H. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- I. Do not use supports or fastening devices to support other than one particular item.
- J. Support conduits within 18-inches of outlets, boxes, panels, cabinets and deflections unless more stringently required by OESC.
- K. Maximum distance between supports not to exceed 8 foot spacing unless otherwise required by OESC.
- L. Support flexible conduits and metal clad cable within 12-inches of outlets, boxes, panels, cabinets and deflections unless otherwise required by OESC.

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

- M. Maximum distance between supports for flexible conduits and metal clad cable not to exceed 48-inches spacing unless otherwise required by OESC.
- N. Maximum distance between supports for rigid PVC conduits unless otherwise required by OESC is as follows:
 - 1. 1/2-inch or 3/4-inch and 1-inch conduit, 3-feet apart.
 - 2. 1-1/4-inch or 1-1/2-inch and 2-inch conduit, 4-feet apart.
 - 3. 2-1/2-inch and 3-inch conduit, 5-feet apart.
 - 4. 4-inch and 5-inch conduit, 6-feet apart.
 - 5. 6-inch conduit, 7-feet apart.
- O. Maximum distance between supports for auxiliary gutters and wireways unless otherwise required by OESC is as follows:
 - 1. Sheet metal auxiliary gutters and wireways - 4-feet apart horizontally and 10-feet vertically.
 - 2. Non-metallic auxiliary gutters and wireways - 30-inches apart horizontally and 3-feet vertically.
- P. Install strut hangers as instructed by strut manufacturer. Suspend strut hangers as instructed by strut manufacturer for the load, with a maximum spacing of 8-feet on center and within 2-feet of outlet box, cabinet, junction box or other channel raceway termination unless otherwise required by OESC.
- Q. Coordinate routing of conduit racks with materials and equipment installed by other trades. Where conduit racks are exposed to view, coordinate location and installation with Architect for optimal appearance.
- R. Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from floor above or roof structure to prevent sagging and swaying.
- S. Provide seismic bracing per OSSC requirements.
- T. Where service disconnects are mounted on building exterior, physically attach service disconnect to the building or structure served.
- U. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- V. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- W. Wet and Damp Locations:
 - 1. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1-inch off wall.

3.4 ROOFTOP CONDUIT SUPPORTS INSTALLATION

- A. Consult roofing manufacturer for roof membrane compression capacities. If necessary, provide a compatible sheet of roofing material (rubber pad) under rooftop support to disperse concentrated loads and add further membrane protection.
- B. Do not use supports that will void roof warranty.
- C. Install supports per manufacturer's instructions and recommendations.

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

- D. Use properly sized clamps to suit conduit sizes.
- E. Install supports for rooftop raceways to raise raceways a minimum of 7/8-inches above the roof structure unless otherwise noted.

END OF SECTION

RACEWAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Rigid Metal Conduit (RMC)
 - 2. Intermediate Metal Conduit (IMC)
 - 3. Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Metal Conduit
 - 4. Electrical Metallic Tubing (EMT)
 - 5. Flexible Metal Conduit (FMC)
 - 6. Liquidtight Flexible Metal Conduit (LFMC)
 - 7. Electrical Polyvinyl Chloride (PVC) Conduit
 - 8. Conduit Fittings
- B. Provide a complete system of conduit and fittings, with associated couplings, connectors, and fittings, as shown on drawings and described in these specifications.

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 26 05 29, Hangers and Supports for Electrical Systems and Equipment
 - 2. Section 26 05 34, Boxes

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.7 DEFINITIONS

- A. Raceway system is defined as consisting of conduit, tubing, duct, and fittings including but not limited to connectors, couplings, offsets, elbows, bushings, expansion/deflection fittings, and other components and accessories. Complete electrical raceway installation before starting the installation of conductors and cables.

RACEWAYS

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Rigid Metal Conduit (RMC):
 - 1. Allied Tube & Conduit
 - 2. Beck Manufacturing Inc.
 - 3. Picoma
 - 4. Wheatland Tube Company
 - 5. Or approved equivalent.
- B. Intermediate Metal Conduit (IMC):
 - 1. Allied Tube & Conduit
 - 2. Beck Manufacturing WL
 - 3. Picoma
 - 4. Wheatland Tube Company
 - 5. Or approved equivalent.
- C. Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit:
 - 1. Allied Tube & Conduit
 - 2. Thomas & Betts Corporation
 - 3. Robroy Industries
 - 4. O'kote Inc.
 - 5. Or approved equivalent.
- D. Electrical Metallic Tubing (EMT):
 - 1. Allied Tube & Conduit
 - 2. Beck Manufacturing WL
 - 3. Picoma
 - 4. Wheatland Tube Company
 - 5. Or approved equivalent.
- E. Flexible Metal Conduit (FMC):
 - 1. AFC Cable Systems Inc.
 - 2. Electri-Flex Company
 - 3. International Metal Hose
 - 4. Or approved equivalent.
- F. Liquidtight Flexible Metal Conduit (LFMC):
 - 1. AFC Cable Systems Inc.
 - 2. Electri-Flex Company
 - 3. International Metal Hose
 - 4. Or approved equivalent.
- G. Electrical Polyvinyl Chloride (PVC) Conduit:
 - 1. AFC Cable Systems Inc.
 - 2. Electri-Flex Company
 - 3. International Metal Hose
 - 4. JM Eagle
 - 5. Or approved equivalent.
- H. Conduit Fittings:

RACEWAYS

1. Bushings:
 - a. Insulated Type for Threaded Raceway Without Factory Installed Plastic Throat Conductor Protection:
 - 1) Thomas & Betts 1222 Series
 - 2) O-Z Gedney B Series
 - 3) Or approved Equivalent.
 2. Raceway Connectors and Couplings:
 - a. Thomas & Betts Series
 - b. O-Z Gedney Series
 - c. Or approved Equivalent.
 3. Expansion/Deflection Fittings:
 - a. EMT: O-Z Gedney Type TX
 - b. RMC: O-Z Gedney Type AX, DX and AXDX, Crouse & Hinds XD
 - c. PVC: O-Z Gedney Type DX with PVC adapters, Carlon E945 Series, Kraloy OPEJ Series
 - d. Or approved equivalent.
- 2.2 RIGID METAL CONDUIT (RMC)
- A. UL 6, ANSI C80.1. Hot dipped galvanized steel conduit after thread cutting.
 1. Fittings: NEMA FB2.10.
- 2.3 INTERMEDIATE METAL CONDUIT (IMC)
- A. UL 1242, ANSI C80.6. Hot dipped galvanized after thread cutting.
 1. Fittings: NEMA FB2.10.
- 2.4 POLYVINYL CHLORIDE (PVC) EXTERNALLY COATED GALVANIZED RIGID METAL CONDUIT
- A. Description: UL 6, ANSI C80.1, and NEMA RN 1; rigid steel conduit with external PVC coating.
 1. PVC Coating: Minimum 40 mils in thickness.
 - B. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.
- 2.5 ELECTRICAL METALLIC TUBING (EMT)
- A. Description: UL 797, ANSI C80.3; steel galvanized tubing.
 - B. Fittings: NEMA FB 1; steel, compression type.
- 2.6 FLEXIBLE METAL CONDUIT (FMC)
- A. Description: UL 1, Interlocked steel construction.
 - B. Fittings: NEMA FB 2.20.
- 2.7 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)
- A. Description: UL 360, inner core made from spiral wound strip of heavy gauge, hot dipped galvanized low carbon steel. 3/4-inch through 1-1/4-inch trade sizes to have a square lock core and contain an integral bonding strip of copper. 1-1/2-inch and larger to have fully interlocked core. Jacket material to be moisture, oil and sunlight resistant flexible PVC.

RACEWAYS

- B. Fittings: NEMA FB 2.20.

2.8 ELECTRICAL POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Description: UL 651, NEMA TC 2; Schedule 80 PVC.
- B. Fittings: NEMA TC 3.

2.9 CONDUIT FITTINGS

- A. Bushings:
 - 1. Insulated type for threaded raceway connectors without factory-installed plastic throat conductor protection.
 - 2. Insulated grounding type for threaded raceway connectors.
- B. Raceway Connectors and Couplings:
 - 1. Steel connectors, couplings, and conduit bodies, hot-dip galvanized.
 - 2. Connector locknuts to be steel, with threads meeting ASTM tolerances. Locknuts to be hot-dip galvanized.
 - 3. Connector throats (EMT, flexible conduit, metal clad cable and cordset connectors) to have factory installed plastic inserts permanently installed. For normal cable or conductor exiting angles from raceway, the cable jacket or conductor insulation to bear only on plastic throat insert.
 - 4. Steel gland, Tomic or Breagle connectors and couplings are recognized for this Contract as having acceptable raceway to fitting electrical conductance.
 - 5. Set screw connectors and couplings, without integral compression glands, are recognized for this Contract as not having acceptable raceway to fitting electrical conductance. A ground conductor sized per this Specification must be included and bonded within raceway assembly utilizing this type connector or coupling.
- C. Provide expansion/deflection fittings for EMT and IMC.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Finished Surfaces: Schedule raceway installation to avoid conflict with installed wall and ceiling surfaces. If unavoidable, coordinate work and repairs with Architect.
- B. Conduit Size:
 - 1. Minimum Size: 3/4-inch for power and control, unless otherwise noted. 3/4-inch for communication/data, unless otherwise noted. 3/4-inch for signal systems, unless otherwise noted.
- C. Underground Installations:
 - 1. More than 5-feet from Foundation Wall: Use PVC.
 - 2. Within 5-feet from Foundation Wall: Use PVC coated RMC.
 - 3. In or Under Slab on Grade: Use PVC.
 - 4. Minimum Size: 1-inch.
- D. In Slab Above Grade:
 - 1. Use PVC.

RACEWAYS

2. Maximum Size Conduit in Slab: Contact Structural Engineer for maximum outside diameter of conduit.
- E. Provide two pull strings/tapes in empty conduits. Types:
 1. Feeders: Polyester measure/pulling tape, Greenlee 4436 or approved.
 2. Branch Circuits and Low Voltage: Greenlee Poly Line 431 or approved.
 3. If fish tape is used for pulling line or low voltage wiring, fiberglass type to be used. Metal fish tapes will not be allowed.
 4. Secure pull string/tape at each end.
 5. Provide caps on ends of empty conduit to be used in future.
 6. Label both ends of empty conduits with location of opposite end.
- F. Elbows: Use fiberglass or PVC coated RMC for underground installations.
- G. Elbow for Low Energy Signal Systems: Use long radius factory ells where linking sections of raceway for installation of signal cable.
- H. Verify that field measurements are as shown on drawings.
- I. Plan locations of conduit runs in advance of the installation and coordinate with ductwork, plumbing, ceiling and wall construction in the same areas.
- J. Locate penetrations and holes in advance where they are proposed in the structural sections such as footings, beams, and walls. Penetrations are acceptable only when the following occurs:
 1. Where shown on the structural drawings.
 2. As approved by the Structural Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
- K. Verify routing and termination locations of conduit prior to rough-in.
- L. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.
- M. Install raceways securely, in neat and workmanlike manner, as specified in NECA 1, Standard Practices for Good Workmanship in Electrical Construction.
- N. Install steel conduit as specified in NECA 101, Standard for Installing Steel Conduits.
- O. Install nonmetallic conduit in accordance with manufacturer's instructions.
- P. Inserts, anchors and sleeves.
 1. Coordinate location of inserts and anchor bolts for electrical systems prior to concrete pour.
 2. Coordinate location of sleeves with consideration for other building systems prior to concrete pour.
- Q. Conduit Supports:
 1. Arrange supports to prevent misalignment during wiring installation.
 2. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
 3. Group related conduits; support using conduit rack. Construct rack using steel channel. Provide space on each for 25 percent additional conduits.

RACEWAYS

- 4. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- 5. Do not attach conduit to ceiling support wires.
- R. Flexible steel conduit length not-to-exceed 6-feet, 3-feet in concealed walls. Provide sufficient slack to reduce the effect of vibration.
- S. Install conduit seals at boundaries where ambient temperatures differ by 10 degrees F or more as shown on the drawings. Install seals on warm side of partition.
- T. Seal raceways stubbing up into electrical equipment. Plug raceways with conductors with duct-seal. Cap spare raceways and plug PVC raceway products with plastic plugs as made by Underground Products, or equal, shaped to fit snugly into the stubup.
- U. Seal raceways penetrating an exterior building wall to prevent moisture and vermin from entering into the electrical equipment.
- V. Use suitable caps on spare and empty conduits to protect installed conduit against entrance of dirt and moisture.
- W. Keep emergency system wiring independent of other wiring systems per NEC 700.
- X. Arrange conduit to maintain headroom and present neat appearance.
- Y. Do not install conduits on surface of building exterior, along vapor barrier, across roof, on top of parapet walls, or across floors, unless otherwise noted on drawings.
- Z. Exposed conduits are permitted only in following areas:
 - 1. Mechanical rooms, electrical rooms or spaces where walls, ceilings and floors will not be covered with finished material.
 - 2. Existing walls that are concrete or block construction.
 - 3. Where specifically noted on Drawings.
 - 4. Route exposed conduit parallel and perpendicular to walls, tight to finished surfaces and neatly offset into boxes.
- AA. Do not install conduits or other electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block area passage's intended usage.
- AB. Install continuous conduit and raceways for electrical power wiring and signal systems wiring.
- AC. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- AD. Maintain adequate clearance between conduit and piping.
- AE. Keep conduits a minimum of 12-inches away from steam or hot water radiant heating lines (at or above 104 degrees F) or 3-inches away from waste or water lines.
- AF. Cut conduit square using saw or pipecutter; deburr cut ends.
- AG. Bring conduit to shoulder of fittings; fasten securely.
- AH. Use conduit hubs to fasten conduit to cast boxes in damp and wet locations.
- AI. Install no more than the equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams.

RACEWAYS

- AJ. Use hydraulic one shot bender to fabricate elbows for bends in metal conduit larger than 2-inch size.
- AK. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- AL. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control, and expansion joints.
- AM. Conduit Terminations for Signal Systems: Provide a plastic bushing on the end of conduit used for signal system wiring.
- AN. Feeders: Do not combine or change feeder runs.
- AO. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07, Thermal and Moisture Protection.
- AP. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation and installer.

3.2 RIGID METAL CONDUIT (RMC) INSTALLATION

- A. Outdoor Locations Above Grade: RMC.
- B. Damp Locations: RMC.
- C. In areas exposed to mechanical damage: RMC.
- D. For security conduits installed exposed and subject to tampering: RMC.

3.3 INTERMEDIATE METAL CONDUIT (IMC) INSTALLATION

- A. Damp Locations: IMC up to 2-inches in diameter.

3.4 POLYVINYL CHLORIDE (PVC) EXTERNALLY COATED GALVANIZED RIGID METAL CONDUIT INSTALLATION

- A. Use PVC coated RMC 36-inch radius ells for power service conduits and 48-inch radius ells for telephone service conduits.

3.5 ELECTRICAL METALLIC TUBING (EMT) INSTALLATION

- A. Dry Locations:
 - 1. Concealed: EMT.
 - 2. Exposed: EMT.
- B. Dry, Protected: EMT.

3.6 FLEXIBLE METAL CONDUIT (FMC) INSTALLATION

- A. Dry Locations: Motors, recessed luminaires and equipment connections subject to movement or vibration, use flexible metallic conduit.
- B. Install 12-inch minimum slack loop on flexible metallic conduit.

RACEWAYS

3.7 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC) INSTALLATION

- A. Use PVC coated liquidtight flexible metallic conduit for motors and equipment connections subject to movement or vibration and subjected to any of following conditions: Exterior location, moist or humid atmosphere, corrosive environments, water spray, oil, or grease.
- B. Install 12-inch minimum slack loop on liquidtight flexible metallic conduit.

3.8 ELECTRICAL POLYVINYL CHLORIDE (PVC) CONDUIT INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide equipment grounding conductor in PVC conduit runs containing power conductors.
- C. Underground Installation: Schedule 80 PVC
- D. Convert PVC conduit to Rigid Metal Conduit (RMC) prior to emerging from underground, concrete encasement, or concrete slab.
- E. Provide expansion fittings to compensate for expansion and contraction per NEC 352.44.
- F. PVC elbows are not acceptable. Use fiberglass or PVC coated RMC.
- G. Trim cut ends inside and outside to remove rough edges.
- H. Provide bushings when entering a box, fitting or other enclosure.

3.9 CONDUIT FITTINGS INSTALLATION

- A. Conduit Joints: Assemble conduits continuous and secure to boxes, panels, luminaires and equipment with fittings to maintain continuity. Provide watertight joints where embedded in concrete, below grade or in damp locations. Seal metal conduit with metal thread primer. Rigid conduit connections to be threaded, clean and tight (metal to metal). Threadless connections are not permitted for RMC.
- B. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- C. Use set screw type fittings only in dry locations. When set screw fittings are utilized provide insulated continuous equipment ground conductor in conduit, from overcurrent protection device to outlet.
- D. Use compression fittings in dry locations, damp and rain-exposed locations. Maximum size permitted in damp locations and locations exposed to rain is 2-inches in diameter.
- E. Use threaded type fittings in wet locations, hazardous locations, and damp or rain-exposed locations where conduit size is greater than 2-inches.
- F. Use PVC coated, threaded type fittings in corrosive environments.
- G. Use insulated type bushings with ground provision at switchboards, panelboards, safety disconnect switches, junction boxes that have feeders 60 amperes and greater.
- H. Condulets and Conduit Bodies:

RACEWAYS

1. Do not use condulets and conduit bodies in conduits for signal wiring, in feeders 100 amp and larger, or for conductor splicing.
- I. Sleeves and Chases - Floor, Ceiling and Wall Penetrations: Provide necessary rigid conduit sleeves, openings and chases where conduits or cables are required to pass through floors, ceilings or walls.
- J. Expansion Joints:
 1. Provide conduits crossing expansion joints where cast in concrete with expansion-deflection fittings, installed per manufacturer's recommendations.
 2. Secure conduits 3-inches and larger to building structure on opposite sides of a building expansion joint with an expansion-deflection fitting across joint installed per manufacturer's recommendations.
 3. Provide conduits less than 3-inches where not cast in concrete with junction boxes securely fastened on both sides of expansion joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits 3-inch and larger may be installed.
 4. Verify expansion/deflection requirements with Structural Engineer prior to installation.
- K. Seismic Joints:
 1. No conduits cast in concrete allowed to cross seismic joint.
 2. Provide conduits with junction boxes securely fastened on both sides of seismic joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. Prior to installation, verify with Architect that 15-inches is adequate for designed movement, and if not, increase this length as required.
 3. Provide conduits less than 3-inches where not cast in concrete with junction boxes securely fastened on both sides of expansion joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits 3-inch and larger may be installed.
- L. Provide rigid conduit coupling flush with surface of slab or wall for conduit stubbed in concrete slab or wall to serve electrical equipment or an outlet under table or to supply shop tool, etc. Provide plug where conduit is to be used in future.

END OF SECTION

BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Outlet Boxes
 - 2. Pull and Junction Boxes
 - 3. Box Extension Adapter
- B. Provide electrical boxes and fittings for a complete installation. Include but not limited to outlet boxes, junction boxes, pull boxes, bushings, locknuts and other necessary components.

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 26 05 33, Raceways
 - 2. Section 26 05 53, Identification for Electrical Systems

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Outlet Boxes:
 - 1. Hubbell
 - 2. Thomas & Betts
 - 3. Eaton/Crouse-Hinds
 - 4. Or approved equivalent.
- B. Pull and Junction Boxes:
 - 1. Eaton/Crouse-Hinds
 - 2. Hoffman
 - 3. Or approved equivalent.

BOXES

- C. Box Extension Adapter:
 - 1. Hubbell
 - 2. Thomas & Betts
 - 3. Eaton/Crouse-Hinds
 - 4. Or approved equivalent.

2.2 OUTLET BOXES

- A. Luminaire Outlet: 4-inch octagonal box, 1-1/2-inches deep with 3/8-inch luminaire stud if required. Provide raised covers on bracket outlets and on ceiling outlets.
- B. Device Outlet: Installation of one or two devices at common location, minimum 4-inches square, minimum 1-1/2-inches deep for non-USB type devices. Installation of one or two devices at common locations, minimum 4-inches square, minimum 2-inches deep for USB type devices. Single- or two-gang flush device raised covers.
- C. Telecom Outlet: Provide 4-inches square, minimum 2-1/8-inch deep box with two-gang plaster ring.
- D. Multiple Devices: Three or more devices at common location. Install one-piece gang boxes with one-piece device cover. Install one device per gang.
- E. Masonry Boxes: Outlets in concrete.
- F. Construction: For interior locations, provide galvanized steel outlet wiring boxes, of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices. All surface mounted outlet boxes are to be drawn. Welded boxes are not acceptable.
- G. Accessories: Provide outlet box accessories for each installation, including mounting brackets, wallboard hangers, extension rings, luminaire studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.
- H. Noise Control: Provide acoustic putty pad to back side of each outlet box installed in acoustic rated walls.

2.3 PULL AND JUNCTION BOXES

- A. Construction: Provide ANSI 49 gray enamel painted sheet steel junction and pull boxes, with screw-on covers; of type shape and size, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.
- B. Location:
 - 1. Provide junction boxes above accessible ceilings for drops into walls for receptacle outlets from overhead.
 - 2. Provide junction boxes and pull boxes to facilitate installation of conductors and limiting accumulated angular sum of bends between boxes, cabinets and appliances to 270 degrees.
- C. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:

BOXES

1. Construction: Galvanized cast iron.
2. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
3. Cover Legend: ELECTRIC.

2.4 BOX EXTENSION ADAPTER

- A. Construction: Diecast aluminum.
- B. Location: Install over flush wall outlet boxes to permit flexible raceway extension from flush outlet to fixed or movable equipment.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate locations of floor boxes and wall mounted wiring device boxes with architectural and structural floor plans prior to rough-in.
- B. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1, Standard Practice of Good Workmanship in Electrical Construction.
- C. Secure boxes rigidly to substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.
- D. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NEC. Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.
- E. Set wall mounted boxes at elevations to accommodate mounting heights shown on Architectural Elevations.
- F. Electrical boxes are shown on drawings in approximate locations unless dimensioned.
 1. Adjust box locations up to 10-feet if required to accommodate intended purpose.
- G. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07, Thermal and Moisture Protection.
- H. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- I. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- J. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12-inches of box.
- K. Box Color Coding and Marking: Reference Section 26 05 53, Identification for Electrical Systems.
- L. Adjust boxes to be parallel with building lines. Boxes not plumb to building lines are not acceptable.
- M. Install knockout closures in unused box openings.
- N. Clean interior of boxes to remove dust, debris, and other material.
- O. Clean exposed surfaces and restore finish.

BOXES

3.2 OUTLET BOXES INSTALLATION

- A. Mount outlet boxes, unless otherwise required by ADA, or noted on drawings, following distances above finished floor:
 - 1. Control Switches:
 - a. 48-inches to the top of outlet box.
 - b. 4-inches above top of backsplash at countertops/workstations, not-to-exceed 44-inches above finished floor to the top of outlet box per ADA requirements.
 - 2. Receptacles: 15-inches to the bottom of outlet box.
 - 3. Telecom Outlets: 15-inches to the bottom of outlet box.
 - 4. Other Outlets: As indicated in other sections of specifications or as detailed on drawings.
- B. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6-inches from ceiling access panel or from removable recessed luminaire.
- C. Flush Outlets in Insulated Spaces: Maintain integrity of insulation and vapor barrier.
- D. Coordinate electrical device locations and elevations (switches and receptacles) with architectural drawings to prevent mounting devices in mirrors, back splashes, and behind cabinets.
- E. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- F. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices. Adjacent boxes not aligned vertically to be adjusted at no additional cost to Owner.
- G. Use flush mounting outlet box in finished areas.
- H. Do not install flush mounting box back-to-back in walls; provide minimum 6-inches separation. Provide minimum 24-inches in acoustic rated walls.
- I. In acoustical walls, apply acoustic putty pad on outlet box prior to installation of acoustical blanket.
- J. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- K. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- L. Use adjustable steel channel fasteners for hung ceiling outlet box.
- M. Use gang box where more than one device is mounted together. Do not use sectional box.
- N. Use gang box with plaster ring for single device outlets.
- O. Adjust flush-mounting outlets to make front flush with finished wall material.

3.3 PULL AND JUNCTION BOXES INSTALLATION

- A. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- B. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6-inches from ceiling access panel or from removable recessed luminaire.
- C. Do not fasten boxes to ceiling support wires.

BOXES

- D. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.4 BOX EXTENSION ADAPTER INSTALLATION

- A. Match material to box.
- B. Install gaskets at exterior and wet locations.

END OF SECTION

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Equipment Nameplates
 - 2. Device Labels
 - 3. Wire Markers
 - 4. Underground Warning Tape

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals not required for this Section.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
 - 2. Manufacturer's standard products of categories and types required for each application as referenced in other Division 26, Electrical Sections. Where more than a single type is specified for application, provide single selection for each product category.
 - 3. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Equipment Nameplates:
 - 1. B & I Nameplates
 - 2. Intellicum
 - 3. JBR Associates
 - 4. Or approved equivalent.
- B. Device Labels:
 - 1. Kroy
 - 2. Brady

IDENTIFICATION FOR ELECTRICAL SYSTEMS

- 3. Or approved equivalent.
- C. Wire Markers:
 - 1. Brady
 - 2. Panduit
 - 3. Sumitomo
 - 4. Or approved equivalent.
- D. Underground Warning Tape:
 - 1. Allen Systems
 - 2. Brady
 - 3. Or approved equivalent.

2.2 EQUIPMENT NAMEPLATES

- A. Engraved phenolic plastic, laminate, minimum 1/8-inch thick in the size indicated, with beveled edge border matching letter color. Federal specification L-P-387. All upper case letters in engraver standard letter style of the size and wording indicated. Punched for mechanical fastening, except where adhesive mounting is necessary due to substrate. Embossed tape style labels are not acceptable.
- B. Color:
 - 1. Normal (Utility): White letters on black background.
 - 2. Life Safety/Critical (Emergency Systems): Black letters on orange background.
 - 3. Equipment Branch (Legally Required Standby Systems): Black letters on yellow background.
- C. Letter Size:
 - 1. Use 1/2-inch letters minimum for identifying major equipment and loads, including switchgear, switchboards, etc.
 - 2. Use 1/4-inch or 1/2-inch letters minimum for identifying panels, breakers, etc.
 - 3. Use 3/16-inch minimum for identifying source, voltage, current, phase, and wire configurations.
- D. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- E. The Architect, Engineer, Commissioning Agent and Owner reserve the right to make modifications to the nameplates as necessary.
- F. Locations:
 - 1. Switchgear, switchboards, sub-distribution switchboards, distribution panels, and branch panels.
 - 2. Main breakers and distribution breakers in switchgear, switchboards, and distribution panels.
 - 3. Equipment including, but not limited to, motor controllers, disconnects, and VFDs.
 - 4. Low-voltage equipment enclosures including, but not limited to, fire alarm panels, access control panels, and lighting control panels.
 - 5. Distribution transformers.

IDENTIFICATION FOR ELECTRICAL SYSTEMS

2.3 DEVICE LABELS

- A. Extra strength, laminated adhesive tape, with 3/16-inch black letters on clear background. Use only for identification of individual wall switches and receptacles. Indicate device name, source panel, and source circuits. Panel and circuit designation written in permanent marker on the back of the plate and inside the back-box. Do not provide punch tape style labels.
- B. Label all junction boxes to show system identification, source circuit, or raceway origin. In finished areas, utilize device label. In unfinished areas or above ceilings, use of permanent ink marker is acceptable.

2.4 WIRE MARKERS

- A. Description: Vinyl-cloth self-adhesive type wire markers.
- B. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, junction boxes, and each load connection.
- C. Power and Lighting Circuits: Branch circuit or feeder number as indicated on drawings and source panel.
- D. Control Circuits: control wire number indicated on schematic and interconnection diagrams on drawings or shop drawings.

2.5 UNDERGROUND WARNING TAPE

- A. Description: 6-inch wide inert polyethylene plastic tape, 4-mil thick, detectable type, colored per APWA recommendations unless otherwise noted with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate designations used on Drawings with equipment nameplates and device labels.
- B. Install nameplates and labels parallel to equipment lines.
- C. Identify empty conduit and boxes with intended use.
- D. Provide typewritten branch panel schedules with protective clear transparent covers accounting for every breaker installed. Use actual room designations assigned by name or number near completion of the work, and not the designations shown on drawings.
- E. Where changes are made in existing panels, distribution boards, etc., provide new labeling and typewritten schedules to accurately reflect the changes.
- F. Provide color coded boxes as follows:
 - 1. Fire Alarm: Red.

3.2 EQUIPMENT NAMEPLATES

- A. Degrease and clean surfaces to receive nameplates.
- B. Secure equipment nameplates to equipment front using self-tapping stainless steel screws.

IDENTIFICATION FOR ELECTRICAL SYSTEMS

- C. Secure equipment nameplates to inside surface of door on panelboard that is recessed in finished locations.
- D. Verify emergency system distribution equipment nameplate colors with Architect/Owner.
- E. Switchgear, switchboards, and panels to include name source, voltage, current phase, wire configuration and fault current rating. Transformers to include source KVA, and secondary voltage, phase, and wire configuration.
- F. Provide nameplates for flush mounted branch panelboards identifying name on front door. On inside of door provide nameplate as noted above. Verify with Architect/Owner if nameplate on outside of door is required.
- G. Provide a second label at branch panelboards listing the means of identification of branch circuit conductors. This identification legend to consist of the color code used for each voltage system (208Y/120V and 480Y/277V). See Specification Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables, for required conductor color code for this project. Include identification of both voltage systems on each label, regardless of the voltage of the panelboard to which the label is affixed. Comply with requirements of NEC 210.5.

3.3 DEVICE LABELS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Degrease and clean surfaces to receive labels.

3.4 WIRE MARKERS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide wire markers on each conductor for power, control, signalling and communications circuits.
- D. Where switches control remote lighting or power outlets, or where switches or outlets in same location serve different purposes, such as light, power, intercom, etc. or different areas, such as corridor and outside, provide plates with 1/8-inch black letters indicating function of each switch or outlet. Also label the function of light switches where two or more are mounted in same locations.

3.5 UNDERGROUND WARNING TAPE

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Identify underground raceways using underground warning tape. Install one continuous tape per underground raceway at 6- to 8-inches below finish grade. Where multiple underground raceways are buried in a common trench and exceeds 16-inch width, install multiple warning tapes not over 10-inches apart (edge to edge) over the entire group of underground raceways.

END OF SECTION

IDENTIFICATION FOR ELECTRICAL SYSTEMS

OCCUPANCY AND VACANCY SENSORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Occupancy/Vacancy Sensors (Ceiling and Wall Mounted)
 - 2. Combined Occupancy Sensor/Wall Switches ("Sensor/Switches")
 - 3. Automatic Switches

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Provide wiring diagrams indicating low voltage and line voltage wiring requirements.
 - 2. Provide, on reproducible architectural floor plan, a layout of sensors indicating their sensing distribution.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Use manufacturer's published testing and adjusting procedures to adjust sensors time delay, daylight sensitivity, and passive infrared sensitivity to satisfaction of the Owner.
 - 2. Prepare and complete report of test procedures and results. Submit these test procedures and results to Owner and Architect.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Occupancy/Vacancy Sensors (Ceiling and Wall Mounted):
 - 1. Passive Infrared Occupancy/Vacancy Sensors:
 - a. Acuity Controls
 - b. WattStopper
 - c. Leviton
 - d. Hubbell
 - e. Greengate

OCCUPANCY AND VACANCY SENSORS

- f. Steinel
 - g. Or approved equivalent.
 - 2. Ultrasonic Occupancy/Vacancy Sensors:
 - a. WattStopper
 - b. Leviton
 - c. Hubbell
 - d. Greengate
 - e. Acuity Controls
 - f. Steinel
 - g. Or approved equivalent.
 - 3. Dual Technology Occupancy/Vacancy Sensors:
 - a. WattStopper
 - b. Leviton
 - c. Hubbell
 - d. Greengate
 - e. Acuity Controls
 - f. Steinel
 - g. Or approved equivalent.
 - B. Combined Occupancy/Vacancy Sensor:
 - 1. Lutron
 - 2. Acuity Controls
 - 3. WattStopper
 - 4. Leviton
 - 5. Hubbell
 - 6. Greengate
 - 7. Steinel
 - 8. Or approved equivalent.
 - C. Basis of Design: Occupancy/Vacancy sensor layout on Drawings are designed based on WattStopper product line. Approved manufacturers listed are allowed on condition of meeting the specified conditions including complete sensor coverage of the area controlled and switching of luminaires in the area controlled. Provide additional sensors and power switch packs as needed to provide the same level of functionality as shown on Drawings or required in Specifications. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.

2.2 GENERAL

- A. Occupancy sensor designation indicates sensors automatically turn lights ON when the sensor detects the presence of a person and will automatically turn lights OFF when no presence is detected for a specified amount of time (automatic-on and automatic-off).
- B. Vacancy sensor designation requires someone to manually turn the lights ON. The sensor will then automatically turn the lights OFF when no presence is detected for a specified amount of time (manual-on and automatic-off).
- C. Provide occupancy sensors to sense presence of human activity within desired space and enable or disable on/off manual lighting control function provided by local switches.
- D. Upon detection of human activity by detector, sensor initiates time delay to maintain lights on for present period of time. Field adjustable time delay setting from 30 seconds to 15 minutes.

OCCUPANCY AND VACANCY SENSORS

- E. Factory set sensors for maximum sensitivity.
- F. LED lamp built into sensor indicates when occupant is detected.
- G. Provide zero cross relay control with sensors and sensor/switched; relay contacts close and open with AC voltage signal is at zero.
- H. Where line voltage sensors and sensor/switches are used, provide to match voltage of controlled circuit.
- I. Line Voltage Sensors, Control Units, and Relays: UL listed.

2.3 OCCUPANCY/VACANCY SENSORS (CEILING AND WALL MOUNTED)

- A. Passive Infrared Sensors:
 - 1. Sensor Function: Detects human presence in floor area being controlled by detecting changes in Infrared energy. Sensor detects small movements, i.e., when people are writing while seated at a desk.
 - 2. Provide temperature compensated dual element pyro-electric sensor and with multi element Fresnel lens.
 - 3. Sensor utilizes DIP switches for adjustment to time delay and override. Field adjustable settings for sensitivity.
 - 4. Provide daylight filter to ensure that sensor is insensitive to short-wavelength infrared waves, i.e., those emitted by sun.
 - 5. Adjustments and mounting hardware under removable cover to prevent tampering with adjustments and hardware.
 - 6. Sensor utilizes advanced digital signal processing technology to reduce false offs without reducing sensitivity.
 - 7. Ceiling-Mounted Sensor:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. 360 degree sensor range; coverage: 1200 SF, unless otherwise noted on drawings.
 - c. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
 - d. Provide internal form C dry contacts for HVAC control.
 - e. Basis of Design: Wattstopper CI-300 Series.
 - 8. Wall-Mounted Sensor:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. 90 degree sensor range with dense wide angle lens; coverage: 1000 SF for desktop motion, unless otherwise noted on Drawings.
 - c. Swivel mounting bracket for corner mounting to wall or ceiling.
 - d. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
 - e. Provide internal form C dry contacts for HVAC control.
 - f. Basis of Design: Wattstopper CX Series.
- B. Ultrasonic Occupancy/Vacancy Sensors:
 - 1. Sensor Function: Detects human presence in controlled floor area by detecting Doppler shifts in 40kHz ultrasound created by sensor.

OCCUPANCY AND VACANCY SENSORS

2. Sensors are precision crystal controlled and do not interfere with each other when two or more are placed in same area. Sensor includes advanced digital signal processing to reduce false on signals without decreasing sensitivity, as well as immunity to RFI/EMI sources.
 3. Sensor utilizes DIP switches for adjustment to time delay and override. Field adjustable settings for sensitivity.
 4. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
 5. Provide adjustments and mounting hardware under removable cover to prevent tampering.
 6. Ceiling-Mounted Sensor:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. Maximum protrusion of 1.1-inches and blend in aesthetically with ceiling.
 - c. Coverage: 360 degree sensor range; coverage: 2,000 SF, unless otherwise noted on Drawings.
 - d. Provide internal form C dry contacts for HVAC control.
 - e. Basis of Design: Wattstopper WT Series.
 7. Ceiling Mounted Sensor - Hallway Sensor Coverage:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. Maximum protrusion of 1.5-inches and blend in aesthetically with ceiling.
 - c. Coverage: 90 linear feet.
 - d. Provide internal form C dry contacts for HVAC control.
 - e. Basis of Design: Wattstopper UT-300-3 Series.
- C. Dual Technology Sensors:
1. Sensor Function: Combined capability of passive infrared with ultrasonic or microphonic technology as described above.
 2. Function: Upon a person entering a space, motion must be sensed by both technologies before lighting will be turned on. After this has occurred, detection by either technology will hold lighting on. Sensors retrigger time delay where only one motion is necessary to turn on lights within 5 seconds after turning off.
 3. Wall-Mounted Sensor:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. 90 degree sensor range with dense wide angle lens, coverage; 1000 SF for desktop motion, unless noted on drawings.
 - c. Swivel mounting bracket for corner mounting to wall or ceiling.
 - d. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
 - e. Provide internal form C dry contacts for HVAC control.
 - f. Basis of Design: Wattstopper DT Series.
 4. Ceiling-Mounted Sensor:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. 360 degree sensor range; coverage: 1000 SF for half-step motion, unless otherwise noted on Drawings.
 - c. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
 - d. Provide internal form C dry contacts for HVAC control.

OCCUPANCY AND VACANCY SENSORS

- e. Basis of Design: Wattstopper DT-300 Series.

2.4 COMBINED OCCUPANCY/VACANCY SENSOR/WALL SWITCHES ("SENSOR/SWITCHES")

- A. Completely self-contained sensor system that fits into standard single gang box. Internal transformer power supply, latching dry contact relay switching mechanism compatible with electronic ballasts, compact fluorescent, and inductive loads. Triac and other harmonic generating devices are not allowed.
- B. Passive infrared sensor technology includes advanced signal processing to reduce false triggers without increasing sensitivity. LED indicator blinks when occupant sensed.
- C. Rated to switch loads: 800 watts incandescent or 120-volt ballast; 1000 watts 277 volt ballast. Zero-crossing technology switches lighting off when AC voltage is at zero, minimizes contact wear.
- D. Provide adjustable daylight feature that holds lighting "off" when desired footcandle level is present.
- E. Provide integral off override switch with no leakage current to load or ground.
- F. Vandal-resistant lens.
- G. Includes neutral wire to meet NEC 2014 Code.
- H. Finish: White.
- I. Alerts for impending shut-off: light flash, audible, both or none.
- J. Standard Sensor/Switch:
 - 1. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off). Factory set to manual on/auto off.
 - 2. 180 degree sensor range; coverage: 150 SF for desktop activity.
 - 3. Basis of Design: Wattstopper PW-101 Series.

2.5 AUTOMATIC SWITCHES

- A. Digital Timer Switch:
 - 1. Controls up to 1800 watts at 120 volt, 4100 watts at 277 volt, suitable for ballast and motor loads.
 - 2. Compatible with Decora style faceplate.
 - 3. Provide low voltage (24VAC/VDC) version where used as input to lighting relay panel; includes single-pole, double-throw isolated relay rated for 1A at 30VDC.
 - 4. Electroluminescent LCD display shows timer countdown.
 - 5. Time out setting range from 5 minutes to 12 hours. Lights can be turned off before time-out setting by holding down on/off button.
 - 6. Timer countdown can be reset to beginning by holding down push button for 2 seconds.
 - 7. Zero crossing circuitry.
 - 8. Finish: White.
 - 9. Room lighting flashed and switch beeps 5 minutes and 1 minute prior to switching room lighting off. Either visible or audible features can be disabled.
 - 10. Basis of Design: Wattstopper TS-400 Series.

OCCUPANCY AND VACANCY SENSORS

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install occupancy/vacancy sensors as directed by manufacturer's instructions. Complete connections to control circuits, occupancy sensors, power supply pack and low voltage wiring.
- B. Provide power packs for sensor to control number of circuits and/or switch legs within its area of coverage.
- C. Field adjust each sensor to maximize its coverage of room space.
- D. Relocate sensors with ultrasonic technology to avoid being closer to HVAC diffusers and power packs than recommended by manufacturer.
- E. Field set time delay for each device as noted below:
 - 1. Restrooms: 15 minutes.
 - 2. Storage Rooms, Janitor's Closets, Unisex Restrooms: 5 minutes.
 - 3. All Other Spaces: 15 minutes.
 - 4. Time Switches: 2-hours.
- F. Coordinate HVAC control requirements with controls contractor prior to installation.
- G. Lighting System Testing and Commissioning:
 - 1. Test lighting controls to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with Drawings and Specifications. Provide functional testing of sequences of operation to ensure operation in accordance with Drawings and Specifications. Provide complete report of test procedures and results to engineer and insert approved copy into project closeout documents.
 - 2. Testing includes:
 - a. Daylight Automatic Controls
 - b. Occupant Sensing Automatic Controls
 - c. Automatic Time and Override Controls for Interior Lighting
 - d. Automatic Time and Photo Controls for Exterior Lighting

END OF SECTION

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Provision of materials, installation and testing of:
 - 1. Wall Switches
 - 2. Receptacles
 - 3. Finish Plates
 - 4. Wall Dimmers
 - 5. Surface Covers

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Wall switches
 - 2. Receptacles
 - 3. Wall Plates
 - 4. Dimmers
 - 5. In-Use Cover

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Wall Switches:
 - 1. Toggle Type Characteristics:
 - a. Cooper AH1201
 - b. Hubbell HBL1221
 - c. Leviton 1221
 - d. Legrand P&S PS20AC1
 - e. Or approved equivalent.
- B. Receptacles:

WIRING DEVICES

1. Industrial Grade:
 - a. Cooper 5362
 - b. Hubbell HBL5362
 - c. Bryant BRY5362
 - d. Leviton 5362
 - e. Legrand P&S 5362A
 - f. Or approved equivalent.
 2. Ground Fault Circuit Interrupter (GFCI) Receptacle - 20 Amp:
 - a. Cooper WRS GF20W
 - b. Hubbell GFR5362SGW
 - c. Legrand P&S 2097TRWR
 - d. Or approved equivalent.
- C. Finish Plates:
1. Bryant
 2. Cooper
 3. Hubbell
 4. Leviton
 5. Legrand P&S
 6. Or approved equivalent.
- D. Wall Dimmers:
1. Lutron Maestro Series
 2. Or approved equivalent.
- E. Surface Covers:
1. Aluminum with Gasket, Blanks, Single Gang:
 - a. Bell 240-ALF
 - b. Carlon
 - c. Or approved equivalent.
 2. 2-Gang:
 - a. Bell 236-ALF
 - b. Carlon
 - c. Or approved equivalent.
 3. While-in-Use Weatherproof Cover:
 - a. Die Cast Cover:
 - 1) Intermatic
 - 2) Hubbell
 - 3) Cooper
 - 4) Or approved equivalent.
- F. Provide lighting switches and receptacles of common manufacturer and appearance.
- 2.2 WALL SWITCHES
- A. Characteristics: Toggle type, quiet acting, 20 amp, 120/277 volt, UL listed for motor loads up to 80 percent of rated amperage, extra heavy duty.
- B. Finish: White.

WIRING DEVICES

2.3 RECEPTACLES

- A. Duplex Receptacles Characteristics: Straight parallel blade, 125 volt, 2 pole, 3 wire grounding.
 - 1. Industrial Grade: Back and side wired. Single piece, rivetless. Brass grounding strap and back-wired ground screw. 20 amp.
- B. Ground Fault Circuit Interrupter (GFCI) Receptacle: Feed through type, back-and-side wired, tamper-resistant, weather resistant self-testing, 20 amp, 125VAC.
- C. Surge Protector Receptacle: Feed-through type, back and side wired, 20 amp, 125VAC, LED monitor light, MOV protection in L-N, L-L, and N-G modes for up to 9000 amp surges. Minimum 170 joule rating.
- D. Special Purpose Receptacles: Reference Drawings for NEMA Standard Specification.
- E. Finish:
 - 1. Same exposed finish as switches.

2.4 FINISH PLATES

- A. Finish Plates: Type 302 stainless steel with smooth satin finish.
- B. Provide telephone/signal device plates; activated outlets to have coverplates to match modular jack.

2.5 WALL DIMMERS

- A. Provide wall dimmers compatible with type of load controlled (i.e. line voltage, low voltage, 2-wire, 3-wire, 0-10v). Finish to match wall switches. Size dimmers to accept connected load. Do not cut fins. Where dimmers are ganged together, provide a single multi gang coverplate.
- B. LED indicator dots show by what percentage controlled lighting is dimmed. Programmable settings for maximum and minimum trim settings, and rate of change in lighting levels.

2.6 SURFACE COVERS

- A. Material: Galvanized steel, drawn, 1/2-inch raised industrial type with openings appropriate for devices installed on surface receptacles.
- B. Cast Box and Extension Adaptors: Aluminum with gasket, blanks single gang or 2-gang.
- C. While-in-Use Weatherproof Cover: NEMA 3R when closed over energized plug. Vertical mount for duplex receptacle. Provide continuous use cover with cover capable of closing over energized cord cap with bottom aperture for cord exit.
 - 1. Die cast cover with closed cell neoprene foam gasket: Capable of being locked closed to prevent tampering or unauthorized use.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. See Architectural elevations for location and mounting height of wiring devices. Review Architectural elevations prior to rough-in and contact Architect immediately if conflicts are found between Architectural and Electrical Drawings. Do not rough-in devices until conflicts are resolved.

WIRING DEVICES

- B. Install wiring devices and finish plates plumb with building lines, equipment cabinets and adjacent devices. Devices not plumb will be fixed at no additional cost to Owner.
- C. Orientation:
 - 1. Install wiring devices with long dimension oriented vertically at centerline height shown on drawings or as specified.
 - 2. Vertical Alignment: When more than one device is shown on drawings in close proximity to each other, but at different elevations, align devices on a common vertical center line for best appearance. Verify with Architect.
 - 3. Horizontal Alignment: When more than one device is shown on drawings in close proximity to each other with same elevation, align devices on a common horizontal center line for best appearance. Verify with Architect.
- D. Provide labeling per Section 26 05 53, Identification for Electrical Systems.
- E. Test wiring devices to ensure electrical continuity of grounding connections, and after energizing circuitry, to demonstrate compliance with requirements. Test receptacles for line to neutral, line to ground and neutral to ground faults. Correct any defective wiring.
- F. Submit report of compliance and results of receptacle and equipment tests:
 - 1. Voltage measurements for fixed electrical equipment with conductive surfaces in patient care vicinity (6-feet from patient table or bed).
 - 2. Impedance measurements for a minimum of 10 percent of receptacles in patient care facility.
 - 3. Physical integrity of each receptacle in patient care areas.
 - 4. Continuity of grounding circuit in each electrical receptacle in patient care areas.
 - 5. Correct polarity of hot and neutral connections in each electrical receptacle in patient care areas.
 - 6. Retention force of grounding blade of each receptacle.

3.2 WALL SWITCHES INSTALLATION

- A. At time of substantial completion, replace those items which have been damaged.

3.3 RECEPTACLES INSTALLATION

- A. Upon installation, adhere to proper and cautious use of convenience receptacles. At time of substantial completion, replace those items which have been damaged, including those burned and scored by faulty receptacles or cord caps.
- B. GFCI Receptacles: One GFCI receptacle may not be used to provide GFCI protection to downstream duplex receptacles on the same branch circuit.

3.4 FINISH PLATES INSTALLATION

- A. Do not install items until finish painting is complete. Replace scratched and paint splattered finish plates and wiring devices.

3.5 WALL DIMMERS INSTALLATION

- A. Install per manufacturer's recommendations and wiring diagrams.

WIRING DEVICES

3.6 SURFACE COVERS INSTALLATION

- A. Do not install items until finish painting is complete. Replace scratched and paint splattered finish plates and wiring devices.

END OF SECTION

OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Fuses
 - 2. Molded Case Circuit Breakers

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Product data and instantaneous let-through current curves and average melting time current curves for fuses supplied to project.
 - 2. Product data and time/current trip curves for circuit breakers supplied to project.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements apply to this Section.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fuses:
 - 1. Bussmann
 - 2. Ferraz-Shawmut
 - 3. Littelfuse
 - 4. McGraw-Edison
 - 5. Or approved equivalent.
- B. Molded Case Circuit Breakers:
 - 1. Eaton Electrical
 - 2. ABB/General Electric
 - 3. Siemens
 - 4. Schneider Electric/Square D
 - 5. Or approved equivalent.

OVERCURRENT PROTECTIVE DEVICES

2.2 FUSES

- A. Characteristics:
 - 1. Dual element, time delay, current limiting, nonrenewable type, rejection feature. Blown-fuse indicator window.
 - 2. Combination Loads: UL Class RK1, 1/10 to 600 amp. UL Class L, above 600 amps.
 - 3. Motor Loads: UL Class RK5, 1/10 to 600 amp.
 - 4. Fuse pullers for complete range of fuses.

2.3 MOLDED CASE CIRCUIT BREAKERS

- A. 1-, 2- or 3-pole bolt-on, single handle common trip, 600VAC or 250VAC as indicated on Drawings.
- B. Overcenter toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.
- C. Calibrate for operation in 40 degrees C ambient temperature.
- D. 15 to 150 Amp Breakers: Permanent trip unit containing individual thermal and magnetic trip elements in each pole.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review the submitted product data for equipment furnished by the Owner, and furnished under other Divisions of this contract, particularly under Divisions 22 and 23.
 - 2. Confirm the equipment nameplate maximum overcurrent protection (MOCP) and make accommodations and adjustments to overcurrent protective devices as necessary to coordinate with the nameplate rating.
- B. Install all items in accordance with manufacturers written instructions.

3.2 FUSES

- A. Fuses: For each class and ampere rating of fuse installed, provide the following quantities of spares for quantity of fuses installed:
 - 1. 0 to 24: Provide 6 spare.
 - 2. 25 to 48: Provide 9 spare.
 - 3. 49 and Above: Provide 12 spare.

3.3 MOLDED CASE CIRCUIT BREAKERS

- A. Provide testing of ground fault interrupting breakers.
- B. Provide circuit breakers, as specified and on Drawings, for installation in panelboards, individual enclosures or combination motor starters.
- C. Provide ground fault interrupter circuit breakers for equipment in damp or wet locations.
- D. Provide device on handle to lock breaker in "ON" position for breakers feeding time switches, night lights and similar circuits required to be continuously energized.

OVERCURRENT PROTECTIVE DEVICES

- E. Shunt Trip Circuit Breakers: Provide wiring to remote trip switch/contacts as indicated on Drawings.
- F. Provide multi-pole branch circuit breakers for multiwire branch circuits for simultaneous disconnection of circuits.

END OF SECTION

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Toggle Type Disconnect Switches
 - 2. Manual Motor Starters
 - 3. Safety Switches
 - 4. Enclosed Circuit Breakers

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 26 28 00, Overcurrent Protective Devices.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Toggle Type Disconnect Switches:
 - 1. Cooper
 - 2. Hubbell
 - 3. Leviton
 - 4. Legrand (Pass & Seymour)
 - 5. Slater
 - 6. Or approved equivalent.
- B. Manual Motor Starters:
 - 1. Eaton Electrical
 - 2. ABB/General Electric
 - 3. Siemens
 - 4. Schneider Electric/Square D
 - 5. Or approved equivalent.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- C. Safety Switches:
 - 1. Eaton Electrical
 - 2. ABB/General Electric
 - 3. Siemens
 - 4. Schneider Electric/Square D
 - 5. Or approved equivalent.
- D. Enclosed Circuit Breakers:
 - 1. Eaton Electrical
 - 2. ABB/General Electric
 - 3. Siemens
 - 4. Schneider Electric/Square D
 - 5. Or approved equivalent.

2.2 TOGGLE TYPE DISCONNECT SWITCHES

- A. Rating: 120 or 277 volt, 1 or 2 pole, 20 amp, 1 hp maximum.
- B. Enclosure:
 - 1. NEMA 1: Dry locations/Indoors.
 - 2. NEMA 3R: Damp or wet locations/Outdoors.
- C. Handle lockable in 'off' position.

2.3 MANUAL MOTOR STARTERS

- A. Quick-Make, Quick-Break. Thermal overload protection. Device labeled with maximum voltage, current, and horsepower.
- B. Enclosure:
 - 1. NEMA 1: Dry locations/Indoors.
 - 2. NEMA 3R: Damp or wet locations/Outdoors.

2.4 SAFETY SWITCHES

- A. Heavy duty fusible type and non-fusible type (as indicated on drawings), dual rated, quick-make, quick-break with fuse rejection feature for use with Class R fuses only, unless other fuse type is specifically noted.
- B. Clearly marked for maximum voltage, current, and horsepower.
- C. Operable handle interlocked to prevent opening front cover with switch in 'on' position.
- D. Switches rated for maximum available fault current.
- E. Handle lockable in 'off' position.
- F. Enclosure:
 - 1. NEMA 1: Dry locations/Indoors.
 - 2. NEMA 3R: Damp or wet locations/Outdoors.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

2.5 ENCLOSED CIRCUIT BREAKERS

- A. Molded case circuit breakers:
 - 1. 1-, 2-, or 3-pole bolt on, single-handle common trip, 250VAC as indicated on drawings.
 - 2. Overcenter toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.
 - 3. Calibrate for operation in 40C ambient temperature.
 - 4. 15 to 150 Amp Breakers: Permanent trip unit containing individual thermal and magnetic trip elements in each pole.
 - 5. Provide handle mechanisms that are lockable in the open (off) position.
 - 6. Circuit breakers to have minimum symmetrical interrupting capacity as indicated on Drawings.
- B. Enclosure:
 - 1. NEMA 1: Dry locations/Indoors.
 - 2. NEMA 3R: Damp or wet locations/outdoors.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Obtain and review the submitted product data for equipment furnished by the Owner, and furnished under other Divisions of this contract, particularly under Divisions 22 and 23.
- B. Confirm the equipment nameplate maximum overcurrent protection (MOCP) and make accommodations and adjustments to switches, fuses and circuit breakers as necessary to coordinate with the nameplate rating
- C. Install in accordance with manufacturer's instructions.
- D. Provide engraved nameplates per Section 26 05 53, Identification for Electrical Systems.
- E. Apply neatly typed adhesive tag on inside door of each fusible switch indicating NEMA fuse class and size installed.

3.2 TOGGLE TYPE DISCONNECT SWITCHES

- A. Install fuses in fusible disconnect switches. Coordinate fuse ampere rating with installed equipment. Do not provide fuses of lower ampere rating than motor starter thermal units.
- B. Install products, systems and equipments in accordance with manufacturers written instructions and requirements.
- C. See General Installation Requirements above.

3.3 MANUAL MOTOR STARTERS

- A. Provide disconnecting means within sight of each motor controller and of each motor. Motor controller disconnecting means equipped with lock-out/tag-out padlock provisions do not require a disconnect switch at the controlled motor location. Locate disconnect means in view of and not inside of equipment, such that tools are not needed to remove covers to access the disconnecting means.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- B. Install products, systems and equipments in accordance with manufacturers written instructions and requirements.
- C. See General Installation Requirements above.

3.4 SAFETY SWITCHES

- A. Install products, systems and equipments in accordance with manufacturers written instructions and requirements.
- B. See General Installation Requirements above.

3.5 ENCLOSED CIRCUIT BREAKERS

- A. Install products, systems and equipments in accordance with manufacturers written instructions and requirements.
- B. See General Installation Requirements above.

END OF SECTION

LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Luminaires
 - 2. LED Drivers
 - 3. Lamps
 - 4. Emergency LED Luminaire Power Supply
- B. Provide wiring for complete and operating lighting system.

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NECA 500 - Commercial Lighting.
 - 2. UL 8750 – Light Emitting Diode (LED) equipment for use in lighting products.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Submit product data for:
 - a. LED Luminaires: Electrical ratings, dimensions, mounting, material, clearances, terminations, wiring, connection diagram, LM-79 photometric data, LM-80 lumen depreciation data.
 - b. LED Drivers
 - c. Lamps
 - d. Emergency LED Luminaire Power Supply
 - 2. Submittal Cutsheets: Highlight, circle or otherwise graphically indicate which option(s) are being selected for the products submitted. Cutsheets that are not edited to indicate which products and options are submitted for this project or that list only catalog numbers to identify submitted options are not acceptable.
 - 3. Specified manufacturers are approved to submit bid. However, inclusion does not relieve manufacturer from supplying product as described.
 - 4. Provide the following operating and maintenance instructions as required by Section 26 00 00, Electrical Basic Requirements:
 - a. Luminaires
 - b. LED Drivers
 - c. Lamps
 - d. Emergency LED Luminaire Power Supply

LIGHTING

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Provide luminaires acceptable to code authority for application and location installed.
 - 2. Comply with applicable ANSI standards.
 - 3. Comply with applicable NEMA standards.
 - 4. Provide luminaires and lampholders that comply with UL standards and have been listed and labeled for location and use indicated by a testing agency acceptable by the AHJ (e.g., UL, ETL, and the like).
 - 5. Comply with OESC as applicable to installation and construction of luminaires.
 - 6. Comply with fallout and retention requirements of OSSC for diffusers, baffles, and louvers.
 - 7. Provide LED luminaires from the same manufacturer and manufacturing LED source batch for similar applications (e.g., all LED downlights from a single manufacturer and batch, all linear LED products from single manufacturer and batch).

1.6 WARRANTY

- A. Warranty as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. LED Luminaire Manufacturer's Warranty: Not less than 5 years for luminaire based on date of substantial completion. Includes normal cost of labor to replace luminaire. Replacement luminaire will match physical dimensions, physical appearance, chromaticity, lumen output and photometric characteristics of original installed equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Luminaires:
 - 1. Reference description and manufacturers in Luminaire Schedule on Drawings.
 - 2. Or approved equivalent.
- B. LED Drivers:
 - 1. Indoor Drivers:
 - a. eldoLED Series
 - b. Advance/Philips
 - c. Osram Sylvania
 - d. Or approved equivalent.
 - 2. Outdoor Drivers:
 - a. Advance/Philips
 - b. Osram Sylvania
 - c. LG
 - d. Or approved equivalent.
- C. Lamps:

LIGHTING

1. LED (Light Emitting Diode) Lamps:
 - a. Nichia
 - b. Cree
 - c. Osram Sylvania
 - d. GE Lumination
 - e. Or approved equivalent.
 2. Unless specific manufacturer not shown on this list is indicated in the Luminaire Schedule.
 3. Special types as indicated in Luminaire Schedule.
 4. Or approved equivalent.
- D. Emergency LED Luminaire Power Supply:
1. Bodine
 2. Hatch
 3. Fulham
 4. Or approved equivalent.

2.2 LUMINAIRES

- A. Luminaires: Reference description and manufacturers in Luminaire Schedule on drawings.
- B. Where recessed luminaires are installed in cavities intended to be insulated, provide IC rated luminaires or other code approved installation.
- C. UL label luminaires installed under canopies, roof or open porches, and similar damp or wet locations, as suitable for damp or wet location.
- D. Suspended luminaires: Provide minimum 24-inch adjustability in aircraft cable length where used.
- E. Recessed Luminaires: Frame compatible with ceiling material installed at particular luminaire location. Provide proper factory trim and frame for luminaire to fit location and ceiling material. Verify with Architectural Reflected Ceiling Plan prior to submittals.
- F. Finishes:
 1. Manufacturer's standard finish (unless otherwise indicated) over corrosion resistant primer.
 2. Interior Light Reflecting Finishes: White or specular finish with not less than 85 percent reflectance.
 3. Exterior Finishes: As detailed in Luminaire Schedule or on drawings. Refer cases of uncertain applicability to Architect for resolution prior to release for fabrication.
- G. Light Transmitting Components:
 1. Plastic diffusers, molded or extruded of 100 percent virgin acrylic.
 2. Prismatic acrylic, extruded, flat diffusers, 0.125-inch overall thickness, unless otherwise noted.
- H. LED Luminaires:
 1. UL listing of luminaire includes drivers, transformers, enclosures, rated wire, communications devices and accessories needed for a complete and functional system.
 2. LM-79: Testing and measurement of absolute photometry, chromaticity (CCT) and luminaire power. Report provided by DOE certified independent testing laboratory. CCT as specified in Luminaire Schedule.

LIGHTING

3. Standards: ANSI C78.377, LM-79 and LM-82 compliant for performance characteristics, photometry, colorimetry, efficacy and thermal characteristics.
4. LM-80 + TM-21: Testing and measurement, and statistical prediction of LED lamp life. Report provided by DOE certified independent testing laboratory.
5. LEDs in one module/luminaire: Supplied from same batch/bin and fall within 3-step MacAdam Ellipse, or as described in Luminaire Schedule, whichever is the more stringent requirement.
6. Provide luminaires with integral LED thermal management system (heat sinking).
7. Luminaires to be equipped with an LED driver that accepts 120V through 277V, 50Hz to 60Hz (universal). Component-to-component wiring within the luminaire will carry no more than 80 percent of rated current and be listed by UL for use at 600VAC at 302 degrees F/150 degrees C or higher. Plug disconnects to be listed by UL for use at 600VAC, 15A or higher.
8. Provide luminaires with individual LED arrays/modules and drivers that are accessible and replaceable from exposed side of the luminaire.

2.3 LED DRIVERS

A. General:

1. Performance: Meet dimming range called out in Luminaire Schedule, free from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.
2. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
3. Minimum efficiency of 85 percent, power factor greater than or equal to 0.90, compliance with reduction of hazardous substances (RoHS). Rated for operating temperature range of area in which driver is installed.
4. Limit inrush current to minimize breaker tripping.
 - a. Base specification: NEMA 410 standard for inrush current for electronic drivers.
 - b. Preferred Specification: Meet or exceed 30 milliamp-squared-seconds at 277VAC for up to 50 watts of load and 75 amps at 240 microseconds at 277VAC for 100 watts of load.
5. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
6. No visible change in light output with a variation of plus/minus 10 percent line voltage input.
7. Total Harmonic Distortion less than 10 percent and meet ANSI C82.11 maximum allowable THD requirements at full output. THD at no point in the dimming curve allows imbalance current to exceed full output THD.
8. Support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:
 - a. Adjustment of forward LED voltage, supporting 3V through 55V.
 - b. Adjustment of LED current from 150mA to 1.4A at the 100 percent control input point in increments of 1mA.
 - c. Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.
9. Operate for a (+/- 10 percent) supply voltage of 120V through 277VAC at 60Hz.

LIGHTING

10. UL Recognized under the component program and modular for simple field replacement. Drivers that are not UL Recognized or not suited for field replacement will not be considered.
 11. Ability to provide no light output when the analog control signal drops below 0.3 V, or the DALI/DMX digital signal calls for light to be extinguished and consume 0.5 watts or less in this standby. Control dead band between 0.3V and 0.65V included to allow for voltage variation of incoming signal without causing noticeable variation in luminaire to luminaire output.
- B. Light Quality:
1. Over the entire range of available drive currents, driver to provide step-free, continuous dimming to black from 100 percent to 0.1 percent and 0 percent relative light output, or 100 percent to 1 percent light output and step to 0 percent where indicated. Driver to respond similarly when raising from 0 percent to 100 percent.
 - a. Driver must be capable of 20 bit dimming resolution for white light LED drivers or 15 bit resolution for RGBW LED drivers.
 2. Driver must be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels.
 3. Drivers to track evenly across multiple luminaires at all light levels, and must have an input signal to output light level that allows smooth adjustment over the entire dimming range.
 4. Driver and luminaire electronics to deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100 percent to 0.1 percent luminaire will have:
 - a. LED dimming driver to provide continuous step-free, flicker free dimming similar to incandescent source.
 - b. Base specification: Based on IEEE PAR1789, minimum output frequency should be greater than 1250 Hz.
 - c. Preferred specification: Flicker index to be equal to incandescent, less than 1 percent at all frequencies below 1000 Hz.
- C. Control Input:
1. Provide control protocol to match lighting control system specified for use with luminaire.
 2. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers:
 - a. Meet IEC 60929 Annex E for General White Lighting LED drivers.
 - b. Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
 - c. Meet ESTA E1.3 for RGBW LED drivers.
- 2.4 LAMPS
- A. Provide lamps for luminaires.
 - B. Provide lamp catalogued for specified luminaire type.
 - C. Incandescent Lamps: Not allowed unless noted in Luminaire Schedule.
 - D. LED (Light Emitting Diode):

LIGHTING

1. LED manufacturer will include, but not be limited to, light source, luminaire, power supply and control interface with added components as needed for complete and functioning system.
 - a. Comply with ANSI chromaticity standard for classifications of color temperature. See Luminaire Schedule for specified LED lamp color and color temperature. UL or ETL listed and labeled.
 - b. Luminaire testing per IESNA LM-79 and LM-80 procedures.
 - c. Lamp life for white LEDs: 50,000 plus hours with lamp failure occurring when LED produces 70 percent of initial rated lumens.
 - d. Lamp life for color LEDs: 30,000 plus hours with lamp failure occurring when LED produces 50 percent of its initial rated lumens.
 - e. LED Drivers: Reverse polarity protection, open circuit protection, require no minimum load. Minimum 80 percent efficiency. Class A noise rating.
 - f. Dimming: LED system capable of full and continuous dimming.
 - g. Correlated Color Temperature (CCT): See Luminaire Schedule for selection of color temperature for each luminaire. Ranges given below reflect maximum allowable tolerances for color temperature range for each nominal CCT.
 - 1) Nominal CCT:
 - (a) 2700 K (2725 ± 145)
 - (b) 3000 K (3045 ± 175)
 - (c) 3500 K (3465 ± 245)
 - (d) 4000 K (3985 ± 275)
 - h. Color Rendering Index (CRI) to be greater than or equal to 80.
2. Special types as indicated in Luminaire Schedule.

2.5 EMERGENCY LED LUMINAIRE POWER SUPPLY

- A. Internal Type: Self-contained, modular, battery unit, factory mounted within luminaire body and compatible with driver. Comply with UL 924.
 1. Emergency Connection: Operate one LED module continuously at a minimum output of 1400 lumens each. Connect unswitched circuit to battery unit and switched circuit to luminaire driver.
 2. Test Push Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 3. Battery: Sealed, maintenance-free, nickel-cadmium type. Sized for a minimum output of 90 minutes.
 4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
- B. External Type: Self-contained, modular, battery unit, suitable for powering one or more LED modules, remote mounted from luminaire. Comply with UL 924.
 1. Emergency Connection: Operate one LED module continuously. Connect unswitched circuit to battery unit and switched circuit to luminaire driver.
 2. Charger: Fully automatic, solid-state, constant-current type.
 3. Housing: NEMA 250, Type 1 enclosure.
 4. Test Push Button: Visible and accessible without entering ceiling space.

LIGHTING

- a. Push-to-test type, in remote unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - c. Faceplate Finish: Verify finish with Architect for each room prior to ordering materials.
5. Battery: Sealed, maintenance-free, nickel-cadmium type. Sized for a minimum output of 90 minutes.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install per manufacturer's written installation instructions and requirements.
- B. Install luminaires securely, in neat and workmanlike manner.
- C. Install luminaires of types indicated where shown and at indicated heights in accordance with manufacturer's written instructions and with recognized industry practices to ensure that luminaires comply with requirements and serve intended purposes.
- D. Wiring:
 1. Recessed luminaires to be installed using flexible metallic conduit with luminaire conductors spliced to branch circuit conductors in nearby accessible junction box over ceiling. Junction box fastened to building structural member within 6-feet of luminaire.
 2. Luminaires for lift out and removal from ceiling pattern without disconnecting conductors or defacing ceiling materials.
 3. Flexible connections where permitted to exposed luminaires; neat and straight, without excess slack, attached to support device.
 4. Install junction box, flexible conduit and high temperature insulated conductors for through wiring of recessed luminaires.
- E. Relamp luminaires which have failed lamps at substantial completion.
- F. Replace LED drivers deemed as excessively noisy by Architect, Engineer, or Owner.
- G. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- H. Support luminaires larger than 2- by 4-foot size independent of ceiling framing.
- I. Locate recessed ceiling luminaires as indicated on architectural reflected ceiling plan.
- J. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- K. Exposed Grid Ceilings:
 1. Support surface mounted luminaires in grid ceiling directly from building structure.
 2. Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires.
 3. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.
- L. Install recessed luminaires to permit removal from below.

LIGHTING

- M. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- N. Install clips to secure recessed grid-supported luminaires in place.
- O. Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated on Architectural Drawings.
- P. Install accessories furnished with each luminaire.
- Q. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- R. Bond products and metal accessories to branch circuit equipment grounding conductor.
- S. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.
- T. Where manufactured wiring assemblies are used, ensure that wiring assembly manufacturer sends components to appropriate luminaire manufacturer for respective installation of proper components.
- U. Coordination:
 - 1. Coordination of Conditions: Coordinate ceiling construction, recessing depth and other construction details prior to ordering luminaires for shipment. Refer cases of uncertain applicability to Architect for resolution prior to release of luminaires for shipment. Where luminaires supplied do not match ceiling construction, replace luminaires at no cost to Owner.
 - 2. Electrical drawings are schematic, identifying quantity and type of luminaires used and their approximate location, but are not to be used for dimensional purposes. Reference architectural drawings for exact locations, including mounting heights.
 - 3. Provide lighting indicated on drawings with luminaire of the type designated and appropriate for location.
 - 4. Provide LED luminaires with driver compatible to lighting control system as shown in drawings and as specified.
 - 5. Where remote drivers are required, ensure adequate accessibility to driver. Upsize conductors between luminaire and driver to accommodate voltage drop.
- V. Field Quality Control:
 - 1. Perform field inspection in accordance with Division 01, General Requirements.
 - 2. Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- W. Cleaning:
 - 1. Clean electrical parts to remove conductive and deleterious materials.
 - 2. Remove dirt and debris from enclosures.
 - 3. Clean paint splatters, dirt, dust, fingerprints, and debris from luminaires.
 - 4. Clean photometric control surfaces as recommended by manufacturer.
 - 5. Clean finishes and touch up damaged finishes per by manufacturer's instructions.
- X. Demonstrate luminaire operation for minimum of two hours.

LIGHTING

3.2 LUMINAIRES

- A. Install per manufacturer's written installation instructions and requirements.
- B. Align, mount and level luminaires uniformly. Use ball hangers for suspended stem mounted luminaires.
- C. Avoid interference with and provide clearance from equipment. Where indicated locations for luminaires conflict with locations for equipment, change locations for luminaire by minimum distance necessary as directed by Architect.
- D. Suspended Luminaires: Mounting heights indicate clearances between bottom of luminaire and finished floors.
- E. Emergency Egress Luminaires: Provide unswitched circuit for battery charging and autotransfer circuiting for exit signs and luminaires with integral batteries. Where test switch cannot be integral to luminaire, mount remote test switch flush-to-ceiling and adjacent to egress luminaire.
- F. Interior Luminaire Supports:
 - 1. Support Luminaires: Anchor supports to structural slab or to structural members within a partition, or above a suspended ceiling.
 - 2. Maintain luminaire positions after cleaning and relamping.
 - 3. Support luminaires without causing ceiling or partition to deflect.
 - 4. Provide mounting supports for recessed and pendant mounted luminaires as required by IBC.
- G. Adjusting:
 - 1. Aim and adjust luminaires as indicated.
 - 2. Focus and adjust floodlights, spotlights and other adjustable luminaires, with Architect, at such time of day or night as required.
 - 3. Align luminaires that are not straight and parallel/perpendicular to structure.
 - 4. Position exit sign directional arrows as indicated.

3.3 LED DRIVERS

- A. Install lamps per manufacturer's installation instructions and requirements.
- B. Where driver is remote mounted, size wiring based on type of driver, driver distance from luminaire, and voltage/power level, and manufacturer's installation instructions.
- C. Protect 0-10V input from line voltage mis-connection, and so it will be immune and the output unresponsive to induced AC voltage on the control leads.

END OF SECTION

ELECTRONIC SAFETY BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 DESIGN-BUILD SUMMARY

- A. Work included in 28 00 01 applies to Division 28, Electronic Safety work to provide materials, labor, tools, permits and incidentals to make electronic safety systems ready for Owner's use for proposed project.

1.2 DESIGN-BUILD INSTRUCTIONS

- A. This document is issued to give Bidders a basis for preparing a proposal to design and install a complete Electronic Safety system for this project.
- B. Alternates to this Document may be offered as a separate proposal.

1.3 DESIGN-BUILD DESIGN APPROACH

- A. Use this Specification as a guide for design/engineering requirements, workmanship and materials or construction. Utilize design-build concept throughout construction phase of project.
- B. Investigate and be apprised of applicable codes, rules, and regulations as enforced by Authority Having Jurisdiction (AHJ).
- C. Visit the Site of the proposed construction. Verify and inspect the existing site to determine conditions that affect this work.

1.4 DESIGN-BUILD DESIGN CRITERIA/CALCULATIONS

- A. Related Work Specified Elsewhere:
 - 1. Contents of Section apply to Division 28, Electronic Safety Specifications.
 - 2. Requirements of Section are a minimum for Division 28, Electronic Safety Sections, unless otherwise stated in each Section, in which case that Section's requirements take precedence.
- B. Fire Alarm Design Criteria:
 - 1. Refer to Section 28 31 00, Fire Detection and Alarm, for fire alarm system design criteria.
- C. Fire Alarm Equipment:
 - 1. Refer to Section 28 31 00, Fire Detection and Alarm, for fire alarm equipment requirements.

1.5 SECTION INCLUDES

- A. Work included in 28 00 01, Electronic Safety Basic Requirements applies to Division 28, Electronic Safety work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of electronic safety systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.

ELECTRONIC SAFETY BASIC REQUIREMENTS

2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
3. Install: Includes unloading, unpacking, assembling, erecting, installing, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent," substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities having jurisdiction, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.6 RELATED SECTIONS

- A. Contents of Section apply to Division 28, Electronic Safety Contract Documents.
- B. Related Work:
 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits
- C. Contents of Division 26, Electrical apply to this Section.

1.7 REFERENCES AND STANDARDS

- A. References and Standards per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 28, Electronic Safety Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
 1. State of Oregon:
 - a. OAR - Oregon Administrative Rules
 - b. OESC - Oregon Electrical Specialty Code
 - c. OFC - Oregon Fire Code
 - d. OMSC - Oregon Mechanical Specialty Code
 - e. OPSC - Oregon Plumbing Specialty Code
 - f. OSSC - Oregon Structural Specialty Code
 - g. OEESC - Oregon Energy Efficiency Specialty Code
 - h. Oregon Elevator Specialty Code
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 1. ABA - Architectural Barriers Act

ELECTRONIC SAFETY BASIC REQUIREMENTS

2. ADA - Americans with Disabilities Act
3. ANSI - American National Standards Institute
4. ASCE - American Society of Civil Engineers
5. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
6. ASHRAE Guideline 0, the Commissioning Process
7. ASME - American Society of Mechanical Engineers
8. ASTM - ASTM International
9. CFR - Code of Federal Regulations
10. EPA - Environmental Protection Agency
11. ETL - Electrical Testing Laboratories
12. FM - FM Global
13. ISO - International Organization for Standardization
14. NEC - National Electric Code
15. NEMA - National Electrical Manufacturers Association
16. NFPA - National Fire Protection Association
17. OSHA - Occupational Safety and Health Administration
18. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association
19. UL - Underwriters Laboratories Inc.

D. See Division 28, Electronic Safety individual Sections for additional references.

1.8 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
 2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via posted to ftp site. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.
 3. Product Data: Provide manufacturer's descriptive literature for products specified in Division 28, Electronic Safety Sections.
 4. Identify/mark each submittal in detail. Note what difference, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the specifications and drawings.
 - a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment

ELECTRONIC SAFETY BASIC REQUIREMENTS

- or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
- b. Include technical data, installation instructions and dimensioned drawings for products, equipment and devices installed, furnished or provided. Reference individual Division 28, Electronic Safety specification Sections for specific items required in product data submittal outside of these requirements.
 - c. See Division 28, Electronic Safety individual Sections for additional submittal requirements outside of these requirements.
- 5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
 - 6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
 - 7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
 - 8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 28, Electronic Safety Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical and Division 28, Electronic Safety submittals.
 - 9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
 - 10. Substitutions and Variation from Basis of Design:
 - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor are required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals." For any product marked "or approved equivalent," a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
 - c. Where manufacturer equipment or model numbers are indicated with no exceptions, substitutions will be rejected.
 - 11. Shop Drawings:
 - a. Provide coordinated shop drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Reference individual

ELECTRONIC SAFETY BASIC REQUIREMENTS

- Division 28, Electronic Safety specification Sections for additional requirements for shop drawings outside of these requirements.
- b. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
12. Samples: Provide samples when requested by individual Sections.
13. Resubmission Requirements:
- a. Make any corrections or change in submittals when required by Architect/Engineer review comments. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
 - b. Resubmit for review until review indicates no exception taken or "make corrections noted."
 - c. When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.
14. Operation and Maintenance Manuals, Owner's Instructions:
- a. Reference individual Division 28, Electronic Safety Specification Sections for additional requirements for operations and maintenance manuals.
 - b. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
 - 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes and quantities relevant to each piece of equipment.
 - 3) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub-assemblies.
 - 4) Include Warranty per Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Sections.
 - 5) Include product certificates of warranties and guarantees.
 - 6) Include copy of start-up and test reports specific to each piece of equipment.
 - 7) Include commissioning reports.
 - 8) Engineer will return incomplete documentation without review.
 - 9) Engineer will provide one set of review comments in Submittal Review format. Arrange for additional reviews; Bear costs for additional reviews at Engineer's hourly rates.
 - c. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per

ELECTRONIC SAFETY BASIC REQUIREMENTS

Section 28 00 01, Electronic Safety Basic Requirements Article titled "Demonstration."

- d. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
- 15. Record Drawings:
 - a. Maintain at site at least one set of drawings for recording "as-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements and location of concealed items. Include items changed by addenda, field orders, supplemental instructions, and constructed conditions.
 - b. Record Drawings are to include equipment locations, calculations, and schedules that accurately reflect "as constructed or installed" for project.
 - c. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.
 - d. See Division 28, Electronic Safety individual Sections for additional items to include in Record Drawings.

1.9 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (e.g. cable tray, panels, etc.) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.

ELECTRONIC SAFETY BASIC REQUIREMENTS

1.10 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.11 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, plumbing, cable trays, lights, and electrical services with architectural and structural requirements, and other trades (including ceiling suspension and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Advise Architect in event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- C. Verify in field exact size, location, and clearances of existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacture, including but not limited to panels, devices and equipment unless otherwise specified in individual Division 28, Electronic Safety Sections.

2.2 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or FM approved or have adequate approval or be acceptable by state, county, and city authorities.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
 - 1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
 - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.

ELECTRONIC SAFETY BASIC REQUIREMENTS

3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

2.3 ACCESS PANELS

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.
- B. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 28, Electronic Safety Sections. In absence of specific requirements, comply with the following:
 1. Provide flush mounting access panels for systems and individual components, service of electronic safety systems equipment and junction boxes requiring maintenance, inspection or servicing. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
 - a. Ceiling access panels to be minimum of 24-inch by 24-inch required and approved size.
 - b. Wall access panels to be minimum of 12-inch by 12-inch required and approved size.
 - c. Provide screwdriver operated catch.
 - d. Manufacturers and Model:
 - 1) Drywall: Karp KDW.
 - 2) Plaster: Karp DSC-214PL.
 - 3) Masonry: Karp DSC-214M.
 - 4) 2 hour rated: Karp KPF-350FR.
 - 5) Manufacturers: Karp, Milco, Elmdor, Acudor, or approved equivalent.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.
- B. Install equipment having components requiring access (i.e., devices, equipment, electrical boxes, panels, etc.) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.
- D. Earthwork:
 1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork

ELECTRONIC SAFETY BASIC REQUIREMENTS

- divisions. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
 - E. Firestopping:
 - 1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around conduit, raceway and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - F. Plenums:
 - 1. In plenums, provide plenum rated materials that meet the requirements to be installed in plenums.
- 3.2 SEISMIC CONTROL
 - A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 28 Electronic Safety Sections.
 - B. General:
 - 1. Earthquake resistant designs for Electronic Safety (Division 28) systems and equipment to conform to regulations of jurisdiction having authority.
 - 2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
 - 3. Provide means to prohibit excessive motion of safety equipment during earthquake.
- 3.3 REVIEW AND OBSERVATION
 - A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.
 - B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 - 1. Underground conduit and wire installation prior to backfilling.
 - 2. Prior to covering walls when electronic safety systems installation is started.
 - 3. Prior to ceiling cover/installation.
 - 4. When main systems, or portions of, are being tested and ready for inspection by AHJ.

ELECTRONIC SAFETY BASIC REQUIREMENTS

- C. Final Punch: Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements in Division 01, General Requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 - 1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
 - 2. Prior to changing over to new system, verify that every item is thoroughly prepared. Install new wiring to point of connection.
 - 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
 - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 - 4. Organize work to minimize duration of power interruption.

3.5 CUTTING AND PATCHING

- A. Confirm Cutting and Patching Requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 - 1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
 - 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
 - 3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
 - 4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, repair, refinish and leave in condition matching existing prior to commencement of work.
 - 5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.6 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

ELECTRONIC SAFETY BASIC REQUIREMENTS

3.7 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with the individual Division 28, Electronic Safety Sections and the following:
 - 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust.
 - 2. Protect equipment and pipe to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 - 3. Protect devices, panels and similar items until in service.
 - 4. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.

3.8 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.
- B. Upon completion of work and adjustment of equipment, test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Staff as specified in Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified factory certified instructor at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.9 CLEANING

- A. Confirm cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28 Sections.
- B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.
- B. Install equipment in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to building structure. Maintain manufacturer's recommended clearances.

ELECTRONIC SAFETY BASIC REQUIREMENTS

- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- D. Provide miscellaneous supports required for installation of equipment, conduit and wiring.

3.11 PAINTING

- A. Confirm Painting requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 - 1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e. hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
 - 2. In electrical and mechanical room, on roof or other exposed areas, equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 3. See individual equipment Specifications for other painting.
 - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
 - 5. Conduit: Clean, primer coat and paint interior conduit exposed in finished areas with two coats paint suitable for metallic surfaces. Color selected by Architect.

3.12 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 - 1. Coordinate locations/sizes of access panels with Architect prior to work.

3.13 DEMOLITION

- A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In the absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 - 1. Scope:
 - a. It is the intent of these documents to provide necessary information and adjustments to electronic safety system required to meet code, and accommodate installation of new work.
 - b. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve underground utilities. Replace damaged items with new material to match existing.
 - c. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access, access to different areas. Owner will cooperate to best of their ability to assist in coordinated schedule, but will remain final authority as to time of work permitted.
 - 2. Examination:
 - a. Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to locate and preserve utilities. Replace damaged items with new material to match existing.
 - 3. Promptly notify Owner if systems are found which are not shown on Drawings.

ELECTRONIC SAFETY BASIC REQUIREMENTS

4. Execution:
 - a. Remove existing electronic safety equipment, devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless shown as retained or relocated on Drawings.
 - b. Provide temporary wiring and connections to maintain electrical continuity of existing systems during construction. Remove or relocate electrical boxes, conduit, wiring and equipment as encountered in removed or remodeled areas in existing construction affected by this work.
 - c. Remove and restore wiring which serves usable existing outlets clear of construction or demolition.
 - d. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, provide new conduit and wire to bypass abandoned outlets.
 - e. If existing conduits pass through partitions or ceiling which are being removed or remodeled, provide new conduit and wire to reroute clear of construction or demolition and maintain service to existing load.
 - f. Extend circuiting and devices in existing walls to be furred out.
 - g. Remove abandoned wiring to source of supply.
 - h. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
 - i. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
 - j. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
 - k. Remove abandoned wiring to leave site clean.
 - l. If existing electrical equipment contains PCBs (Polychlorinated Biphenyl), replace with new non-PCB equipment. Dispose of material containing PCBs as required by federal and local regulations.
 - m. Repair adjacent construction and finishes damaged during demolition work.
 - n. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
5. Existing Fire Alarm System: Maintain existing system in service during construction. Disable system only to make switchovers and connections.
 - a. Notify Owner before partially or completely disabling system.
 - b. Notify local fire service.
 - c. Make notifications at least 3 working days in advance.
 - d. Make temporary connections to maintain service in areas adjacent to work area.

3.14 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Cleaning
 - b. Operation and Maintenance Manuals
 - c. Training of Operating Personnel
 - d. Record Drawings

ELECTRONIC SAFETY BASIC REQUIREMENTS

- e. Warranty and Guaranty Certificates
- f. Start-up/test Documents and Commissioning Reports

3.15 FIELD QUALITY CONTROL

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 - 1. Tests:
 - a. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in Closeout Documents.
 - b. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

END OF SECTION

FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Fire Alarm Control Units
 - 2. Notification Appliance Circuit Panels
 - 3. Manual Pull Stations
 - 4. Fixed Temperature Heat Detectors
 - 5. Rate-of-Rise and Fixed Temperature Heat Detectors
 - 6. Photoelectric Type Detectors
 - 7. Duct-Mounted Smoke Detectors
 - 8. Relay Modules
 - 9. Control Modules
 - 10. Input Modules
 - 11. Fault Isolation Modules
 - 12. Combination Horn/Strobes
 - 13. Strobes
 - 14. Horns
 - 15. Miscellaneous Accessories
- B. Scope:
 - 1. Provide modification and extension of the existing fire alarm system to accommodate remodel.
- C. In addition, provide design for the following as required in these Contract Documents:
 - 1. Fire Alarm System modification and extension.
- D. System Design:
 - 1. Design Criteria:
 - a. These are Contractor designed systems. Contact AHJ prior to bid to verify systems' requirements. Design systems in compliance with code as interpreted by the AHJ.
 - 2. Design of Fire Alarm System:
 - a. Provide design of the fire alarm system as required by code.
 - b. In addition to code requirements, provide the following:
 - 1) Manual pull stations at exits.
 - 2) Smoke detection in halls and corridors and spaces open to halls and corridors.
 - 3) Audible fire alarm notification throughout building. Provide visible notification in public and common use areas.
 - c. Fire Alarm Sequence of Operation: Match Existing.
 - d. Supervisory Sequence of Operation: Match Existing.
 - e. Trouble Sequence of Operation: Match Existing.

1.2 RELATED SECTIONS

- A. Contents of Division 28, Electronic Safety and Security and Division 01, General Requirements apply to this Section.
- B. Division 26, Electrical requirements apply to this section.

FIRE DETECTION AND ALARM

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Division 28, Electronic Safety and Security and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NFPA 72, National Fire Alarm and Signaling Code, adopted edition.
 - 2. NFPA 70, National Electrical Code, adopted edition.

1.4 SUBMITTALS

- A. Submittals as required by Division 28, Electronic Safety and Security and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Shop drawings to include the following:
 - a. Provide system designer NICET certification number or Engineer's signature and seal on shop drawings.
 - b. Identification of system designer and evidence of qualification or certification of designer as required by AHJ.
 - c. Floor plans indicating walls, doors, partitions, room descriptions, device/component locations.
 - d. Ceiling height and ceiling construction details.
 - e. A symbol legend with device catalog number, description, back box size and mounting requirements.
 - f. Detailed riser diagram.
 - g. Device address adjacent to each device symbol. Notification appliance circuit and number adjacent to each notification appliance symbol.
 - h. Point to point wiring indicating the quantity and gauge of the conductors and size of conduit/raceway used.
 - i. Wiring connection diagrams for control equipment, annunciators, power supplies, chargers, initiating devices, notification appliances, components being connected to the system and interfaces to associated equipment.
 - j. Battery calculations for each battery backed fire alarm control unit.
 - k. Voltage drop calculations for each notification appliance circuit, indicating individual appliance current draw, conductor run length and size.
 - l. Complete sequence of operation.
 - 2. Prior to final acceptance, submit a letter confirming that inspections have been completed and system is installed and functioning in accordance with Specifications. Include manufacturer representative's certification of installation and letter of warranty.
 - 3. Operation and Maintenance Manuals. Provide manuals containing the following:
 - a. Catalog Cut Sheets
 - b. System Components, Initiating Devices and Notification Appliances' Installation Sheets
 - c. Manufacturer's Installation, Operation and Maintenance Manual
 - d. Program Data File Printout
 - e. Program Data File on Electronic Storage Media
 - f. Record Drawings
 - g. Record Drawings on Electronic Storage Media
 - h. One year warranty agreement including parts and labor. Warranty period begins upon date of completion.

FIRE DETECTION AND ALARM

- i. Record of Completion
- j. Test Reports
- k. Instruction Chart

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Division 28, Electronic Safety and Security and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. City of Portland, OR requirements, ordinances and amendments.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Division 28, Electronic Safety and Security and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fire Alarm Control Units:
 - 1. Notifier
 - 2. No substitutions permitted.
- B. Notification Appliance Circuit Panels:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. Alarmsaf
 - 3. Altronix
 - 4. Federal Signal
 - 5. Wheelock
 - 6. Or approved equivalent.
- C. Manual Pull Stations:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. No substitutions permitted.
- D. Fixed Temperature Heat Detectors:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. No substitutions permitted.
- E. Rate-of-Rise and Fixed Temperature Heat Detectors:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. No substitutions permitted.
- F. Photoelectric Type Detectors:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. No substitutions permitted.
- G. Duct-Mounted Smoke Detectors:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. No substitutions permitted.
- H. Relay Modules:

FIRE DETECTION AND ALARM

1. Same manufacturer as fire alarm control equipment.
 2. No substitutions permitted.
- I. Control Modules:
1. Same manufacturer as fire alarm control equipment.
 2. No substitutions permitted.
- J. Input Modules:
1. Same manufacturer as fire alarm control equipment.
 2. No substitutions permitted.
- K. Fault Isolation Modules:
1. Same manufacturer as fire alarm control equipment.
 2. No substitutions permitted.
- L. Combination Horn/Strobes:
1. Must be compatible with fire alarm control equipment and notification appliance circuit panels.
 2. Same manufacturer as fire alarm control equipment.
 3. System Sensor
 4. Or approved equivalent.
- M. Strobes:
1. Must be compatible with fire alarm control equipment and notification appliance circuit panels.
 2. Same manufacturer as fire alarm control equipment.
 3. System Sensor
 4. Or approved equivalent.
- N. Horns:
1. Must be compatible with fire alarm control equipment and notification appliance circuit panels.
 2. Same manufacturer as fire alarm control equipment.
 3. System Sensor
 4. Or approved equivalent.
- O. Miscellaneous Accessories:
1. Weatherproof/Surface Backboxes:
 - a. Same manufacturer as fire alarm detection devices or notification appliances.
 - b. Or approved equivalent.
 2. Circuit Conductors:
 - a. Allied Wire and Cable
 - b. Belden
 - c. CCI
 - d. West Penn Wire
 - e. Or approved equivalent.
 3. Surge Protection:
 - a. Ditek
 - b. Transtector
 - c. Or approved equivalent.
 4. Batteries:

FIRE DETECTION AND ALARM

- a. Same manufacturer as fire alarm control equipment.
 - b. Power-Sonic
 - c. Werker
 - d. Or approved equivalent.
 - 5. Locks and Keys:
 - a. Same manufacturer as fire alarm control equipment.
 - b. Or approved equivalent.
 - 6. Instruction Charts:
 - a. Confirm make and model with architect prior to ordering.
 - 7. Framed Floor Map:
 - a. Confirm make and model with architect prior to ordering.
 - P. Substitutions:
 - 1. For other acceptable manufacturers of specified control units, submit product data showing equivalent features and compliance with Contract Documents.
 - 2. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with contract documents.
 - Q. Equipment to be supplied by a certified manufacturer representative.
- 2.2 FIRE ALARM CONTROL UNITS
- A. Existing Notifier Model NFS-320.
 - B. Program Software:
 - 1. Programmed control point activation includes selective control of HVAC and other fire safety and auxiliary functions.
 - C. Power Supply: Provide power supply(s), adequate to serve control panel modules, remote annunciators, addressable devices, notification appliances and other connected devices.
 - D. Addressing: Provide each initiating device with its own discrete address.
- 2.3 NOTIFICATION APPLIANCE CIRCUIT PANELS
- A. Provide power supply(s), adequate to serve modules, remote annunciators, addressable devices, notification appliances and other connected devices or appliances.
 - B. Loss of normal and emergency power automatically causes system to transfer to battery power. Indicate battery power operation by yellow lamp and audible annunciation at control panel and remote annunciator panels. Upon return of 120VAC power, unit recharges batteries to full capacity and maintains battery on float charge. Provide trickle charge adequate capacity to maintain battery fully charged with automatic rate charge.
 - C. Provide batteries in locking cabinet manufactured for purpose.
- 2.4 MANUAL PULL STATIONS
- A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.
 - B. Semi-flush, red finish, nongrasping operation; maximum pull strength as allowed per ADA criteria.

FIRE DETECTION AND ALARM

- C. Stations do not allow closure without keyed reset.

2.5 FIXED TEMPERATURE HEAT DETECTORS

- A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.
- B. Rated 135 degrees F or 190 degrees F as required by space use.
- C. Provide off-white, low-profile detectors.

2.6 RATE-OF-RISE AND FIXED TEMPERATURE HEAT DETECTORS

- A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.
- B. Responding to 15 degrees F temperature rise per minute and to 135 degrees F fixed temperature as required by space use.
- C. Provide off-white, low-profile detectors.

2.7 PHOTOELECTRIC TYPE DETECTORS

- A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.
- B. Panel adjustable sensitivity, LED source, multiple cell, 360 degree smoke entry, visual latching operation indicator, insect screen, functional test switch, two-wire operation and vandal-resistant locking feature.

2.8 DUCT-MOUNTED SMOKE DETECTORS

- A. Photoelectric type. Duct sampling tubes extending width of duct, visual indication of detector actuation, direct housing mount. Detector powered from control panel, power on indicator light. Detector rated for air velocity, humidity and temperature of duct and environment where installed.

2.9 RELAY MODULES

- A. Signaling line circuit interface module that connects to other building systems for control of fire/life safety functions, e.g., air-handler shutdown, fire/smoke damper closure, elevator recall.
- B. Module powered from control panel.

2.10 CONTROL MODULES

- A. Signaling line circuit interface module that provides notification appliance circuits or system control outputs.
- B. Module powered from control panel.

2.11 INPUT MODULES

- A. Signaling line circuit interface module that provides initiating device circuits for connection to contact closure initiating devices.

FIRE DETECTION AND ALARM

- B. Module powered from control panel.
- 2.12 FAULT ISOLATION MODULES
- A. Signaling line circuit interface modules that provide isolation of wire-to-wire shorts on a signaling line circuit with automatic reconnection upon correction of short circuit.
 - B. Provide module with status indicator LED.
- 2.13 COMBINATION HORN/STROBES
- A. Multi-candela, flush wall and ceiling mount, white finish, insect-proof.
 - B. Provide horn/strobes that meet the latest requirements of NFPA 72, ANSI 117.1 and UL 1971. Candela rating as required by NFPA 72.
- 2.14 STROBES
- A. Multi-candela, flush wall and ceiling mount, white finish, insect-proof.
 - B. Provide strobes that meet the latest requirements of NFPA 72, ANSI 117.1 and UL 1971. Candela rating as required by NFPA 72.
- 2.15 HORNS
- A. Flush wall and ceiling mount, white finish, insect-proof.
 - B. Provide horns that meet the latest requirements of NFPA 72.
- 2.16 MISCELLANEOUS ACCESSORIES
- A. Circuit Conductors: Copper or optical fiber; color code and label. Type FPL, FPLR and FPLP as required by NEC. Minimum signaling line circuit and initiating device circuit wire size: AWG18. Minimum notification appliance circuit wire size: AWG14, or as approved by Engineer. Fiber optic cable as required by manufacturer.
 - B. Surge Protection: In accordance with IEEE C62.41 B3 combination waveform and NFPA 70; except for optical fiber conductors.
 - C. Batteries: Sealed lead acid type. Provide additional cabinet, if required due to space limitations in control panels.
 - D. Locks and Keys:
 - 1. Deliver keys to Owner.
 - 2. Provide same standard lock and key for each key operated switch and lockable panel and cabinet; provide five keys of each type.
 - E. Instruction Charts:
 - 1. Printed instruction chart for operators, showing steps to be taken when signal is received (normal, alarm, supervisory and trouble); easily readable from normal operator's station.
 - 2. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
 - F. Framed Floor Map:
 - 1. Provide framed floor plan of facility.

FIRE DETECTION AND ALARM

2. Frame: Stainless steel or aluminum with polycarbonate or glass cover.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Obtain Architect's approval of locations of devices, appliances and annunciators before installation.
- B. Circuits:
 1. Signaling Line Circuits (SLC): Class B
 2. Notification Appliance Circuits (NAC): Class B.
- C. Spare Capacity:
 1. Notification Appliance Circuits: Minimum 25 percent spare current capacity. Utilize UL maximum current draw values for notification appliances. Maximum 10 percent voltage drop.
 2. Signaling Line Circuit: Minimum 25 percent spare capacity.
- D. Power Sources:
 1. Primary: Dedicated branch circuits of facility power distribution system.
 2. Secondary: Storage batteries.
 3. Capacity: Sufficient to operate fire alarm system under normal supervisory condition for 24 hours and operate alarm signals for five minutes at end of standby period.
- E. Obtain approval of system design from AHJ prior to installation. Do not begin installation without approval from AHJ and submittal review comments from Engineer.
- F. Install in accordance with applicable codes, NFPA 72, NFPA 70 and the Contract Documents.
- G. In accordance with manufacturer's instructions, provide wiring, conduit and outlet boxes required for the erection of a complete system as described in these specifications, as shown on Drawings and as required by AHJ.
- H. Conceal wiring, conduit, boxes and supports where installed in finished areas.
- I. Provide raceway system for cabling concealed in walls and hard ceilings and in locations where cabling is exposed. Where exposed, provide surface raceway in finished areas and surface mounted EMT in non-finished areas.
- J. Provide cabling and conduits system suitable for wet locations for below grade systems.
- K. At junction boxes and termination points, provide identification tags on wires and cables.
- L. Route wiring to avoid blocking access to equipment requiring service, access, or adjustment.
- M. Fire Safety Systems Interfaces:
 1. Fire Safety Functions: Provide power and control conduit, wiring, boxes and terminations to power devices and interface to fire alarm system.
 - a. Doors:
 - 1) Provide smoke detectors and addressable control relays to release magnetic hold open devices and roll-down fire doors and door locks. Verify requirements and quantities prior to bidding.

FIRE DETECTION AND ALARM

- 2) Smoke Barrier Door Magnetic Holders: Release upon activation of smoke detectors in smoke zone on either side of door.
 - 3) Electronic Locks or Electromagnetic Door Locks on Egress Doors: Unlock smoke zone egress doors upon activation of any alarm initiating device or suppression system in smoke zone.
 - 4) Overhead Coiling Fire Doors: Release upon activation of smoke detectors on either side of door.
 - b. HVAC Systems:
 - 1) Fire/Smoke Dampers and Smoke Dampers:
 - (a) Provide required smoke detectors, relays, wiring and the like.
 - (b) Connect control and power wiring to dampers per manufacturer's instructions.
 - (c) Verify quantities, location and requirements of dampers with Division 23, HVAC Drawings and Specifications and mechanical system installer.
 - 2) Air Moving Systems:
 - (a) Provide duct-mounted smoke detectors on air systems with air flow rates exceeding 2000 CFM. Coordinate with Division 23, HVAC.
 - (b) Install duct-mounted smoke detector(s) on return side of air system.
 - (c) Provide control wiring from addressable relay contacts to air handling equipment controller. Connect to controller so that when duct-mounted smoke detector is activated, the air handling equipment is shut down.
 - (d) Provide duct-mounted smoke detectors rated for air velocity, temperature and humidity of duct. Verify quantities, locations and requirements with Division 23, HVAC Drawings and mechanical system installer.
 - (e) Where duct-mounted smoke detectors are mounted in inaccessible building void spaces provide access hatch. Provide access hatch with fire rating equivalent to rating of wall, ceiling, or shaft being penetrated.
- N. Inspection and Testing for Completion:
- 1. System testing and commissioning to be performed by a certified manufacturer representative.
 - 2. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.
 - 3. Document audibility measurements and verify intelligibility for each space on record drawings.
 - 4. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction and adjustments.
 - 5. Provide tools, software and supplies required to accomplish inspection and testing.
 - 6. Prepare for testing by ensuring that work is complete and correct; perform preliminary tests as required to test system.
 - 7. Correct defective work, adjust for proper operation and retest until entire system complies with Contract Documents.
 - 8. Notify Owner seven days prior to beginning completion inspections and tests.
 - 9. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

FIRE DETECTION AND ALARM

10. Diagnostic Period: After successful completion of inspections and tests, operate system in normal mode for at least 14 days without any system or equipment malfunctions.
 - a. Record all system operations and malfunctions.
 - b. If a malfunction occurs, start diagnostic period over after correction of malfunction.
 - c. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.
 - d. At end of successful diagnostic period, complete and submit NFPA 72 "Inspection and Testing Form."
- O. Owner Personnel Instruction:
 1. Provide the following instruction to designated Owner personnel:
 - a. Hands-On Instruction: On-site, using operational system.
 - b. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.
 2. Basic Operation: One-hour sessions for attendant personnel, security officers and engineering staff; combination of classroom and hands-on:
 - a. Initial Training: One session pre-closeout.
 - b. Refresher Training: One session post-occupancy.
 3. Detailed Operation: Two-hour sessions for engineering and maintenance staff; combination of classroom and hands-on:
 - a. Initial Training: One session pre-closeout.
 - b. Refresher Training: One session post-occupancy.
 4. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data and record drawings available during instruction.
 5. Provide means of evaluation of trainees suitable to type of training given; report results to Owner.
- P. Closeout:
 1. Closeout Demonstration:
 - a. Demonstrate proper operation of functions to Owner.
 - b. Be prepared to conduct any of the required tests.
 - c. Have at least one copy of operation and maintenance data, copy of project record drawings, input/output matrix and operator instruction chart(s) available during demonstration.
 - d. Have authorized technical representative of control unit manufacturer present during demonstration.
 - e. Demonstration may be combined with inspection and testing required by AHJ. Notify AHJ in time to schedule demonstration.
 - f. Repeat demonstration until successful.
 2. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
 - a. Specified diagnostic period without malfunction has been completed.
 - b. Approved operating and maintenance data has been delivered.
 - c. Spare parts, extra materials and tools have been delivered.
 - d. All aspects of operation have been demonstrated to Architect.
 - e. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
 - f. Occupancy permit has been granted.
 - g. Specified pre-closeout instruction is complete.
 3. Perform post-occupancy instruction within three months after date of occupancy.

FIRE DETECTION AND ALARM

3.2 FIRE ALARM CONTROL UNITS

- A. Perform system programming at the fire alarm control panel. Program the system without shutting the system down. Programming is done off line. Update and maintain hard copy and CD-ROM copy of program at the site.
- B. Room Name Labeling: Control unit schedules, programming and labeling for electrical equipment, to use the room names and room numbers that the Architect adopts at the date of substantial completion of construction. This work is to be done at no added cost to the Owner.

3.3 NOTIFICATION APPLIANCE CIRCUIT PANELS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide notification appliance circuit panel power supplies with 120VAC dedicated circuit per NFPA requirements.
- D. Do not install cabinets or equipment below the battery cabinet. Do not locate battery and charging system cabinets in ceiling space.

3.4 MANUAL PULL STATIONS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.
- D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.5 FIXED TEMPERATURE HEAT DETECTORS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.
- D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.6 RATE-OF-RISE AND FIXED TEMPERATURE HEAT DETECTORS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.
- D. Provide protective guard where device is subject to abuse and where required by AHJ.

FIRE DETECTION AND ALARM

3.7 PHOTOELECTRIC TYPE DETECTORS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.
- D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.8 DUCT-MOUNTED SMOKE DETECTORS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

3.9 RELAY MODULES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

3.10 CONTROL MODULES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

3.11 INPUT MODULES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

3.12 FAULT ISOLATION MODULES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

FIRE DETECTION AND ALARM

- D. Provide Fault Isolator Modules for signaling line circuit per code requirements and manufacturer instructions.

3.13 COMBINATION HORN/STROBES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed labels on notification appliances with appliance circuit number and sequence. Labels to be visible from the floor without magnification.
- D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.14 STROBES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed labels on notification appliances with appliance circuit number and sequence. Labels to be visible from the floor without magnification.
- D. Provide wire guards or protective covers where device is subject to abuse and where required by AHJ.

3.15 HORNS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed labels on notification appliances with appliance circuit number and sequence. Labels to be visible from the floor without magnification.
- D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.16 MISCELLANEOUS ACCESSORIES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Weatherproof/Surface Backboxes: Provide manufacturer's weatherproof backbox listed for use in areas where the device or appliance is subject to humidity in excess of listed rating. Provide manufacturer surface backboxes where devices cannot be installed recessed.
- D. Protective Guard:
 - 1. Wire Guard.
 - 2. Protective Cover.
- E. Circuit Conductors: Provide wiring to meet the requirements of national, state and local electrical codes. Provide color coded wiring as recommended and specified by the fire alarm and detection system manufacturer. Provide Type FPLR cable when in a riser application or FPLP cable when installed in plenums.

FIRE DETECTION AND ALARM

- F. Surge Protection:
 - 1. Equipment Connected to Alternating Current Circuits: Maximum let through voltage of 350 V(ac), line-to-neutral and 350 V(ac), line-to-line; do not use fuses.
- G. Instruction Charts: Install chart adjacent to fire control unit.
- H. Framed Floor Map: Provide framed floor plan of facility adjacent to the annunciator panel identifying room names/numbers, device/addresses or fire zone number and description as utilized on the annunciator panel, as required by local AHJ. Check with the local fire department for size and approved mounting location.

END OF SECTION