

NICK FISH TENANT IMPROVEMENT MERKATO

PROJECT MANUAL - VOLUME 2 OF 2
SPECIFICATIONS DIVISIONS 21 - 33

100% CD

MAY 08, 2026



SALAZAR
ARCHITECT

THIS PAGE INTENTIONALLY BLANK

SECTION 00 01 00 - SPECIFICATIONS TABLE OF CONTENTS

PROJECT MANUAL - VOLUME 1 OF 2

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

00 01 00 Specifications Table of Contents

DIVISION 01 - GENERAL REQUIREMENTS

01 10 00 Summary
01 20 00 Price and Payment Procedures
01 25 00 Product Substitution Procedures
01 25 00.01 Substitution Request Form, Bid Phase
01 25 00.02 Substitution Request Form, CA Phase
01 26 00 Contract Modification Procedures
01 30 00 Administrative Requirements
01 31 00 Project Management and Coordination
01 32 16 Construction Progress Schedule
01 33 00 Submittal Procedures
01 40 00 Quality Requirements
01 42 19 Reference Standards
01 50 00 Temporary Facilities and Controls
01 57 22 Construction Indoor Air Quality
01 60 00 Product Requirements
01 61 16 Delegated Design Requirements
01 70 00 Execution and Closeout Requirements
01 74 19 Construction Waste Management and Disposal
01 78 00 Closeout Submittals
01 79 00 Demonstration and Training
01 81 13 Sustainability Requirements

DIVISION 02 - EXISTING CONDITIONS

– NOT USED –

DIVISION 03 - CONCRETE

03 30 00 Cast-in-Place Concrete
03 35 43 Polished Concrete Floor Finishing

DIVISION 04 - MASONRY

– NOT USED –

DIVISION 05 - METAL

05 50 00 Metal Fabrications

DIVISION 06 - WOOD AND PLASTIC

06 10 00 Rough Carpentry

06 20 23 Interior Finish Carpentry

06 41 00 Architectural Casework

06 61 19 Quartz Surfacing Fabrications

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 21 00 Thermal Insulation

07 84 13 Penetration Firestopping

07 92 00 Joint Sealants

DIVISION 08 - OPENINGS

08 11 13 Hollow Metal Doors and Frames

08 14 16 Flush Wood Doors

08 31 13 Access Doors and Frames

08 38 00 Double Acting Impact Traffic Doors

08 71 00 Door Hardware

08 71 00.01 Door Hardware Index

08 80 00 Glazing

DIVISION 09 - FINISHES

09 22 16 Non-Structural Metal Framing

09 29 00 Gypsum Board

09 30 00 Tiling

09 51 13 Acoustical Panel Ceilings

09 65 00 Resilient Flooring

09 65 13 Resilient Base and Accessories

09 67 23 Resinous Flooring

09 84 33 Sound-Absorbing Wall Panels

09 91 00 Painting

DIVISION 10 - SPECIALTIES

10 11 00 Visual Display Units

10 14 00 Signage

10 14 19 Dimensional Letter Signage

10 26 00 Wall Protection

10 26 23 Wall and Door Protection

10 28 00	Restroom and Custodial Accessories
10 43 13	Defibrillator Cabinets
10 44 13	Fire Protection Cabinets
10 44 16	Fire Extinguishers
10 57 23	Closet and Utility Shelving

DIVISION 11 - EQUIPMENT

11 40 00	Foodservice Equipment
----------	-----------------------

DIVISION 12 - FURNISHINGS

12 24 13	Roller Window Shades
----------	----------------------

DIVISION 13 - SPECIAL CONSTRUCTION

– NOT USED –

DIVISION 14 - CONVEYING EQUIPMENT

– NOT USED –

PROJECT MANUAL - VOLUME 2 OF 2**DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS**

00 01 00	Specifications Table of Contents
----------	----------------------------------

DIVISION 21 - FIRE SUPPRESSION

21 13 00	Fire Suppression Sprinkler System
----------	-----------------------------------

DIVISION 22 - PLUMBING

22 05 00	Plumbing Materials and Methods
22 07 00	Plumbing Insulation
22 10 00	Plumbing Piping and Pumps
22 30 00	Plumbing Equipment
22 40 00	Plumbing Fixtures

DIVISION 23 - HEATING VENTILATING AND COOLING

23 01 00	HVAC Design Requirements
23 05 00	HVAC Materials and Methods
23 05 90	Testing, Adjusting, and Balancing
23 07 00	HVAC Insulation
23 11 23	Facility Fuel Gas Systems
23 31 00	HVAC Ducts and Casings
23 34 00	HVAC Fans

23 80 00 Terminal HVAC Equipment

DIVISION 26 - ELECTRICAL

26 05 00 Common Work Results for Electrical
26 05 19 Electrical Power Conductors and Cables
26 05 20 Nonmetallic-Sheathed Cables
26 05 26 Grounding and Bonding for Electrical Systems
26 05 29 Hangers and Supports for Electrical Systems
26 05 33 Raceway and Boxes for Electrical Systems
26 05 53 Identification for Electrical Systems
26 24 16 Panelboards
26 27 26 Wiring Devices
26 50 00 Lighting

DIVISION 27 - COMMUNICATIONS

– NOT USED –

DIVISION 28 - ELECTRICAL SAFETY AND SECURITY

– NOT USED –

DIVISION 31 - EARTHWORK

– NOT USED –

DIVISION 32 - EXTERIOR IMPROVEMENTS

– NOT USED –

DIVISION 33 - UTILITIES

– NOT USED –

END OF TABLE OF CONTENTS

THIS PAGE INTENTIONALLY BLANK

SECTION 21 13 00 - FIRE SUPPRESSION SPRINKLER SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

- A. The provisions of the General Requirements, Supplementary Requirements, and Division 1 apply to the plumbing work specified in this Division.
- B. The requirements of this section apply to the fire suppression system including special systems required for solar battery storage room.
- C. Provide all items, articles, materials, equipment, operations and/or methods listed, mentioned, shown and/or scheduled on the Drawings and/or in these Specifications, including all design, labor, supervision, services, permits, fees, and incidentals necessary and required to provide a complete and operable facility with complete systems as shown, specified, and required by applicable codes. Provide all labor and material and perform such other services necessary and reasonably incidental to the design and installation of an automatic sprinkler and standpipe system for all areas indicated on the Drawings and as required by the Governing Agency.

1.2 QUALITY ASSURANCE

- A. Contractor Qualifications:
 - 1. Established fire protection contractor regularly engaged in the design and installation of automatic fire sprinkler systems.
 - 2. Employ workers experienced and skilled in this trade.
 - 3. System Designer: Qualified and certified for the design of fire protection sprinkler systems. NICET level III or IV technician or Professional Engineer experienced in the design of sprinkler systems.
- B. Governing Agency: All work in accordance with and accepted by the following hereafter referred to Governing Agencies:
 - 1. State of Oregon Fire Marshal.
 - 2. City of Portland, Oregon Fire Marshal.
- C. Design Requirements:
 - 1. Comply with the latest issue of NFPA Standard 13.
 - 2. Design, lay out and install hydraulically calculated wet and dry pipe systems, including standpipes, utilizing code approved automatic devices designed particularly for use in this type of system.
 - 3. Provide hydraulic calculation methods design data information in accordance with NFPA 13. Include all friction losses from point of flow test to remote sprinkler area.
 - 4. Fire Sprinkler Coverage: As required by the Governing Agency and including fire protection of all areas including the following:
 - a. Exterior canopies of combustible construction.
 - b. Covered decks and patios.
 - c. Covered parking areas.
 - d. Attic spaces of combustible construction.
 - e. Window wash sprinklers at exposures.

- f. Solar Battery Storage room.
 - 5. Occupancy Hazard: Occupancy Hazard designation in accordance with the Governing Agency requirements, including special hazard for solar battery storage room.
 - 6. Seismic Restraint: Include load calculations for seismic restraints.
 - 7. Contractor shall review all drawings and determine where unheated spaces, concealed combustible spaces, overhead doors, or similar special conditions exist and provide sprinkler protection as required.
 - 8. Revisions to the Contractor's design required by the Governing Agency shall be at the Contractor's expense.
- D. Acceptable Manufacturers: All sprinkler specialty material by Reliable, Globe, Tyco, Viking, Automatic Sprinkler Corp. of America with UL or FM approval for use in automatic sprinkler systems. All materials and equipment suitable for 175 psi working pressure.
- E. Field Wiring: It is the intent of these specifications that all systems shall be complete and operable. Refer to all drawings and specifications, especially the electrical drawings, to determine voltage, phase, circuit ampacity and number of connections provided. Provide all necessary field wiring and devices from the point of connection indicated on the electrical drawings. All equipment shall be installed in compliance with the Electrical Code and the equipment's UL listing. Bring to the attention of the Architect in writing, all conflicts, incompatibilities, and/or discrepancies prior to bid or as soon as discovered.
- 1.3 WORK OF OTHER CONTRACTS
- A. Work under this contract shall be conducted in a manner to allow for the future installations of such equipment or items listed in other sections of this Specification.
- 1.4 WORK OF OTHER DIVISIONS
- A. Work under this Division shall be conducted in a manner to cooperate with the installation of such equipment or items as specified in other Divisions.
- B. Consult all Drawings and Specifications in this project and become familiar with all equipment to be installed. Coordinate all aspects of the construction with the other trades on the job to ensure that all work and materials required to provide a complete and operational facility are included in the bid.
- 1.5 SUBMITTALS
- A. Working Drawings:
- 1. Prepare fire protection system working drawing showing locations and types of heads or outlets, alarm valves and devices, pipe sizes and cutting lengths, test tees and valves, drain valves, and other related items. Include pipe nodes and remote areas referenced in the calculations. Plans shall be stamped and signed by the responsible certified designer. Plans shall be completed using CAD.
 - 2. Prepare drawings identifying and detailing all penetrations of structural elements. All such penetrations shall be reviewed and approved by the structural engineer prior to proceeding with installation drawings.
 - 3. Provide 3 sets of drawings showing sprinkler head locations and layout coordinated with architectural ceiling details to the Architect for review prior to submitting details to the Governing Agencies.
 - 4. Provide 6 sets of drawings to the Architect to be provided to Insurance Underwriter for approval.

-
5. Provide 6 sets of drawings to designated representatives of the Fire Marshal for approval.
 6. Then provide 6 sets of approved Drawings to the Architect for final review.
- B. Submittals: Provide submittals for the following products.
1. Sprinkler Heads: Product Data for each type of head.
 2. Alarm flow or pressure switches.
 3. Fire department connection.
 4. System control valves and trim.
 5. Piping supports and braces.
 6. Piping materials.
 7. Alarm bell.
 8. Standpipe components.
 9. Air compressor or air maintenance device.
 10. Miscellaneous Equipment.
 11. Double detector check backflow preventer with remote reader.
- C. Test Reports: Submit certificates of completion of tests and inspections.
- 1.6 EXTRA STOCK
- A. Additional Heads: Provide number, type and temperature rating installed as required to meet NFPA 13 requirements.
- B. Storage Cabinet: Provide as required to receive reserve sprinkler heads and special installation tools required.
- C. Index Label: Provide for each head indicating manufacturer, model, orifice, size or K-factor, and temperature rating. Also provide inside cabinet a list of heads stored within and brief description of where installed.
- 1.7 WARRANTY
- A. Furnish, prior to application for final payment, three copies of written and signed guarantee effective a period of one year from date of completion and acceptance of entire project; agree to correct, repair and/or replace defective materials and/or equipment or the results of defective workmanship without additional expense to the Owner. Where no response satisfactory to the Owner has occurred within three working days from the written report of a warranty covered defect, the contractor shall agree to pay for the cost of repair of the reported defect by a contractor of the Owner's choice.
- B. Where the manufacturer's guarantee exceeds one year, the longer guarantee shall govern and include the Contractor's labor.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Miscellaneous Sprinkler Specialties: Complete system including all items required by the Governing Agency including but not limited to:
1. Electric alarm switch and indoor and outdoor alarm bell or horn/strobe.

2. Valve monitoring switches with two outputs (one to fire alarm & one to sprinkler bell).
 3. Wiring from the alarm switches to the point of connection in the Fire Alarm Control Panel. Coordinate with the Electrical Work specified in Division 28.
- B. Sprinkler Heads: Approved heads with temperature ratings required for service indicated.
1. Unfinished Areas: Upright, pendant or sidewall spray type, plain bronze.
 2. Finished Areas: White flush concealed ceiling and sidewall heads in finished ceilings, walls, and soffits with white escutcheons. Where piping is exposed use chrome plated upright heads.
 3. Dry pendant or dry sidewall heads for small areas subject to freezing and for pendant heads on dry pipe systems.
 4. Exterior Areas: Bronze heads, field paint escutcheons at exterior locations to match adjacent surfaces.
- C. System Piping:
1. Underground Water Piping: Ductile cast iron water pipe; ANSI A-21.51; with mechanical joints, ANSI A-21.10 and ANSI A21.11; and with concrete thrust blocks as detailed on the Drawings.
 2. At contractor's option, one piece type 304 stainless steel, factory fabricated and tested sprinkler riser may be used.
 3. Above Ground Water Piping: Use standard weight (schedule 40) black steel pipe ASTM A53, A135, or A795, and cast iron screwed or mechanical joint fittings especially adapted and approved for sprinkler work. Use reducing fittings where changes in pipe size occur. Bushings are prohibited. Provide galvanized pipe for dry systems.
 4. At Contractor's option, Schedule 10 black steel pipe ASTM A135 or ASTM A795, and mechanical joint fittings specifically approved for sprinkler use, may be substituted for the black steel pipe specified above. Pipe shall be UL listed and FM approved for 300 psi working pressure. Pipe must have a CRR of 1.00 or greater. Provide galvanized pipe for dry systems.
 5. At contractor's option, in accordance with code and upon approval of the authority having jurisdiction, approved plastic fire sprinkler piping materials may be used.
 6. At contractor's option, flexible sprinkler head drops may be used in lieu of rigid piping. Hose assembly shall be UL listed and FM approved. Ceiling attachment bracket shall be seismically certified. Hose assembly constructed of fully welded corrugated stainless steel hose with stainless steel overbraid with threaded stainless steel pipe fittings. No gaskets, O-rings, flares, or similar mechanical joints permitted.
- D. Pipe Escutcheons: Provide polished chrome escutcheons on pipe extending through finished walls and ceilings, oversized to meet seismic requirements.
- E. Valves: UL and/or FM listed for fire protection service.
1. Iron body OS&Y pattern, bronze mounted double disc, parallel seat.
 2. Iron body butterfly style with EPDM liner, bronze disc with indicating type gear operator.
 3. Bronze body ball valve, three-piece design, with approved operator.
 4. Where required by Governing Agency, provide wall or post style indicating valves.
 5. Standpipe Valves: Angle or straight pattern rough chrome gate valve with cap and retaining chain.

- F. Valve Monitoring Switches: Provide approved monitoring switches where required by Governing Agency. In vaults and other areas where flooding conditions may occur, provide submersible type switches.
- G. Sprinkler Guards: Standard manufacture.
- H. Floor Control Station: Assembly consisting of shutoff valve with tamper switch, flow switch, test valve and drain valve.
- I. Water Service Connection Backflow Preventer:
 - 1. Connect to fire water service with code approved double check valve assembly made up of two internally spring loaded check valves, indicating monitored shut-off valves and test cocks -see civil plans.
 - 2. When required by serving utility, include a smaller bypass double check assembly and meter with remoter readout.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Connect to water supply source as shown on Drawings, check adequacy, and call any deficiency to attention of Architect. Verify underground piping has been flushed. Coordinate with work in Division 22 and 33.
- B. Install all piping in a true and even manner with lines pitched for drainage and system arranged so that it can be entirely emptied of water. Install hangers at all branch line connections to cross mains and at all other points as required in NFPA standards.
- C. Support all pipe work from building construction with mild steel hangers spaced not more than 12 feet on centers. Support mains independently of branches, and in no case shall branch hangers assume any portion of the weight of mains. Do not bend hanger rods. Provide seismic restraints and flexible connections in accordance with building code requirements.
- D. Do not drill or punch flanges of beams, purlins, joists, etc. for hangar attachment without written permission from the structural engineer. Coordinate with the structural engineer for written criteria for drilling of holes in joists and beams for passage of sprinkler piping.
- E. Locate sprinkler heads in repeating, modular pattern, centered and accurately coordinated with ceiling grid as indicated. Conceal all piping unless indicated otherwise. Coordinate design with lighting and exposed HVAC duct layout in areas without ceilings.
- F. Maintain clearances between sprinkler heads and ceiling mounted items such as light fixtures. Use of pendant sprinklers to reduce clearances will not be permitted.
- G. Flexible sprinkler head drops, including attachment brackets, shall be installed in accordance with the manufacturer's instructions and approvals.
- H. Locate and install the required fire sprinkler alarm flow switch, relief valve, and test and drain valves where required by the Governing Agency. Identify valves with approved permanent placard.
- I. Provide a listed, supervised shutoff valve and a pressure gauge in each riser. A backflow preventer assembly may serve as the shutoff valve when located in the riser room. Mount hydraulic calculation placard in visible location on each riser.

- J. Securely anchor the air compressor in place and connect to the dry pipe valve with rigid piping and a braided/corrugated flexible stainless steel connector.

3.2 TEST

- A. Test all pipes to a hydrostatic pressure of 200 psi and maintain for four hours minimum. Perform other tests as directed by Governing Agency.

3.3 PAINT

- A. All exposed piping and hangers shall be painted under Division 9.
- B. Do not paint sprinklers.

3.4 CERTIFICATE OF COMPLETION

- A. Obtain and deliver to Owner a certificate, in duplicate, stating that system as installed has been inspected and accepted by authorities and/or agencies having jurisdiction, and that all regulations affecting work have been satisfied. Submit an acceptable certificate to the Owner before final payment is requested.
- B. Certificate: Minimum NFPA Figure 24.1 information per NFPA 13.

END OF SECTION 21 13 00

SECTION 22 05 00 - PLUMBING MATERIALS AND METHODS

PART 1 GENERAL

1.1 DESCRIPTION

- A. The provisions of the General Requirements, Supplementary Requirements, and Division 1 apply to the plumbing work specified in this Division.
- B. The requirements of this Section apply to the plumbing systems specified in these Specifications and in other Division 22 sections.
- C. Provide all items, articles, materials, equipment, operations and/or methods listed, mentioned, shown and/or scheduled on the Drawings and/or in these Specifications, including all labor, supervision, services, permits, fees, and incidentals necessary and required to provide a complete and operable facility with complete systems as shown, specified, and required by applicable codes.
- D. The work shall include, but not be limited to, the following systems:
 - 1. Water and sanitary sewer service complete per serving utility company requirements.
 - 2. Service and distribution piping including valves, supports, insulation, etc.
 - 3. Complete plumbing systems, including fixtures, trim, equipment, etc.
 - 4. Rough-in and final connection of plumbing equipment and fixtures furnished under other Divisions of this Specification.
 - 5. Special systems as specified herein.
- E. Advise subcontractor, suppliers, and vendors involved in the work specified in this Section of the applicable requirements.

1.2 QUALITY ASSURANCE

- A. All work and materials shall conform to all applicable local and state codes and all federal, state and other applicable laws and regulations. All clarifications and modifications which have been cleared with appropriate authorities are listed under the applicable sections. All electrical products shall bear the label of a recognized testing laboratory such as UL or CSA.
- B. Whenever the requirements of the Specifications or Drawings exceed those of the applicable code or standard, the requirements of the Specifications and Drawings shall govern.
- C. Codes and Standards: Comply with the provisions of the following referenced codes, standards and specifications:
 - 1. Federal Specifications (FS)
 - 2. American National Standards Institute (ANSI)
 - 3. National Electrical Manufacturer's Association (NEMA)
 - 4. National Fire Protection Association (NFPA)
 - 5. Underwriters Laboratories, Inc. (UL)
 - 6. Factory Mutual (FM)
 - 7. International Building Code (IBC) with State and Local Amendments
 - 8. International Mechanical Code (IMC) with State and Local Amendments

-
9. Uniform Plumbing Code (UPC) with State and Local Amendments
 10. American Society for Testing and Materials (ASTM)
 11. Americans with Disabilities Act (ADA)
 12. International Fire Code (IFC) with State and Local Amendments
 13. Energy Policy Act (EPAct)
 14. Manufacturers Standardization Society (MSS)
 15. National Sanitation Foundation (NSF)
 16. American Gas Association (AGA)
- D. Each piece of equipment furnished shall meet all detailed requirements of the Drawings and Specifications and shall be suitable for the installation shown. Equipment not meeting all requirements will not be acceptable, even though specified by name. Where two or more units of the same class of equipment are furnished, use product of the same manufacturer; component parts of the entire system need not be products of same manufacturer. Furnish all materials and equipment, new and free from defect and of size, make, type and quality herein specified or approved by the Architect. All materials shall be installed in a neat and professional manner.
- E. All apparatus shall be built and installed to deliver its full rated capacity at the efficiency for which it was designed.
- F. The Drawings and Specifications are complementary. What is called for by one shall be as though called for by both.
- G. Drawings: Do not scale drawings for roughing-in measurements, nor use as shop drawings. Make field measurements and prepare shop drawings as required. Coordinate work with shop drawings of other specification divisions.
- H. Field Wiring: It is the intent of these specifications that all systems shall be complete and operable. Refer to all drawings and specifications, especially the electrical drawings, to determine voltage, phase, circuit ampacity and number of connections provided. Provide all necessary field wiring and devices from the point of connection indicated on the electrical drawings. All equipment shall be installed in compliance with the Electrical Code and the equipment's UL listing. Bring to the attention of the Architect in writing, all conflicts, incompatibilities, and/or discrepancies prior to bid or as soon as discovered.
- 1.3 WORK OF OTHER CONTRACTS
- A. Work under this contract shall be conducted in a manner to allow for the future installations of such equipment or items listed in other sections of this Specification.
- 1.4 WORK OF OTHER DIVISIONS
- A. Work under this Division shall be conducted in a manner to cooperate with the installation of such equipment or items as specified in other Divisions.
- B. HVAC piping systems, fuel piping systems, fire suppression piping systems, and control devices and control wiring relating to the heating and air conditioning systems are specified under other Divisions of these Specifications except for provisions or items specifically noted on the Drawings or specified herein.

- C. Consult all Drawings and Specifications in this project and become familiar with all equipment to be installed. Coordinate all aspects of the construction with the other trades on the job to ensure that all work and materials required to provide a complete and operational facility are included in the bid.
- D. All sections of Division 22 are interrelated and shall be considered in their entirety when interpreting any material, method, or direction listed in any section of Division 22. Individual sections are not written for specific subcontractors or suppliers but for the General Contractor.

1.5 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES (SUBMITTALS)

- A. Submit in accordance with Division 1 full technical and descriptive shop drawing data on proposed materials and equipment as detailed in each section.
- B. The Contractor shall verify that all equipment submitted can be delivered and installed within the time constraints of the construction period.
- C. Include the manufacturer, type, style, catalog number, complete specification, certified dimensions, included options and accessories and description of physical appearance for each item submitted. Reproduction of catalog data sheets shall be clean and legible to show all details, including gauge of metal used.
- D. Include only information on exact equipment to be installed, not general catalogs of the manufacturer. Where sheets show proposed equipment as well as other equipment, identify proposed equipment with rubber stamp arrow or similar concise method.
- E. Submit with each copy a transmittal letter verifying that all included equipment submittals have been carefully considered for quality, dimensions, function, and have been coordinated with the Drawings and Specifications. Guarantee that proposed materials will meet or exceed the quality and function of those specified.
- F. Include field wiring diagrams and connection diagrams for all control and/or low voltage systems, including floor plans.
- G. Submittal Review: The submittal review process is a means to provide quality control. The action noted to be taken (or where conflicts with the contract documents are not noted) shall not be interpreted by the Contractor as automatic "change orders." Approval of the data for substitution and shop drawings shall not eliminate the contractor's responsibility for compliance with Drawings or Specifications, nor shall it eliminate the responsibility for freedom from errors of any sort in the data discovered prior to or after the review process. Deviations, discrepancies, and conflicts between the submittals and the Contract Documents shall be called to the Architect's attention in writing at the time of transmittal of the data.
- H. Unless otherwise directed by Division 1, submittal data shall be in a 3-ring plastic binder with a clear plastic sleeve and a project identification sheet inserted. Arrange submittals numerically with specification sections identified on divider tabs. All required sections shall be submitted at one time.

1.6 PRODUCT SUBSTITUTION

- A. Materials other than those specified may be approved for this project providing a written request is submitted to the Architect prior to bid in accordance with Instructions to Bidders. Requests shall include complete specifications, dimensions, manufacturer and catalog number for each item for which approval is desired. If, in the opinion of the Architect, the material is not complete or if it is not an acceptable substitute, he may reject it. The Architect's evaluation will be based solely on the material submitted.

1.7 CHANGE ORDERS

- A. All supplemental cost proposals by the Contractor shall be accompanied by a complete itemized breakdown of labor and materials without exception. At the Architect's request, the contractor's estimating sheets for the supplemental cost proposals shall be made available to the Architect. Labor must be separated and allocated for each item of work.

1.8 RECORD DOCUMENTS

- A. Project Record (As-Installed) Drawings:

1. Maintain a set of record drawings on the job site as directed in Division 1.
2. Keep Drawings clean, undamaged, and up to date.
3. Record and accurately indicate the following:
 - a. Depths, sizes, and locations of all buried and concealed piping and all cleanouts, whether concealed or exposed, dimensioned from permanent building features.
 - b. Locations of all valves.
 - c. Changes, additions, and revisions due to change orders, obstructions, etc. Eradicate extraneous information.
 - d. Locations of tracer wire terminal points.
 - e. Model numbers of installed equipment.
4. Make Drawings available when requested by Architect for review.
5. Submit as part of the required Project Closeout documents.

- B. Operating and Maintenance Manuals: Submit five (5) sets of Operating and Maintenance Instructions, including manufacturer's service data, wiring diagrams, and parts lists and vendors for all serviceable items of equipment, valve charts, balancing data, final control diagrams showing final set points, and any additional equipment added by change order, bound in three-ring, vinyl or canvas covered, loose-leaf binders organized with index and thumb-tab markers for each classification of equipment or data.

1.9 WARRANTY

- A. Furnish, prior to application for final payment, three copies of written and signed guarantee effective a period of one year from date of completion and acceptance of entire project; agree to correct, repair and/or replace defective materials and/or equipment or the results of defective workmanship without additional expense to the Owner. Where no response satisfactory to the Owner has occurred within three working days from the written report of a warranty covered defect, the contractor shall agree to pay for the cost of repair of the reported defect by a contractor of the Owner's choice.
- B. Where the manufacturer's guarantee exceeds one year, the longer guarantee shall govern and include the Contractor's labor.

PART 2 PRODUCTS

2.1 GENERAL

- A. General: Provide all new materials and equipment, identical to apparatus or equipment in successful operation for a minimum of two years. Provide materials of comparable quality omitted here but necessary to complete the work. Maximum allowable variation from stated capacities, minus 5% to plus 10% as approved in each case.

- B. Compatibility: Provide products which are compatible with other portions of the work and provide products with the proper or correct power and fuel-burning characteristics, and similar adaptations for the project.
- C. Efficiency: Service (Domestic) Water Heating Equipment shall comply with the State Energy code. Where equipment efficiencies are indicated, the use of alternate or substitute manufacturer's equipment with lower efficiencies is not permitted.
- D. Storage and Handling:
 - 1. Delivery: Deliver to project site with manufacturer's labels intact and legible.
 - 2. Handling: Avoid damage.
 - 3. Storage: Inside protected from weather, dirt and construction dust. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.

2.2 VALVES

- A. General: Provide factory fabricated valves of the type, body material, temperature and pressure class, and service indicated. Bronze gate, globe and check valves shall comply with MSS-SP-80. Ball valves shall comply with MSS-SP-110. Iron gate and globe valves shall comply with MSS-SP-70. Iron check valves shall comply with MSS-SP-71. Butterfly valves shall comply with MSS-SP-67. Valve size same as connecting pipe size.
- B. Acceptable Manufacturers: Milwaukee, Crane, Grinnell, Nibco, Hammond, Stockham, Legend, Watts, FNW, and Walworth. NIBCO numbers are given except as noted. Where possible, provide valves from a single manufacturer.
- C. Valve styles: Domestic hot and cold water.
 - 1. Valves 3" and Smaller:
 - a. Ball: Two-piece, DZR brass body, full port, 600 psi WOG, Fig. T/S-585-70.
 - b. Check: Bronze body, swing check, 200 psi WOG, T/S-413B (bronze disc) or T/S-413Y (Teflon disc).
 - 2. Valves 3" through 12":
 - a. Ball: Three-piece, bronze body, full port, 600 psi WOG, T/S-595Y.
 - b. Gate (to 3"): Bronze body, non-rising stem, 200 psi WOG, T/S-133.
 - c. Gate (4" to 12"): Iron body, bronze trim, non-rising stem, solid wedge, bolted bonnet, 200 psi WOG, F-619.
- D. Selection of Valve Ends (Pipe Connections): Select and install valves with ends matching the types of pipe/tube connections.

2.3 HANGERS AND SUPPORTS

- A. General: Provide factory-fabricated horizontal piping hangers, clamps, hanger rod, inserts, supports, etc., of the recommended MSS type and size. The Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry Practice SP-58 and SP-69 are referenced in this section.
- B. Manufacturers: Holdrite Silencer acoustic hangers to be used for all water and waste piping per the acoustic report.

- C. Corrosion Protection: Provide materials which are zinc plated or factory painted to prevent corrosion. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated, plastic coated, or by other recognized industry methods.

2.4 PENETRATION FIRE STOPPING

- A. Through-penetration fire stopping system tested and listed by Underwriters Laboratories. Hilti, 3M, Metacaulk, SpecSeal, or approved.
- B. Select system for proper application based on wall construction, type of penetrating item, wall rating, etc.

PART 3 EXECUTION

3.1 LAYOUT AND COORDINATION

- A. Site Examination: Before starting work, carefully examine site and all contract Drawings. Become thoroughly familiar with conditions governing work on this project. Verify all indicated elevations, building measurements, roughing-in dimensions and equipment locations before proceeding with any of the work.
- B. Sleeves, Inserts, Cast-in-Place Work: Provide sleeves, inserts, anchoring devices, cast-in-place work, etc. which must be set in concrete sequenced at the proper time for the project schedule.
- C. Coordination:
 - 1. The drawings are based on equipment of a certain manufacturer and may be identified as such. Where alternate manufacturers or approved substitutes are incorporated into the work, any required design changes are the responsibility of the contractor. Such changes may include changes in utility or system connection sizes, location, or orientation, service clearances, structural support or acoustic considerations.
 - 2. Where the work must be sequenced and positioned with precision in order to fit into the available space, prepare accurate scale shop drawings showing the actual physical dimensions required for the installation and submit prior to purchase/fabrication/installation of any of the elements involved in the coordination.
 - 3. Cooperate with other trades in furnishing material and information for sleeves, bucks, chases, mountings, backing, foundations and wiring required for installation of mechanical items.
 - 4. Coordinate all work with other trades and determine in advance where interfacing of the mechanical work and other work are required to be connected together. Provide all materials and equipment to make those connections. Submit shop drawings showing required connections where special conditions exist.
- D. Discrepancies: Report immediately any error, conflict or discrepancy in Plans, Specifications and/or existing conditions. Do not proceed with any questionable items of work until clarification of same has been made. Should rearrangement or re-routing of piping be necessary, provide for approval the simplest layout possible for that particular portion of the work.

3.2 UTILITY COORDINATION

- A. Utility Coordination: Coordinate all aspects of the incoming plumbing utility services indicated with the city engineer, serving utility, and the off-street improvements contractor. Requirements of the utility company which exceed the provisions made on the Drawings or covered by these Specifications shall take precedence. Provisions made on the Drawings or Specifications in excess of the utility company's requirements shall take precedence. No additional compensation will be allowed the contractor for connection fees or additional work or equipment not covered in the Drawings or Specifications which are a result of policies of the serving utilities.

3.3 MECHANICAL EQUIPMENT WIRING

- A. Provide all mechanical equipment motors, automatic temperature, limit, float and similar control devices required, with wiring complete from power source indicated on Electrical Drawings.
- B. Provide properly rated motor overload and undervoltage protection and all manual or automatic motor operating devices for all mechanical equipment.
- C. Equipment and systems shown on the Drawings and/or specified, are based upon requirements of specific manufacturers which are intended as somewhat typical of several makes which may be approved. Provide all field wiring and/or devices necessary for a complete and operable system including controls for the actual selected equipment/system.

3.4 GENERAL INSTALLATION

- A. Locating and Positioning Equipment: Observe all Codes, Regulations and good common practice in locating and installing mechanical equipment and material so that completed installation presents the least possible hazard. Maintain adequate clearances for repair and service to all equipment and comply with Code requirements.
- B. Arrangement: Arrange rigid piping parallel with primary lines of the building construction, and with a minimum of 7' overhead clearance in all areas where possible. Unless indicated otherwise, conceal all piping. Locate operating and control equipment properly to provide easy access, and arrange entire mechanical work with adequate access for operation and maintenance. Give right-of-way to piping which must slope for drainage. Set all equipment level or as recommended by manufacturer. Under no conditions shall beams, girders, footings or columns be cut for mechanical items. Casting of pipes into concrete is prohibited unless so shown on Drawings.
- C. Drip Pans: Provide drip pans under all domestic hot water heaters. Provide 3/4" drainage piping, properly discharged to over floor drain, to building waste system or as shown on the Drawings.
- D. Access Panels: Provide access panels with proper backing reinforcement for all equipment, dielectric unions, valves and items requiring service and installed above ceilings, behind walls, or in furring, complete with correct frame for type of building construction involved. Exact size, number and location of access panels are not necessarily shown on Drawings. Use no panel smaller than 12" by 12" for simple manual access or smaller than 16" x 20" where personnel must pass through.
- E. Adjusting: Adjust and calibrate all automatic mechanical equipment, mixing valves, flush valves, float devices, etc. Adjust flow rates at each piece of equipment or fixture.
- F. Building Vapor Barrier: Wherever the building insulation vapor barrier is penetrated by piping, hangers, conduits, etc., provide clear self-adhesive tape recommended by the insulation manufacturer around the penetrations.

3.5 VALVE INSTALLATION

- A. General: Comply with the following requirements:
1. Install valves where required for proper operation of piping and isolation of equipment, including valves in branch lines where necessary to isolate sections of piping, and where shown on the drawings. Install valves at low points in piping systems that must be drained for service or freeze protection.
 2. Locate valves in accessible spaces (or behind access panels) and so that separate support can be provided when necessary.
 3. Install valves with stems pointed up, in the vertical position where possible, but in no case with stems pointed downward from a horizontal plane.
- B. Valve Access: Provide access panels to all valves installed behind walls, in furring or otherwise inaccessible.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. General: Proceed with the installation of hangers, supports and anchors only after the required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) the proper placement of inserts, anchors and other building structural attachments.
1. Install hangers, supports, clamps, and attachments to support piping and equipment properly from the building structure. Use no wire or perforated metal strap to support piping, and no supports from other piping or equipment. For exposed continuous pipe runs, install hangers and supports of the same type and style as installed for adjacent similar piping.
 2. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated or by other recognized industry methods.
 3. Support piping independently of fire sprinkler piping.
 4. Arrange supports to prevent eccentric loading of joists and joist girders. Locate supports at panel points only.
- B. Provisions for Movement:
1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate the action of expansion joints, expansion loops, expansion bends and similar units.
 2. Install hangers and supports so that equipment and piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
 3. Install hangers and supports to provide the indicated pipe slopes.
- C. Pipe Support:
1. Vertical Spacing: Support at base, at equivalent of every floor height (maximum 10' as required by Code) and just below roof line.
 2. Screwed or Welded Steel or Copper Piping: Maximum hanger spacing shall be as follows:

	<u>Steel</u>	<u>Copper</u>
1-1/4" and smaller	7' span	6' span
1-1/2" pipe	9' span	6' span
2" pipe	10' span	10' span
2-1/2" & larger	12' span	10' span
 3. PVC, ABS and Other Rigid Plastic Pipe: Maximum hanger spacing and minimum rod diameters as follows:

- a. Continuous support 1/2" to 4" pipe size Fee & Mason No. 109 channels with Fee & Mason No. 108 hanger. Lay pipe directly into the channel with fittings or couplings placed in spaces between channel sections. Secure piping to the channel at intervals between hangers with a few turns of vinyl electrical tape.
 - b. Non-Continuous Support: Maximum 4' spans or shorter if required by manufacturer for temperatures and pipe schedule.
 - c. Arrange supports to allow free movement, but restrict upward movement of lateral runs so as not to create reverse grade on drainage pipe. Use double bolt clamp or band hanger with restraint (Tolco fig. 25).
4. PEX and Other Flexible Plastic Pipe:
- a. Continuous support: Channel support system as specified above or in exposed locations may be supported within EMT tubing supported as specified for steel pipe.
 - b. Non-continuous support: Maximum 32" spans in concealed locations.
5. Install additional hangers or supports at concentrated loads such as pumps, valves, etc. to maintain alignment and prevent sagging.
6. Support Rod: Hanger support rods sized as follows:

<u>Pipe and Tube Size</u>		<u>Rod Size</u>	
<u>Inches</u>	<u>mm</u>	<u>Inches</u>	<u>mm</u>
1/2" to 4"	12.7 to 101.6	3/8"	9.5
5" to 8"	127.0 to 203.2	1/2"	12.7
10" to 12"	254.0 to 304.8	5/8"	15.9

- D. Adjust hangers and supports to bring piping to proper levels and elevations.
- E. Provide all necessary structural attachments such as anchors, beam clamps, hanger flanges and brackets in accordance with MSS SP-69. Attachments to beams and joists wherever possible. Supports suspended from other piping, equipment, floor sheathing, etc., are not acceptable.
- F. Horizontal banks of piping may be supported on common steel channel member spaced not more than the shortest allowable span required on the individual pipe. Maintain piping at its relative lateral position using clamps or clips. Allow lines subject to thermal expansion to roll axially or slide. Size channel struts for piping weights.
- G. Installation of drilled-in concrete anchors shall comply with the manufacturer's instructions for working load, depth of embedment, and spacing between anchors and from the edge of the slab. Use only wedge style anchors.

3.7 EQUIPMENT CONNECTIONS

- A. Provide complete plumbing connections for all items of equipment requiring such connections, including incidental piping, fittings, trim and labor necessary for a finished working installation.
- B. Verify the rough-in and finish requirements for all equipment provided under other Divisions of the work and requiring plumbing connections with equipment supplier and installer prior to rough-in. Minimum branch pipe size for fixtures shall be 1/2". Final piping connection to fixture stops shall be made using metal pipe or tube.

3.8 PROTECTION

- A. Protect all work and materials against loss or damage. Close all pipe openings with caps or plugs. At final completion, thoroughly clean and deliver all work and equipment in an unblemished new condition. Keep all motors and bearings in watertight and dustproof covers during entire course of installation.

3.9 PIPE PENETRATION FIRE STOPPING

- A. Install as recommended by manufacturer and in accordance with the product's UL listing. Below are the minimum installation requirements.
 - 1. Install specified penetrating item(s) with required annular spacing in proper size wall or floor opening. Support penetrating item(s) adequately on both sides of construction.
 - 2. Clean all opening and penetrating item surfaces in penetration area to remove loose debris, dirt, oil, wax, grease, old caulking, etc.
 - 3. If needed or required for gypsum or concrete block walls, install specified galvanized steel wire mesh or sleeve recessed and centered inside wall around penetrating item(s) so that it is snug against perimeter of opening.
 - 4. When required, install specified type and depth of backing material in annular space, recessed to required fill depth of fire stopping caulking.
 - 5. Gun, trowel, and/or pump fire stopping sealant to specified depth in annular space around penetrating item(s). Trowel sealant surfaces flush with wall or floor surfaces to a smooth, defect-free finish. Where required, apply specified size caulking bead around penetrating item(s) at zero annular contact areas and tool smooth.

3.10 PLUMBING WORK CLOSEOUT

- A. General: Refer to the Division 1 sections for general closeout requirements. Calibrate all equipment requiring same. Complete each system as shown or specified herein and place in operation except where only roughing-in or partial systems are called for. Each system shall be tested and left in proper operation free of leaks, obstructions, or contamination.
- B. Record Drawings: Submit record set of drawings as previously specified in this Section.
- C. Closeout Equipment/Systems Operations: Sequence operations properly so that work of project will not be damaged or endangered. Coordinate with seasonal requirements. Operate each item of equipment and each system in a test run of appropriate duration with the Architect present, and with the Owner's operating personnel present, to demonstrate sustained, satisfactory performance. Adjust and correct operations as required for proper performance. Clean and lubricate each system, and replace dirty filters, excessively worn parts and similar expendable items of the work.
- D. Operating Instructions: Conduct a walk-through instruction seminar for the Owner's personnel who are to be involved in the continued operation and maintenance of plumbing equipment and systems. Provide written instructions outlining and explaining the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, seasonal provisions, security, safety, efficiency and similar features of the systems.

END OF SECTION 22 05 00

THIS PAGE INTENTIONALLY BLANK

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this section apply to the insulation of plumbing systems specified elsewhere in these specifications.
- B. The requirements of Section 22 05 00, Common Plumbing Materials and Methods, also apply to this section.

1.2 QUALITY ASSURANCE

- A. Minimum Insulation Thickness and Thermal Performance: Comply with the State of Oregon Energy Efficiency Code except where more stringent requirements are specified herein.
- B. Composite (Insulation, Jacket or Facing and Adhesives) Fire and Smoke Hazard Ratings: Not to exceed a flame spread of 25 or smoke development of 50 and containing less than 0.1% by weight deca-PDE fire retardant.
- C. Component Ratings of Accessories (Adhesives, Mastics, Cements, Tapes, Finishing Cloth for Fittings): Same as "B" requirements above and permanently treated. No water soluble treatments.

1.3 SUBMITTALS

- A. Submit catalog data and performance characteristics for each product specified.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. General: In addition to the requirements specified in Section 22 05 00, the following apply:
 - 1. Deliver insulation, coverings, cements, adhesives and coatings to the site in factory-fabricated containers with the manufacturer's stamp or label affixed showing fire hazard ratings of the products. Store insulation in original wrappings and protect from weather and construction traffic.
 - 2. Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged insulation. Remove such insulation from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Insulation Manufacturers: Johns Manville, Owens-Corning, Knauf, Certain Teed, Armstrong, Pabco, Imcoa or Nomaco. Johns Manville products are listed unless indicated otherwise.
- B. Adhesive Manufacturers: Foster, 3M, Insul-Coustic, Borden, Kingco or Armstrong.

2.2 PIPING INSULATION

- A. Interior and Exterior Piping Systems 32 to 180 Deg. F: Glass fiber preformed pipe insulation with a minimum K-value of 0.23 at 75 deg. F, a minimum density of 3.5 pounds per cubic foot within all-service vapor barrier jacket, vinyl or pre-sized finish and pressure sensitive seal containing less than 0.1% by weight deca-PDE fire retardant.

- B. Pipe Temperatures Minus 30 to 180 Deg. F: Flexible, preformed, pre-slit, self-sealing elastomeric pipe insulation up to 2-1/8" ID, thermal conductivity of 0.27 BTU/hr. sq. ft./in. at 75 deg. F and vapor transmission rating of 0.2 perms/inch. Armstrong "Armaflex 2000" or, in concealed locations, Imcoa or Nomaco also approved.

2.3 INSULATION ACCESSORIES

- A. Insulation Compounds and Materials: Provide rivets, staples, bands, tapes, adhesives, cements, coatings, sealers, welded studs, etc., as recommended by the manufacturer for the insulation and conditions specified. No staples allowed on cold water piping systems.
- B. PVC Protective Jacketing and Valve and Pipe Fitting Covers: Johns Manville Zeston 2000, Proto LoSmoke, or Ceel-Co Ceel-Tite 100 Series with precut fitting fiberglass insulation or approved.
- C. Jacket Lap Sealing Adhesives: Foster Drion 85-75 contact cement or approved substitute.
- D. Saddles and Shields: Install to prevent crushing of insulation at support points.
 - 1. Protection Saddles: MSS Type 39.
 - 2. Protection Shields: MSS Type 40.
 - 3. Preinsulated Pipe Supports: Calcium silicate load bearing metal jacketed inserts. Pipe Shields Inc. or accepted substitute.
 - a. Pipe supported on rods - Models A1000, A2000, A3000, A4000.
 - b. Pipe supported on flat surfaces - Models A1000, A2000, A3000, A4000.
 - c. Pipe supported on pipe rolls - Models A3000, A4000, A5000.
 - d. Vertical riser clamp – Models E1000, E1100, E1200.

PART 3 - EXECUTION

3.1 PIPING INSULATION

- A. General: Do not insulate underground piping.
- B. At the contractor's option and in accordance with Part 2 of this section, elastomeric insulation may be installed on domestic water piping in thicknesses providing overall thermal resistance equivalent to the glass fiber insulation. Increased thickness is typically required. Installation shall comply with the manufacturer's recommendation with joints and seams completely sealed.
- C. Domestic Water Piping:
 - 1. Insulate with glass fiber pipe covering, 1/2" thick for 1" and larger cold water piping.
 - 2. Insulate circulated hot water piping with 1" thickness for 1" and smaller hot water piping; 1-1/2" for 1-1/4" and larger hot water piping.
 - 3. Insulate hot water return piping same as hot water piping.
 - 4. Pex cold water mains and dwelling unit branch lines not required to be insulated.
 - 5. Hot water and Hot water recirc lines to be fully insulated except for 1/2" dwelling unit branch lines down stream of unit manifold.
- D. Interior Rain Drains:
 - 1. Concealed: Insulate with 1" thick one pound density glass fiber blanket and continuous vapor barrier jacket.

- 2. Exposed: Insulate with 3.5 pound density glass fiber insulation with continuous vapor barrier jacket.

- E. Waste Lines: Insulate all pipe exposed to outside temperatures with 3/4" thick glass fiber pipe insulation with a vapor barrier jacket. Insulate over freeze protection heat trace where indicated – including exposed piping in parking garage.

- F. Pipe Fittings: Insulate and finish all fittings including valve bodies, bonnets, unions, flanges and expansion joints with precut fiberglass insulation and preformed PVC covers sealed to adjacent insulation jacket for continuous vapor barrier covering over all fittings.

- G. Piping Insulation Lap Seams and Butt Joints: Install insulation jacket in accordance with manufacturer's recommendation and without staples on cold water lines. Where jacket joint and lap seams have not adhered, remove affected section of insulation and reinstall or apply lap sealing adhesive in accordance with manufacturer's instructions.

END OF SECTION 22 07 00

THIS PAGE INTENTIONALLY BLANK

SECTION 22 10 00 - PLUMBING PIPING AND PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide pipe, pipe fittings, piping specialties, pumps and related items required for complete piping system.
- B. Related Work: The requirements of Section 22 05 00, Common Plumbing Materials and Methods, also apply to this section.

1.2 QUALITY ASSURANCE

- A. General: ASTM, and ANSI Standards are indicated. In addition, special standards are referenced where neither ASTM nor ANSI Standards are applicable.
- B. Labeling: All piping shall be continuously and legibly labeled on each length as required by codes and standards and including as a minimum, country of origin, manufacturer's identification marking, wall thickness designation, and applicable standards and approvals. Fittings shall be labeled as required by the referenced standard. Tubular fixture traps shall be stamped with manufacturer's mark and material thickness.
- C. Potable Water Valves: Potable water piping materials not limited to faucets, mixing valves, shutoff valves, or pressure reducing valves. Valves shall meet NSF Standard 61, Section 9, for drinking water faucets and shall be brass construction. Brass components which contact water within the faucet shall be from brass which contains no more than 3 percent lead by dry weight.
- D. Definitions: Where piping fluid is not indicated in the following paragraphs, provide similar piping materials for similar fluids (i.e., "make-up water" = "domestic water"; "wet stand pipe" = "fire sprinkler pipe"; "drainage piping" = "sanitary/storm sewer piping").
- E. Plumbing System Disinfection and Testing shall be performed by an experienced, qualified, chemical treatment agency. Mt. Hood Chemical, Chemcoa, or approved alternate.
- F. Installer certification: Where piping systems include proprietary components, systems, or methods (PEX, Propress, Victaulic, etc.) the installers shall be certified by the product manufacturer for the installation of the product to ensure the validity of the factory warranty. Include installer certification documents with the product material submittals.

1.3 STORAGE AND HANDLING

- A. Provide factory-applied end caps on each length of pipe and tube. Maintain end caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube. Protect flanges, valves, and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.4 SUBMITTALS

- A. Submit catalog data for each product specified.

PART 2 PRODUCTS

2.1 PIPING MATERIALS

- A. Copper Pipe and Tube:
 - 1. Application:
 - a. Domestic water

-
- b. Priming lines
 - c. Condensate lines where heat traced.
 - 2. Pipe: ASTM B88.
 - a. Above Ground Domestic Water: Type L hard temper copper with soldered joints.
 - b. Underground Domestic Water and Priming Lines: Type L soft annealed with no joints or type K hard tempered copper with silver soldered joints.
 - 3. Fittings: Wrought copper solder-joint fittings, ANSI B16.22.
- B. Cast Iron DWV Pipe:
- 1. Application: 1-1/2" and larger in all non-residential areas including below and through the fire rated PT slabs. Vertical Risers between floors to be Cast Iron
 - a. Sanitary waste
 - b. Plumbing vent
 - c. Rain drain
 - 2. Pipe: Hubless cast iron soil pipe, CISPI 301-05/ASTM A 888-05.
 - 3. Fittings: Hubless cast iron fittings: CISPI 301-05/ASTM A 888-05.
 - 4. Couplings:
 - a. Light Duty: Standard couplings meeting CISPI 310/ASTM A 1277.
 - b. Heavy Duty: No-hub couplings meeting ASTM C 1540, and FM 1680. ASTM C 564 neoprene gasket, type 304 SS corrugated shield and type 304 SS clamping bands. Four bands on 1-1/2" thru 4" pipe and 6 bands on 5" thru 10" pipe.
 - 5. Manufacturers: Cast iron pipe and fittings – AB&I, Charlotte Pipe, Tyler Pipe, or approved. All pipe shall be labeled by the manufacturer.
- C. Plastic Pipe – Drain, Waste, Vent (DWV):
- 1. Application: All residential areas (excluding risers between multiple floors).
 - a. Sanitary waste
 - b. Plumbing vent
 - 2. Pipe:
 - a. Polyvinyl chloride (PVC) (ASTM D1784) plastic drain, waste and vent pipe (ASTM D2665 and D1785) and fittings (ASTM D2665) (DWV). Solid Core only for sanitary waste piping.
 - 3. Fittings: Provide fittings of the type indicated, matching piping manufacture. Where not otherwise indicated, provide socket style, solvent weld fittings produced and recommended for the service indicated by the piping manufacturer. Fire Penetrations must use a UL listed intumescent sealant collar.
- D. Plastic Pipe:
- 1. Application: Where approved by Code.
 - a. Domestic water, underground
 - b. Water heater & Washer pan drain
 - c. Condensate drains, non-heat traced.

2. Pipe:
 - a. Polyvinyl Chloride and Chlorinated Polyvinyl Chloride Plastic Pipe for Water Service: SDR-PR pipe, ASTM D2241; Schedules 40, 80 and 120, ASTM D1785.
3. Fittings: Provide fittings of the type indicated, matching piping manufacturer. Where not otherwise indicated, provide socket style, solvent weld fittings produced and recommended by the piping manufacturer for the service indicated.

E. Plastic Pipe:

1. Application: Allowed within residential units only.
 - a. Domestic water, 3" and smaller.
2. Pipe:
 - a. Cross-linked polyethylene (PEX) tubing for Water Service: ASTM F877; SDR 9. NSF-pw and NSF 61.
3. Fittings: Provide fittings of the type indicated, matching piping manufacturer. Where not otherwise indicated, provide fittings produced and recommended by the piping manufacturer for the service indicated.

F. Polypropylene Pipe PP-R:

1. Application: Allowed for potable water distribution piping systems.
 - a. Domestic water, 1" and larger.
2. Pipe: Allowed for potable water distribution piping systems.
 - a. Piping shall be manufactured from PP-R (Super PP-R 80) which gives the pipe the short and long term characteristics required by ASTM F 2389 or CSA B137.11. Pipe shall not contain any piping that have been reworked or recycled. Fiber-T piping uses a fiber layer which restricts thermal expansion of the pipe when installed in a Hydronic heating or Hot water system. All pipe shall be made in an extrusion process. All piping shall be certified by NSF International and comply with NSF 14, NSF 61. All pipe shall be certified and comply with the pressure ratings of ASTM F 2389 or CSA B137.11
3. Fittings: Fittings shall be manufactured from PP-R (Super PP-R 80) which gives the fitting the short and long term characteristics required by ASTM F 2389 or CSA B137.11. The fittings will be press molded and shall not contain any fittings that have been reworked or recycled. All fittings shall be certified by NSF International and comply with NSF 14, NSF 61 and ASTM F 2389 or CSA B137.11.
4. Manufacture: Aquatechnik® Fusion-Tech Blue Striped piping, Fiber-T Red Striped piping and fittings.

2.2 MISCELLANEOUS PIPING MATERIALS

- A. Soldering and Brazing Materials: Provide soldering materials as determined by the installer to comply with installation requirements.
1. Tin-Antimony Solder: ASTM B32, Grade 95TA.
 2. Lead-Free Solder: ASTM B32, Grade HB. Harris "Bridgit" approved.
 3. Silver Solder: ASTM B32, Grade 96.5TS.
 4. Flux: Water soluble paste flux.
 5. Brazing filler rod: BCuP rod to suit conditions.

- B. Strainers: "Y-pattern," iron or bronze body rated for pressures indicated with blow-off connection and 20 mesh stainless steel screen.
- C. Tracer Wire: 14 gauge, single strand, copper wire with blue insulation for water, green for sanitary and storm sewers, and yellow for gas. 3M "DBY" direct bury splice kit required at all splices.
- D. Pipe Sleeves: For installation in cast in place concrete floor systems. UL 1479 listed with ratings for fire, smoke, and water intrusion. Cast in place pipe sleeve with external waterstop collar and interior pipe seal and intumescent collar. Holdrite "Hydroflame".

2.3 PIPING SPECIALTIES

- A. Cleanouts: PVC bodies with nickel bronze adjustable top where located in finished or concrete floors.
- B. Floor Drains: PVC construction with anchor flange and stainless steel or nickel bronze top, and other options as indicated by model number. Cast iron drains and tops for heavy duty drains (Including all trash rooms).
- C. Roof drains: Cast iron body and dome with flashing clamp, sump receiver, and underdeck clamp. Drain configuration to match roofing system. Overflow drains with 2" high water dam.
- D. Roof drain outlet nozzle: Polished nickel bronze nozzle with trim ring and threaded or socket pipe connection.
- E. Priming Valves: Smith 2699, Josam 88250, Wade W8800T, Zurn Z1022, Watts MS810 or equivalent Precision Plumbing, Mifab. Locate in closets, under counters or in walls behind access panels as specified in Section 22 05 00. Use copper specified previously for all underground priming lines.
- F. Traps: Except chrome plated fixture traps. Recessed drainage pattern for threaded pipe and same grade as pipe for plastic pipe; with cleanout plugs in trap body in all above grade locations.
- G. Pressure Reducing Valve: Single seat type with renewable stainless steel seat and valve. Size and capacity as shown on Drawings. Bronze bodies with screwed connections on valves 2-1/2" and smaller and flanged steel bodies on valves 3" and larger. Install each PRV with strainer on inlet or internal strainer. Leslie, Watts, Cash-Acme, Zurn-Wilkins, or approved substitute.
- H. Backflow Preventer: Where indicated on the Drawings, install a double check backflow preventer complete with shutoff valves, two separate check valves, and test cocks. USC Foundation for Cross Connection Control, State Health Officials, and serving utility approved. Bronze bodies on units 2" and smaller, and cast iron bodies with bronze trim on units 2-1/2" and larger.
- I. Backflow Preventer: Where indicated on the Drawings (and all buildings with roof gardens, water features or living walls), install a reduced pressure backflow preventer complete with [strainer on inlet,] shutoff valves, two separate check valves, differential relief valve with drain funnel, and test cocks. USC Foundation for Cross Connection Control, State Health Officials, and serving utility approved. Bronze bodies on units 2" and smaller, cast iron bodies with bronze trim on units 2-1/2" and larger, and stainless steel construction for carbonated beverage service.

- J. ~~Trench Drain ""~~: UV and chemical resistant HDPE interlocking ~~[4", 6", 12" wide]~~ channel sections in flat and presloped styles with bottom or end outlets as shown. Provide with grate anchors and construction covers. ~~[Ductile iron frame and grate] [Perforated stainless steel grate] [HDPE grate]~~ Sioux Chief, Zurn.
- K. Freeze Protection Heat Cable: Self-regulating tracing cable with braided tinned copper under TPR outer jacket and all necessary accessories including controls, bulb-stat with 3' capillary, junction/power connection kit, pipe straps, power termination kit, end seal caps, etc. Chromalox SRF-CR equivalent Raychem, Thermon, Nelson CLT-JT, or approved substitute.
- L. ~~Tenant Water Submeters: AWWA and NSF compliant full line size meter with magnetic register drive, permanently sealed register, mobile AMR transmitter compatible with owners equipment. Master Meter FAM.~~
- M. Pipe Sleeves: For installation in cast in place concrete floor systems. UL 1479 listed with ratings for fire, smoke, and water intrusion. Cast in place pipe sleeve with external waterstop collar and interior pipe seal and intumescent collar. Holdrite "Hydroflame".
- N. The Thermostatic Mixing Valve shall be IAPMO lab certified to ASSE 1017 and CSA standards and capable of meeting the control accuracy requirements of these standards at the manufacturer's listed minimum flow rates. The valve shall contain an advanced paraffin sensor with a temperature range of 100° to 160° F (37.8° to 71° C) and factory set at 120° F (38° C) with a lock nut to prevent unauthorized temperature changes. Checks and screens must be integral to the valve. External inlet shut-offs will be included with the valve and shall be a reliable ball valve design. Body material shall be "lead-free" brass with corrosion resistant internal components. Valve shall be Acorn model MV17- (1, 2, 3, 4 or 5).
- O. Grease Interceptor:
1. Model: Great Basin series model **GB-15, GB-20, GB-25, GB-35, GB-50, GB-75 or GB-250**
 2. Description: Schier Great Basin™ grease interceptor model # _____ shall be lifetime guaranteed and made in USA of seamless, rotationally-molded High Density Polyethylene with minimum 3/8" uniform wall thickness. Interceptor shall be furnished for above or below grade installation. Interceptor shall be built in accordance to ASME A112.14.3 (type C) and CSA B481.1, with field adjustable riser system, built-in flow control, built in test caps and three outlet options. Interceptor flow rate shall be _____ GPM. Interceptor grease capacity shall be _____ lbs. Cover shall provide water/gas tight seal and have minimum _____ lbs load capacity.
- P. ~~Oil Separator:~~
1. ~~Model: Oil Reserve Series Model No. OS-15, OS-25 or OS-35~~
 2. ~~Description: Striem Oil Reserve™ oil/sand separator model # _____ shall be lifetime guaranteed and made in USA of seamless, rotationally-molded High Density Polyethylene with minimum 3/8" uniform wall thickness. Separator shall be furnished for above or below grade installation, with field adjustable riser system, built in flow control, vent connections and optional oil draw-off for connection to independent collection tank. Separator flow rate shall be _____ GPM. Separator capacity shall be _____ gallons of oil and _____ gallons of sediment. Cover shall provide water/gas tight seal and have minimum _____ lbs load capacity.~~
- Q. Downspout Boot: Smith No. 1787-12, 4" diameter by 18", offset type. Smith No. 1785 or 1786 for rectangular downspouts.

- ~~R. Backwater and Gate: Cast iron body with brass wedge gate, brass swing check, and separate handle. Provide with proper extension to set floor plate flush with finished floor. Smith 7150 or equivalent Josam, Wade, Watts or Zurn.~~

2.4 BACKFILL MATERIALS

- A. Subbase Materials: A graded mixture of gravel, sand, crushed stone or crushed slag.
- B. Finely-Graded Subbase Material: Well graded sand, gravel, crushed stone or crushed slag, with 100% passing a 3/8" sieve.
- C. Backfill Material: Soil material suitable for compacting to the required densities, and complying with AASHTO designation M145, Group A-1, A-2-4, A-2-5, or A-3.

2.5 PUMPS

- A. Water Pressure Booster: Factory assembled and tested duplex water booster unit complete with pumps, controls, hydro-pneumatic tank, suction and discharge manifolds and all necessary valves, fittings and gauges all mounted on steel support base. One constant speed pump and one variable speed pump.
 - 1. Pumps: Bronze fitted pumps of capacities and types indicated on the Drawings. Provide suction and discharge isolation valve and discharge check valve on each pump. Provide with low/no flow thermal protection system.
 - 2. Manifolds: 300 series stainless steel piping with suction and discharge pressure gauges and pressure relief valve.
 - 3. Hydro-Pneumatic Tank: Precharged ASME 125 psi code steel tank with replaceable butyl rubber bladder FDA approved for potable water. Equip tank with system connections, bladder access flange, drain, air charging valve, ASME code relief valve and lifting lugs.
 - 4. Control Panel: NEMA 3R enclosure pre-wired with disconnect, magnetic starters with 3-leg overload protection, individual pump fused disconnects or circuit breakers, individual pump hand-off-auto selector switches, automatic alternator, control transformer, operating pressure sensor, variable frequency drive, terminal strip for single field power connection, motor run indicator lights, lead pump failure alarm and protection and low suction pressure shut down with manual reset. UL 508 listed
 - 5. Acceptable Manufacturers: as shown on drawings or approved.
- B. Elevator Sump Pump: Submersible, 50 gpm at 17 ft. head, minimum 1/2 horsepower sump pump with integral float switch. Myers, Paco, Hydronix, Zoeller, Viking, Liberty, or approved.

PART 3 - EXECUTION

3.1 UTILITY SERVICE

- A. Plumbing Utility Connections: Complete installation. Contact local serving utilities to determine conditions involved and make or arrange to have connection made at proper time and pay all costs involved.
- B. Sanitary and Storm Sewers: Connect to or arrange for connection to sanitary and storm sewers as shown on the Drawings and as required by the serving utility. Verify depth, size and location prior to installation of the new sewer systems.

- C. Water Service: Connect to or arrange for connection to water service as shown on the drawings. Verify serving utility requirements prior to beginning any installation. Verify water main size, depth, pressure and location prior to starting work.
- D. Fire Service: Connect to or arrange for connection to fire water service as shown on the drawings. Contact local serving utilities to determine conditions involved and make or arrange to have connection made at proper time and pay all costs involved.

3.2 PIPE INSTALLATION

- A. Comply with the following applicable HUD standards:
 - 1. HUD UM 76 CPVC & PB Hot and Cold Water Distributing Pipe.
 - 2. HUD UM 78 PE, ABS, PVC, & PB Plastic Piping for Domestic Water.
 - 3. HUD UM 79a ABS & PVC Plastic Pipe and Fittings for Drain, Waste, and Vent.
- B. General: Install pipe, tube and fittings in accordance with recognized industry practices and plumbing code standards. Install each run accurately aligned with a minimum of joints and couplings, but with adequate and accessible unions and flanges for disassembly, maintenance and/or replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings.
- C. Piping Runs: Route piping close to and parallel with walls, overhead construction, columns and other structural and permanent-enclosure elements of the building. Install piping plumb and level except where pitched for drainage. If not otherwise indicated, run piping in the shortest route which does not obstruct usable space or block access for servicing the building or equipment and avoid diagonal runs. Wherever possible in finished and occupied spaces, conceal piping from view. Do not encase horizontal runs in solid (concrete or CMU) partitions.
- D. Tracer Wire: Install tracer wire as close to underground non-metallic water, sanitary and storm sewers and gas pipe in the trench as possible. Tracer wire shall be accessible at grade via all services, valve and meter boxes, curb cocks, cleanouts at the building, manholes (inside the cover near the top), etc. Locate all points on the record as-installed drawings. Splice into utility tracer system where available. Comply with code requirements.

3.3 PIPING JOINTS

- A. General: Provide joints of the type indicated in each piping system, and where piping and joint as manufactured form a system, utilize only that manufacturer's material.
- B. Threaded Piping: Thread pipe in accordance with ASME B1.20.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. 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 no more than three threads exposed.
- C. Solder Copper Tube and Fitting Joints: In accordance ANSI B 828 with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in a manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens. "T-Drill" field formed tees with brazed joints may be utilized where the main is at least two pipe sizes larger than the branch.
- D. Plastic Pipe/Tube Joints: Comply with manufacturer's instructions and recommendations, and with applicable industry standards:
 - 1. Heat Joining of Thermoplastic Pipe: ASTM D-2657.

-
- 2. Making Solvent-Cemented Joints: ASTM D-2865 and ASTM F-402.
 - E. Insulating (Dielectric) Fittings: Comply with manufacturer's instructions for installing unions or fittings. Install in a manner which will prevent galvanic action and stop corrosion where the "joining of ferrous and non-ferrous piping" is indicated.
 - F. Changes in Direction: Use fittings for all changes in direction. Run lines parallel with building surfaces.
 - G. Line Grades:
 - 1. Drainage Lines: Run at maximum possible grade and in no case less than 1/8" per foot within building.
 - 2. Vents: Pitch for drainage 1/4" per 10'.
 - 3. Water: Pitch to low points and install hose bib drains. 3' minimum depth of ground cover for all lines outside building unless otherwise noted.
 - H. Unions and Flanges: At all equipment to permit dismantling and elsewhere as consistent with good installation practice.
 - I. Expansion: Provide loops, swing joints, anchors, runouts and spring pieces to prevent damage to piping or equipment.
- 3.4 CLEANOUTS
- A. Where required by code, at each change of sewer direction 45 degrees or greater and more than 10' long, at end of each branch or main and spaced not greater than 100' apart, as required by code and/or as shown on Drawings.
- 3.5 MISCELLANEOUS PIPING EQUIPMENT
- A. Floor, Wall and Ceiling Plates: Chrome plated pressed steel or brass screw locked split plates on all pipe penetrations in finished spaces.
 - B. Strainers: Install in a manner to permit access for cleaning and screen removal and with blow-off valve.
 - C. Sleeves: At all cast in place penetrations of concrete or masonry construction. PVC, 24 gauge galvanized steel or Schedule 40 galvanized steel pipe. Use steel pipe sleeves through beams, footings, girders or columns and for all penetrations of walls or floors below grade. Where floor finish is ceramic tile, terrazzo, or similar material extend standard steel pipe sleeves 1-1/2" above finished floor. Fabricate sleeves 1" diameter larger than pipe or insulation. PVC and sheet metal sleeves at non-structural penetrations only.
 - D. Sleeve Caulking: Caulk below grade pipe with rubber link seal. Grout above grade pipe with cement mortar or approved waterproof mastic. Install UL sealing caulk, putty and/or system at all penetrations of fire rated walls, floors and ceiling.
 - E. Trap Priming: Traps serving floor drains, floor sinks, catch basins, and similar fixtures shall be primed in accordance with Code requirements.
 - F. Heat Trace: Apply freeze protection heat trace to traps exposed to outdoor temperatures.
 - G. Domestic Hot Water Mixing Valves: Install in accordance with manufacturers installation instructions and piping diagrams.

3.6 EXCAVATING

- A. General: Do not excavate for mechanical work until the work is ready to proceed without delay, to minimize the total time lapse from excavation to completion of backfilling. Comply with all applicable Federal and state safety regulations and local erosion control requirements.
- B. Width: Excavate for piping with 6" to 9" clearance on both sides of pipe, except where otherwise shown or required for proper installation of pipe joints, fittings, valves and other work. Excavate for other work to provide minimum practical but adequate working clearances.
- C. Depth for Direct Support: For work to be supported directly on undisturbed soil, do not excavate beyond indicated depths, and hand-excavate the bottom cut to accurate elevations. Support the following work on undisturbed soil at the bottom of the excavations:
 - 1. Piping of 5" and less pipe/tube size.
 - 2. Cast-in-place concrete.
- D. Depth for Exterior Piping: Excavate for exterior water-bearing piping (water and drainage) so that the top of piping will not be less than 2' vertical distance below finished grade.
- E. Depth for Unsatisfactory Soil Conditions: Where unsatisfactory soil condition at the bottom of excavation exists, excavate additional depth as directed to reach satisfactory soil-bearing condition. Backfill with subbase material, compacted as directed, to indicated excavation depth.
- F. Excavated Materials: Store excavated material (temporarily) near the excavation, in a manner which will not interfere with or damage the excavation or other work. Do not store under trees (within the drip line). Retain excavated material which complies with the requirements for backfill material. Dispose of excavated material which is either in excess of quantity needed for backfilling or does not comply with requirements for backfill material.

3.7 BACKFILLING

- A. Do not backfill until installed mechanical work has been tested and accepted wherever testing is indicated. Install drainage fill where indicated, and tamp to a uniform firm density. Backfill with finely-graded subbase material to 6" above wrapped, coated and plastic piping. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to the required densities. Do not backfill with frozen materials.

3.8 CLEANING

- A. General: Clean all dirt and construction dust and debris from all mechanical piping systems and leave in a new condition. Touch up paint where necessary. Removed labels and tags from plumbing fixtures and trim.
- B. Disinfection of Domestic Water Piping System:
 - 1. Piping system disinfection shall be performed by an approved agency. The following procedure may be modified upon their recommendation and Engineers approval.
 - 2. Prior to starting work, verify system is complete and clean.
 - 3. Open all drains and fixtures valves in the building starting with the valve nearest the water service line and permit the water to run clear for 10 minutes to eliminate grease, cuttings, flux, and foreign matter.
 - 4. Inject disinfectant at beginning of water system to be disinfected. Introduce free chlorine in liquid form, throughout system to obtain concentration required by local Public Health Department regulations or 50 to 80 mg/L residual.

5. Bleed water from all potable water outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
6. Maintain disinfectant in system for 24 hours.
7. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
8. Flush disinfectant from system until residual is equal to that of incoming water or 1.0 mg/L.
9. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C601. If any sample fails the analysis, repeat the procedure.
10. Include a copy of the bacteriological analysis in the Operating and Maintenance manuals.

C. Sanitary and Storm Drainage System:

1. Remove construction debris from cleanouts, drains, strainers, baskets, traps, etc., and leave same accessible and operable. Place plugs in the end of uncompleted piping at the end of the day or whenever work stops.
2. Before final acceptance of completed sewer system, flush and clean the entire system with water. Trap and remove solid material obtained from flushing and cleaning from the new system. Do not allow debris to enter the existing sewer system.

3.9 TEST

A. General:

1. Minimum duration of two hours or longer, as directed for all tests. Furnish report of test observation signed by qualified inspector. Make all tests before applying insulation, backfilling, or otherwise concealing piping or connecting fixtures or equipment. Where part of the system must be tested to avoid concealment before the entire system is complete, test that portion separately, same as for entire system.
2. Provide all necessary temporary equipment for testing, including pump and gauges. Remove control devices before testing and do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for the indicated pressure and time.
3. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

B. Repair

1. Repair piping system sections which fail the required piping test by disassembly and re-installation, using new materials to the extent required to overcome leakage. Do not use chemical stop-leak compounds, solder, mastics, or other temporary repair methods.
2. Drain test water from piping systems after testing and repair work has been completed.

C. Sewer: Furnish all facilities and personnel for conducting the test. Test in accordance with the requirements of the State Plumbing Inspector and local authorities.

D. Plumbing Waste and Vent Piping: Hydrostatic test by filling to highest point, but not less than 10' water column on major horizontal portion.

E. Water Piping: Hydrostatic pressure of 100 psig without loss for four hours.

3.10 SUPERVISION AND START-UP

- A. Adjust flush valves, pressure reducing valves, mixing valves, water heater thermostats, and similar equipment.
- B. Master mixing valve start-up procedure: Provide a factory authorized representative to review the installation of the mixing valve and verify that the adjustment has been completed by an authorized agent of the manufacture. Provide documentation in the O&M documents showing adjustment has been completed per manufacture instructions. Record supply and return temperatures. Work shall be completed prior to substantial completion.

END OF SECTION 22 10 00

THIS PAGE INTENTIONALLY BLANK

SECTION 22 30 00 – PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this section apply to the plumbing equipment.
- B. Provide plumbing equipment specified and shown on the Drawings.
- C. Related Work: The requirements of Section 22 05 00, Common Plumbing Materials and Methods, also apply to this section.

1.2 QUALITY ASSURANCE

- A. Code: Comply with requirements of the Oregon State Plumbing Specialty Code.
- B. All equipment and component parts shall conform to governing codes. Gas-fired equipment shall be design certified by AGA.
- C. Labeling: All equipment shall have permanent labels affixed by the manufacturer listing model number, capacity, efficiency, approvals, and similar characteristics of the product.

PART 2 - PRODUCTS

2.1 PIPING

- A. Piping, fittings, pumps, and related items are specified in Section 22 10 00.

2.2 ELECTRIC STORAGE WATER HEATERS

- A. Light Commercial Electric Storage Water Heater:
 - 1. UL approved and complying with the State Energy Code and ASHRAE 90.1-1999 requirements with adjustable automatic thermostatically controlled electric insertion elements constructed to withstand 400 degrees F without failure. Heavy glass-lined steel tank with magnesium anode, heat traps, not less than 1-1/2" of non-organic insulation and factory enameled jacket. Install with ASME Code pressure-temperature relief valve and hose bib drain. Capacity as shown on Drawings.
 - 2. Manufacturers: State, Ruud, Rheem, Bradford White, A.O. Smith, Republic, American, or approved substitute.

- B. Commercial Electric Storage Water Heater:
1. UL approved and complying with the State Energy Code and ASHRAE 90.1-1999 requirements with adjustable automatic thermostatically controlled electric insertion elements constructed to withstand 400 degrees F without failure. Heavy glass-lined **[nickel coated or copper lined]** steel tank with magnesium anode, heat traps, *[two vacuum breakers on copper lined tank,]* not less than 1-1/2" of non-organic insulation and factory enameled jacket. Install with ASME Code pressure-temperature relief valve and hose bib drain. Capacity as shown on Drawings. Internal factory circuit fusing on all heaters drawing 48 amps or more per circuit.
 2. Manufacturers: State, Ruud, Rheem, Bradford White, A.O. Smith, Republic, American, or approved substitute.
- F. Water Heater and Tank Seismic Restraints: For water heaters and tanks, Watts "Spacemaker", Holdrite "Quickstrap," or approved.
- G. Water Heater Stands: Galvanized steel stands with anchoring clips for attachment to wall or floor. Watts "Spacemaker", Holdrite, or approved.
- H. Water Heater mounting bracket: Wall or ceiling mounted water heater support and drain pan assembly with seismic restraints. Watts "Spacemaker", Holdrite, or approved.
- I. Domestic Hot Water Expansion Tank: NSF/ANSI 61 compliant lined steel tank for potable water with epoxy exterior finish, anti-microbial lining, air charging valve and corrosion resistant system piping connection. Butyl rubber bladder/diaphragm. Base mounting ring on sizes over 5 gallons. ASME construction on sizes over 10 gallons. Provide with relief valve where working pressure rating is less than 150 psi.
- J. Expansion tank wall mounting bracket: Provide for expansion tanks 5 gallons or less. Holdrite QS.
- K. Dishwasher Booster Heater: UL approved and built to ASME Code for 150 psi working pressure and tested to 300 psi hydrostatic pressure. Glass lined steel tank. Equip heater with immersion type thermostat and elements, 2-1/2" minimum thickness of non-organic insulation, and painted metal jacket. Furnish complete with all necessary electrical equipment and controls, relief valve and instruction manual. Install under counter in location as directed. Include pressure reducing valve as specified. See Piping Diagram on Drawing. Coates, PVI, A.O. Smith, or approved substitute, with a KW rating and minimum capacity indicated on Drawings.

2.7 INSTANTANEOUS WATER HEATERS

- B. Instantaneous Electric Water Heater: Instantaneous, flow through electric heater rated at full 208 volt and 480 volt operating voltages. Capacities as shown on the Drawings. A.O. Smith R4LA series or approved substitute.

PART 3 – EXECUTION

3.1 UTILITY SERVICE

- A. Plumbing Utility Connections: Complete installation. Verify rough in dimensions of equipment prior to installing piping.

3.2 EQUIPMENT INSTALLATION AND CONNECTION

- A. All equipment shall be installed plumb and level unless otherwise recommended by the manufacturer.
- B. Arrange piping connections to equipment to allow removal and replacement of the equipment without disassembly of connecting piping. Provide valves, unions, flanges, etc. at connection points.
- C. Arrange equipment for adequate service access as recommended by the manufacturer and as required by code.
- D. Anchor equipment to resist displacement due to seismic events as detailed on the drawings, recommended by the manufacturer, and as required by code and as specified in other sections of these specifications. Provide seismic straps as specified above for tank type water heaters.
- E. Install drain pans under all water heaters with piping to approved point of disposal.

3.3 EQUIPMENT CLEANING

- A. Remove construction and shipping protection and thoroughly clean all plumbing equipment just prior to building acceptance.

3.4 SUPERVISION AND START-UP

- A. Do not place equipment onto operation until required work of other trades is complete, e.g. venting systems, combustion air ducts, etc.
- B. Follow manufacturer's instructions for start-up and adjustment of equipment.
- C. The installation, start-up, and adjustment of the **[power gas water heater]** shall be performed by an authorized agent of the manufacturer. The manufacturer's agent shall check out and approve the installation and shall also approve and be responsible for adjusting the operating and control system and instructing the Owner's representatives on the system operation.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this section apply to the plumbing fixtures and trim.
- B. Provide fixtures as shown on the Drawings and specified herein. Provide all required fixture trim and accessories for a complete, finished installation.
- C. Related Work: The requirements of Section 22 05 00, Common Plumbing Materials and Methods, also apply to this section.

1.2 QUALITY ASSURANCE

- A. Code: Comply with requirements of the Oregon State Plumbing Specialty Code.
- B. Fixture color: White unless indicated otherwise.
- C. Fixture Samples: Provide actual samples of plumbing fixtures and faucets prior to or included with the submittal package. Approved samples may be incorporated into the project.
- D. Potable Water Valves: Potable water valves not limited to faucets, mixing valves, or pressure reducing valves. Valves shall meet NSF Standard 61, Section 9, for drinking water faucets and shall be brass construction. Brass components which contact water within the faucet shall be from brass which contains no more than 3 percent lead by dry weight.

PART 2 - PRODUCTS

2.1 PIPING

- A. Piping, fittings, and related items as specified in related Sections 22 10 00.

2.2 PLUMBING FIXTURES AND TRIM

- A. Stops: Furnish stop valves for all fixtures. Wheel handle style, in wall, angle or straight through pattern to fit installation. Stops to be all brass with full turn brass stem and replaceable washer, no plastic. Compression nuts to be high copper content brass. Finish to be copper nickel chrome plate where concealed. Finish on exposed stops as noted. Product to carry manufacturer's name. Provide chrome plated shallow escutcheons. McGuire, Chicago, Brasskraft, Keeney, Zurn, or approved substitute.
- B. Fixture Traps: Exposed fixture tailpieces, traps, and wastes shall be chrome plated 17 gauge seamless brass tube with deep or box style escutcheons as required to conceal rough piping. Products to be stamped with manufacturer's name and material gauge. McGuire, Keeney, Zurn, or approved. Concealed fixture traps may be rigid plastic.
- C. Provide handicap piping protector kit on all exposed accessible fixture traps and supplies (I&S Insulation Co. Inc., Brocar Products Inc. kit 500R, McGuire "Prowrap," Plumberex "Pro-2000" or approved substitute.
- D. Fixtures - **SEE PROJECT MANUAL FOR FIXTURE SPECIFICATIONS**. Fixtures to have the following maximum flow rates. All sensor faucets to be battery powered.
 - 1. WC 1.28 GPF
 - 2. LV 0.35 GPM
 - 3. Tub/Shower 1.50 GPM Shower Head

-
- 4. Kitchen sinks/bar sinks 1.50 GPM
 - E. Recessed Clothes Washer Fitting: Hot and cold water valve washing machine waste outlet with quarter turn ball valves and water hammer arresters. Sioux Chief Ox Box. Fire rated where required. With secondary drainage funnel for HVAC unit drainage where required.
 - F. Recessed Single Water Fitting: Hot or Cold water connection with water hammer arrester and quarter turn ball valve. Sioux Chief Ox Box. Fire rated where required.
 - G. Service Sump (Mop Basin)"MS-1":
 - 1. Faucet exposed, brass body, rough plated, long spout, top brace, hose end spout with bucket hook, vacuum breaker and integral stops in shanks. Chicago 897, T & S B-0665-BSTP, or equal Zurn, Delta Commercial, mounted 24" above rim. Install with 18 gauge type 302, No. 4 finish stainless steel splash on the two walls.
 - 2. Molded stone 24" x 36" x 10" deep with vinyl bumper guard and 3" brass body strainer outlet. Fiat, Mustee, Swan or approved substitute. .
 - I. Hose Bibs:
 - 1. "HB-2": Exterior non-freeze hot and cold mixing self-draining type with vacuum breaker, removable handle, brass wall casing and wall clamp. Woodford HC67.
 - 2. "HB-1": Exterior non-freeze self-draining type with vacuum breaker, removable wheel handle, brass wall casing and wall clamp. Woodford 65.
 - 3. "HB-3": Exterior non-freeze anti siphon with integral backflow protection. 3/4" male hose thread with wheel handle. Woodford Residential Model 19.

PART 3 - EXECUTION

3.1 PIPING

- A. Install in accordance with Section 22 10 00.
- B. Hot and cold water stubouts to fixtures shall be copper. Secure stubouts with manufactured bracket system. Hubbard "Holdrite", Sioux chief, or approved.

3.2 FIXTURE INSTALLATION AND CONNECTION

- A. All exposed fixture hardware and piping shall be plated with polished chrome unless otherwise directed in these specifications. Where chair carriers or special carrier design are not indicated, provide wall blocking for anchorage of manufacturers standard mounting bracket.
- B. All fixtures in contact with finished walls and floors shall be caulked with waterproof, white, non-hardening sealant which will not crack, shrink or change color with age.
- C. All fixtures and component parts shall conform to governing codes.
- D. All fixtures shall be securely mounted level and plumb or as recommended by the manufacturer. Mount fixtures intended to be accessible to the handicapped at the dimensions required by code.

3.3 STARTUP

- A. Adjust flush valves, pressure reducing valves, mixing valves, water heater thermostats, and similar equipment.

- B. Remove construction protection, tags and labels and thoroughly clean all plumbing equipment and trim. Scour all fixtures just prior to building acceptance.

END OF SECTION 22 40 00

SECTION 23 01 00 - HVAC DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide detailed HVAC design and construction documents as indicated in:
 - 1. The Mechanical specifications (all sections included in the design assist documents).
 - 2. The Design Assist Drawings.
 - 3. The System Narrative.

1.2 QUALITY ASSURANCE

- A. All systems designs shall conform to all applicable local and state codes and all federal, state and other applicable laws and regulations.
- B. Whenever the requirements of the Specifications exceed those of the applicable code or standard, the requirements of the Specifications shall govern.
- C. The Design shall comply with all LEED or Energy Trust benchmarks as set forth in the Architectural specifications, or the System Narrative.
- D. Codes and Standards: Comply with the provisions of the current edition of the following referenced codes, standards and specifications:
 - 1. American National Standards Institute (ANSI)
 - 2. Oregon Plumbing Specialty Code (OPSC)
 - 3. Oregon Mechanical Specialty Code (OMSC)
 - 4. Oregon Structural Specialty Code (OSSC)
 - 5. Oregon Energy Efficiency Specialty Code (OEESC)
 - 6. Oregon Uniform Fire Code (UFC)
 - 7. National Fire Codes (NFC) by National Fire Protection Association (NFPA).
 - 8. All local amendments of the above codes.
 - 9. All other Codes and Standards referenced throughout these specifications.
- E. All electrical products specified shall in all cases be listed and labeled as an assembly by an approved nationally recognized safety testing organization.
- F. The Contractor shall submit the Drawings for plan review by the Authority having jurisdiction, pay any and all plan review fees, and respond to review comments and revise the Drawings as required.

1.3 COORDINATION

- A. The HVAC Contractor shall coordinate all aspects of the design and installation of the various HVAC systems included in these Specifications including but not limited to connections to utilities, scheduling, space allocation, interfacing of systems, submission of Drawings and equipment submittals, and the successful operation of the completed systems.

- B. The HVAC Contractor shall furnish the Electrical Contractor with the electrical power requirements of all mechanical equipment in a timely manner.

PART 2 - DESIGN

2.1 DESIGN CRITERIA

- A. Scope: Provide complete designs for the following mechanical systems:
1. Complete mechanical system including heating, ventilation, and cooling of all areas utilizing packaged gas heating-electric cooling rooftop units, ductwork systems, exhaust systems, control system, and gas piping system.
- B. Heating, Ventilating, and Cooling System:
1. Air Handling and Distribution:
 - a. The following temperatures shall be the basis of design:
 - 1) Heating season: 70 deg. F DB inside
10 deg. F DB outdoors
 - 2) Cooling season: 75 deg. F inside
95 deg. F outdoors
 - b. Zoning: The building shall be zoned to allow accurate temperature control in areas that experience different heating and cooling loads. Zoning is accomplished through the use of multiple heating and cooling units and independent duct systems. Provide zones as indicated on the Design Assist Drawings and System Narrative.
 - c. Duct Design: The duct system shall be designed to deliver the required air volumes to each space. The maximum allowable duct pressure loss is 0.10" WG per 100 ft. The maximum allowable velocity is 1200 ft/min (900 ft/min for residential areas).
 - d. Provide supply and return air to each space except return air is not required where exhaust fans are provided.
 - e. Provide exhaust for each toilet room at the rate of 10 air changes per hour.
 - f. Air Diffusion: Select air outlets based on a supply air temperature difference of 20 deg. F. Air velocity within the occupied zone (6" to 6' above floor) shall not exceed 50 ft/min. The maximum temperature gradient from floor to 6' shall not exceed 5° F between any two points in the room more than 2' from exterior walls.
 2. Gas Piping: Design gas piping in accordance with the Code and to supply gas to all appliances simultaneously. Include demand of building heating equipment, water heating equipment, and cooking appliances. Contractor has the option of using a low pressure or 2 psi system.
- C. Acoustic Design: The design shall include consideration of the acoustic characteristics of the equipment and systems. Residential exhaust fans shall not exceed 1 sone. The mechanical systems shall not produce noise levels in indicated spaces exceeding the following limits:
- | <u>Space</u> | <u>NC Limit</u> |
|---------------|-----------------|
| Multi-use/Gym | 30 |
| Classrooms | 35 |
| Offices | 35 |

Corridor/Foyer	35
Storage/Mechanical	40
Residential	25
Other	35

- D. Vibration: The mechanical systems shall not generate noticeable vibration in any occupied space. Provide vibration isolation equipment as required.
- E. Seismic Restraint: The Mechanical Contractor is responsible for the design of seismic restraint systems for all portions of the mechanical systems and equipment in accordance with the requirements of the Code.

PART 3 - CONSTRUCTION DOCUMENTS

3.1 CRITERIA

- A. Develop construction documents for the Heating, Ventilating, Air Conditioning, Exhaust, and related mechanical systems. The quality of the Drawings shall be similar to those produced by the Architect and shall be sufficiently detailed to graphically represent the appearance of the installed mechanical systems. Submit the Drawings to the Architect for review.
- B. Installation Drawings: Prepare complete installation Drawings for approval prior to commencement of work. Do not begin installation of any portion of the work until approved Drawings have been returned from the Architect. Installation Drawings shall be the same size, with overall floor plans at the same scale, as the architectural Drawings, and shall include the following information:
 - 1. All HVAC piping sizes and pipe routing.
 - 2. All mechanical equipment located and identified.
 - 3. All ductwork sizes shown and routing through the structure indicated. Provide enlarged floor plans of congested areas such as mechanical rooms and provide building sections indicating coordination of the mechanical systems with the building structure.
 - 4. Gas piping schematic including appliance demand, pipe length, delivery pressure, total building load, and code table used to size piping.
 - 5. Schedule of mechanical equipment including manufacturer's name and model number, and equipment characteristics and capacities.
 - 6. Control systems including field wiring diagrams.
 - 7. Required airflow at all air inlets and outlets.
 - 8. Required ventilation airflow for each space with method of calculation.
 - 9. Legends identifying symbols used on the Drawings.
 - 10. Submit heating and cooling load calculations used to establish equipment capacities and airflow rates (submit on separate 8-1/2" by 11" sheets).
 - 11. Energy code compliance forms (may be indicated on Drawings or on separate 8-1/2" by 11" sheets).

- C. Installation Drawings shall be prepared by or under the supervision of a Professional Engineer or Certified Engineering Technician registered in the state where the work is to be performed. The Engineer or technician shall have been trained and presently be specializing and practicing in the field of mechanical system design. The Engineer or Technician shall stamp and sign all submitted Drawings. Drawings shall include a title block identifying the Contractor, project name and address, drawing name, number, and submittal date and record of revisions to original Drawings.
- D. Contractor shall submit equipment catalog data and shop Drawings as specified in Division 23 specification sections for review by the Engineer. HVAC submittals shall include all air handling equipment, air filters, air inlets and outlets, fire and smoke dampers, insulation, and controls.

END OF SECTION

SECTION 23 05 00 - HVAC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The provisions of the General Requirements, Supplementary Requirements, and Division 1 apply to the HVAC work specified in this Division.
- B. The requirements of this Section apply to the HVAC systems specified in these Specifications and in other Division 23 sections.
- C. Provide all items, articles, materials, equipment, operations and/or methods listed, mentioned, shown and/or scheduled on the Drawings and/or in these Specifications, including all labor, supervision, services, permits, fees, and incidentals necessary and required to provide a complete and operable facility with complete systems as shown, specified, and required by applicable codes.
- D. The work shall include, but not be limited to, the following systems:
 - 1. Heating and cooling equipment.
 - 2. Complete piping systems including valves, supports, etc.
 - 3. Air handling equipment including packaged equipment and exhaust fans.
 - 4. Air distribution systems including ductwork, terminal units, dampers, insulation, and air inlets and outlets.
 - 5. HVAC condensate drain piping system.
 - 6. HVAC control system.
 - 7. Special systems as specified herein.
- E. Advise subcontractor, suppliers, and vendors involved in the work specified in this Section of the applicable requirements.

1.2 QUALITY ASSURANCE

- A. All work and materials shall conform to all applicable local and state codes and all federal, state and other applicable laws and regulations. All clarifications and modifications which have been cleared with appropriate authorities are listed under the applicable sections. All electrical products shall bear the label of a recognized testing laboratory such as UL or CSA.
- B. Whenever the requirements of the Specifications or Drawings exceed those of the applicable code or standard, the requirements of the Specifications and Drawings shall govern.
- C. Codes and Standards: Comply with the provisions of the following referenced codes, standards and specifications:
 - 1. Federal Specifications (FS)
 - 2. American National Standards Institute (ANSI)
 - 3. National Electrical Manufacturer's Association (NEMA)
 - 4. National Fire Protection Association (NFPA)
 - 5. Underwriters Laboratories, Inc. (UL)

6. Factory Mutual (FM)
 7. International Building Code (IBC) with State and Local Amendments
 8. International Mechanical Code (IMC) with State and Local Amendments
 9. Uniform Plumbing Code (UPC) with State and Local Amendments
 10. American Society for Testing and Materials (ASTM)
 11. Americans with Disabilities Act (ADA)
 12. International Fire Code (IFC) with State and Local Amendments
 13. Energy Policy Act (EPAAct)
 14. Manufacturers Standardization Society (MSS)
 15. American Gas Association (AGA)
- D. Each piece of equipment furnished shall meet all detailed requirements of the Drawings and Specifications and shall be suitable for the installation shown. Equipment not meeting all requirements will not be acceptable, even though specified by name. Where two or more units of the same class of equipment are furnished, use product of the same manufacturer; component parts of the entire system need not be products of same manufacturer. Furnish all materials and equipment, new and free from defect and of size, make, type and quality herein specified or approved by the Architect. All materials shall be installed in a neat and professional manner.
- E. All apparatus shall be built and installed to deliver its full rated capacity at the efficiency for which it was designed.
- F. The Drawings and Specifications are complementary. What is called for by one shall be as though called for by both.
- G. Drawings: Do not scale Drawings for roughing-in measurements, nor use as shop Drawings. Make field measurements and prepare shop Drawings as required. Coordinate work with shop Drawings of other specification divisions.
- H. Field Wiring: It is the intent of these specifications that all systems shall be complete and operable. Refer to all Drawings and specifications, especially the electrical Drawings, to determine voltage, phase, circuit ampacity and number of connections provided. Provide all necessary field wiring and devices from the point of connection indicated on the electrical Drawings. All equipment shall be installed in compliance with the Electrical Code and the equipment's UL listing. Bring to the attention of the Architect in writing, all conflicts, incompatibilities, and/or discrepancies prior to bid or as soon as discovered.
- 1.3 WORK OF OTHER CONTRACTS
- A. Work under this contract shall be conducted in a manner to allow for the future installations of such equipment or items listed in other sections of this Specification.
- 1.4 WORK OF OTHER DIVISIONS
- A. Work under this Division shall be conducted in a manner to cooperate with the installation of such equipment or items as specified in other Divisions.
- B. Plumbing piping systems and fixtures and fire suppression piping systems are specified under other Divisions of these Specifications except for provisions or items specifically noted on the Drawings or specified herein.

- C. Consult all Drawings and Specifications in this project and become familiar with all equipment to be installed. Coordinate all aspects of the construction with the other trades on the job to ensure that all work and materials required to provide a complete and operational facility are included in the bid.
- D. All sections of Division 23 are interrelated and shall be considered in their entirety when interpreting any material, method, or direction listed in any section of Division 23. Individual sections are not written for specific subcontractors or suppliers but for the General Contractor.

1.5 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES (SUBMITTALS)

- A. Submit in accordance with Division 1 full technical and descriptive shop Drawing data on proposed materials and equipment as detailed in each section.
- B. The Contractor shall verify that all equipment submitted can be delivered and installed within the time constraints of the construction period.
- C. Include the manufacturer, type, style, catalog number, complete specification, certified dimensions, and description of physical appearance for each item and option submitted. Reproduction of catalog data sheets shall be clean and legible to show all details, including gauge of metal used.
- D. Include only information on exact equipment to be installed, not general catalogs of the manufacturer. Where sheets show proposed equipment as well as other equipment, identify proposed equipment with rubber stamp arrow or similar concise method.
- E. Submit with each copy a transmittal letter verifying that all included equipment submittals have been carefully considered for quality, dimensions, function, and have been coordinated with the Drawings and Specifications. Guarantee that proposed materials will meet or exceed the quality and function of those specified.
- F. Include field wiring diagrams and connection diagrams for all control and/or low voltage systems, including floor plans.
- G. Submittal Review: The submittal review process is a means to provide quality control. The action noted to be taken (or where conflicts with the contract documents are not noted) shall not be interpreted by the Contractor as automatic "change orders." Approval of the data for substitution and shop Drawings shall not eliminate the contractor's responsibility for compliance with Drawings or Specifications, nor shall it eliminate the responsibility for freedom from errors of any sort in the data discovered prior to or after the review process. Deviations, discrepancies, and conflicts between the submittals and the Contract Documents shall be called to the Architect's attention in writing at the time of transmittal of the data.
- H. Unless otherwise directed by Division 1, submittal data shall be in a 3-ring plastic binder with a clear plastic sleeve and a project identification sheet inserted. Arrange submittals numerically with specification sections identified on divider tabs. All required sections shall be submitted at one time.

1.6 PRODUCT SUBSTITUTION

- A. Materials other than those specified may be approved for this project providing a written request is submitted to the Architect prior to bid in accordance with Instructions to Bidders. Requests shall include complete specifications, dimensions, manufacturer and catalog number for each item for which approval is desired. If, in the opinion of the Architect, the material is not complete or if it is not an acceptable substitute, he may reject it. The Architect's evaluation will be based solely on the material submitted.

1.7 CHANGE ORDERS

- A. All supplemental cost proposals by the Contractor shall be accompanied by a complete itemized breakdown of labor and materials without exception. At the Architect's request, the contractor's estimating sheets for the supplemental cost proposals shall be made available to the Architect. Labor must be separated and allocated for each item of work.

1.8 RECORD DOCUMENTS

- A. Project Record (As-Installed) Drawings:
 - 1. Maintain a set of record drawings on the job site as directed in Division 1.
 - 2. Keep Drawings clean, undamaged, and up to date.
 - 3. Record and accurately indicate the following:
 - a. Depths, sizes, and locations of all buried and concealed piping dimensioned from permanent building features.
 - b. Locations of all valves.
 - c. Locations of all fire dampers and other airflow control devices.
 - d. Changes, additions, and revisions due to change orders, obstructions, etc. Eradicate extraneous information.
 - e. Model numbers of installed equipment.
 - 4. Make Drawings available when requested by Architect for review.
 - 5. Submit as part of the required Project Closeout documents.
- B. Operating and Maintenance Manuals: Submit five (5) sets of Operating and Maintenance Instructions, including manufacturer's service data, wiring diagrams, and parts lists and vendors for all serviceable items of equipment, valve charts, balancing data, final control diagrams showing final set points, and any additional equipment added by change order, bound in three-ring, vinyl or canvas covered, loose-leaf binders organized with index and thumb-tab markers for each classification of equipment or data.

1.9 WARRANTY

- A. Furnish, prior to application for final payment, three copies of written and signed guarantee effective a period of one year from date of completion and acceptance of entire project; agree to correct, repair and/or replace defective materials and/or equipment or the results of defective workmanship without additional expense to the Owner. Where no response satisfactory to the Owner has occurred within three working days from the written report of a warranty covered defect, the contractor shall agree to pay for the cost of repair of the reported defect by a contractor of the Owner's choice.

- B. Where the manufacturer's guarantee exceeds one year, the longer guarantee shall govern and include the Contractor's labor.

PART 2 - PRODUCTS

2.1 GENERAL

- A. General: Provide all new materials and equipment, identical to apparatus or equipment in successful operation for a minimum of two years. Provide materials of comparable quality omitted here but necessary to complete the work. Maximum allowable variation from stated capacities, minus 5% to plus 10% as approved in each case.
- B. Compatibility: Provide products which are compatible with other portions of the work and provide products with the proper or correct power and fuel-burning characteristics, and similar adaptations for the project.
- C. Efficiency: Heating and cooling equipment shall comply with ASHRAE Standard 90.1-2010 and the State Energy Code. Where equipment efficiencies are indicated, the use of alternate or substitute manufacturer's equipment with lower efficiencies is not permitted.
- D. Storage and Handling:
 - 1. Delivery: Deliver to project site with manufacturer's labels intact and legible.
 - 2. Handling: Avoid damage.
 - 3. Storage: Inside protected from weather, dirt and construction dust. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.

2.2 ACCESS PANELS

- A. Manufacturers: Inryco/Milcor, Bilco, Elmdor, Karp, Potter-Roemer or accepted substitute. Inryco/Milcor Style DW, K, or M panels as required by construction.
- B. Construction: Flush style, fire rated in fire rated partitions and ceilings. Screwdriver latches on all access panels.

2.3 VALVES

- A. General: Provide factory fabricated valves of the type, body material, temperature and pressure class, and service indicated. Bronze gate, globe and check valves shall comply with MSS-SP-80. Ball valves shall comply with MSS-SP-110. Iron gate and globe valves shall comply with MSS-SP-70. Iron check valves shall comply with MSS-SP-71. Butterfly valves shall comply with MSS-SP-67. Valve size same as connecting pipe size.
- B. Acceptable Manufacturers: Milwaukee, Crane, Grinnell, Nibco, Hammond, Stockham, Legend, Watts, and Walworth. Grooved end valves Victaulic, Tyco-Grinnell, Gruvlock, or accepted substitute. NIBCO numbers are given except as noted. Where possible, provide valves from a single manufacturer.

- C. Valve Styles: See individual Division 23 sections for valve styles.
- D. Selection of Valve Ends (Pipe Connections): Select and install valves with ends matching the types of pipe/tube connections.

2.4 HANGERS AND SUPPORTS

- A. General: Provide factory-fabricated horizontal piping hangers, clamps, hanger rod, inserts, supports, etc., of the indicated MSS type and size. The Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry Practice SP-58 and SP-69 are referenced in this section.
- B. Manufacturers: B-Line, Carpenter & Paterson, Grinnell, Michigan, Superstrut, Tolco, Erico, or accepted substitute. Grinnell figure numbers in parentheses where applicable (or other manufacturers as noted).
- C. Corrosion Protection: Provide materials which are zinc plated or factory painted to prevent corrosion. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated, plastic coated, or by other recognized industry methods.

2.5 PENETRATION FIRE STOPPING

- A. Through-penetration fire stopping system tested and listed by Underwriters Laboratories. Hilti, 3M, Metacaulk, SpecSeal, or approved.
- B. Select system for proper application based on wall construction, type of penetrating item, wall rating, etc.

2.6 ROOF PENETRATIONS

- A. Roof piping, tubing, and conduit penetrations shall be protected by a manufactured penetration assembly. Portals Plus, Inc. or approved.
- B. Roof penetration system shall include continuously welded, 18 gauge galvanized steel roof curb with compatible integral base, acrylic coated ABS curb cap with raised molded opening, EPDM molded cap suitable for penetrating item(s), and stainless steel sealing clamps.

2.7 STARTERS AND SWITCHES

- A. Manufacturers: Cerus Industrial, General Electric, ABB, Allen Bradley, Schneider Electric, Eaton, are approved. Provide starters by same manufacturer throughout project.
- B. General: Provide each motor with starter or switch as approved and recommended by manufacturer of motor or equipment of which motor is a part.

PART 3 - EXECUTION

3.1 LAYOUT AND COORDINATION

- A. Site Examination: Before starting work, carefully examine site and all contract Drawings. Become thoroughly familiar with conditions governing work on this project. Verify all indicated elevations, building measurements, roughing-in dimensions and equipment locations before proceeding with any of the work.
- B. Utility Locations: The location of existing utilities, wires, conduits, pipes, ducts, or other service facilities are shown in a general way only on the Drawings and are taken from existing records. Ascertain whether any additional facilities other than those shown on the plans may be present and determine the exact location and elevations of all utilities prior to commencing installation.
- C. Sleeves, Inserts, Cast-in-Place Work: Provide sleeves, inserts, anchoring devices, cast-in-place work, etc. which must be set in concrete sequenced at the proper time for the project schedule.
- D. Coordination:
 - 1. The Drawings are based on equipment of a certain manufacturer and may be identified as such. Where alternate manufacturers or approved substitutes are incorporated into the work, any required design changes are the responsibility of the contractor. Such changes may include changes in utility or system connection sizes, location, or orientation, service clearances, structural support or acoustic considerations.
 - 2. Where the work must be sequenced and positioned with precision in order to fit into the available space, prepare accurate scale shop Drawings showing the actual physical dimensions required for the installation and submit prior to purchase/fabrication/installation of any of the elements involved in the coordination.
 - 3. Cooperate with other trades in furnishing material and information for sleeves, bucks, chases, mountings, backing, foundations and wiring required for installation of mechanical items.
 - 4. Coordinate all work with other trades and determine in advance where interfacing of the mechanical work and other work are required to be connected together. Provide all materials and equipment to make those connections. Submit shop Drawings showing required connections where special conditions exist.
- E. Discrepancies: Report immediately any error, conflict or discrepancy in Plans, Specifications and/or existing conditions. Do not proceed with any questionable items of work until clarification of same has been made. Should rearrangement or re-routing of piping be necessary, provide for approval the simplest layout possible for that particular portion of the work.

3.2 MECHANICAL EQUIPMENT WIRING

- A. Provide all mechanical equipment motors, automatic temperature, limit, float and similar control devices required, with wiring complete from power source indicated on Electrical Drawings.
- B. Provide properly rated motor overload and undervoltage protection and all manual or automatic motor operating devices for all mechanical equipment.

- C. Equipment and systems shown on the Drawings and/or specified, are based upon requirements of specific manufacturers which are intended as somewhat typical of several makes which may be approved. Provide all field wiring and/or devices necessary for a complete and operable system including controls for the actual selected equipment/system.

3.3 GENERAL INSTALLATION

- A. Locating and Positioning Equipment: Observe all Codes, Regulations and good common practice in locating and installing mechanical equipment and material so that completed installation presents the least possible hazard. Maintain adequate clearances for repair and service to all equipment and comply with Code requirements.
- B. Arrangement: Arrange piping parallel with primary lines of the building construction, and with a minimum of 7' overhead clearance in all areas where possible. Unless indicated otherwise, conceal all piping. Locate operating and control equipment properly to provide easy access, and arrange entire mechanical work with adequate access for operation and maintenance. Give right-of-way to piping which must slope for drainage. Set all equipment level or as recommended by manufacturer. Under no conditions shall beams, girders, footings or columns be cut for mechanical items. Casting of pipes into concrete is prohibited unless so shown on Drawings.
- C. Access Panels: Provide access panels with proper backing reinforcement for all equipment, dielectric unions, valves and items requiring service and installed above ceilings, behind walls, or in furring, complete with correct frame for type of building construction involved. Exact size, number and location of access panels are not necessarily shown on Drawings. Use no panel smaller than 12" by 12" for simple manual access or smaller than 16" x 20" where personnel must pass through.
- D. Adjusting: Adjust and calibrate all automatic mechanical equipment, temperature controls, float devices, etc. Adjust flow rates at each piece of equipment or fixture.
- E. Building Vapor Barrier: Wherever the building insulation vapor barrier is penetrated by piping, hangers, conduits, etc., provide clear self-adhesive tape recommended by the insulation manufacturer around the penetrations.
- F. Condensate drainage: Provide a complete condensate piping system discharging to an approved receptor. Discharging to the exterior is not permitted. Heat trace and insulate all condensate piping located outdoors. See Division 22 for approved piping materials and methods.

3.4 VALVE INSTALLATION

- A. General: Comply with the following requirements:
 - 1. Install valves where required for proper operation of piping and isolation of equipment, including valves in branch lines where necessary to isolate sections of piping, and where shown on the Drawings.
 - 2. Locate valves in accessible spaces (or behind access panels) and so that separate support can be provided when necessary.

3. Install valves with stems pointed up, in the vertical position where possible, but in no case with stems pointed downward from a horizontal plane.
- B. Valve Access: Provide access panels to all valves installed behind walls, in furring or otherwise inaccessible.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. General: Proceed with the installation of hangers, supports and anchors only after the required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) the proper placement of inserts, anchors and other building structural attachments.
 1. Install hangers, supports, clamps, and attachments to support piping and equipment properly from the building structure. Use no wire or perforated metal to support piping, and no supports from other piping or equipment. For exposed continuous pipe runs, install hangers and supports of the same type and style as installed for adjacent similar piping.
 2. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated or by other recognized industry methods.
 3. Arrange supports to prevent eccentric loading of joists and joist girders. Locate supports at panel points only.
- B. Provisions for Movement:
 1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate the action of expansion joints, expansion loops, expansion bends and similar units. Install specified seismic restraints to restrict excessive movement.
 2. Install hangers and supports so that equipment and piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
 3. Install hangers and supports to provide the indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.
- C. Pipe Support:
 1. Vertical Spacing: Support at base, at equivalent of every floor height (maximum 10' as required by Code) and just below roof line.
 2. Screwed or Welded Steel or Copper Piping: Maximum hanger spacing shall be as follows:

	<u>Steel</u>	<u>Copper</u>
1-1/4" and smaller	7' span	6' span
1-1/2" pipe	9' span	6' span
2" pipe	10' span	10' span
2-1/2" & larger	12' span	10' span
 3. Install additional hangers or supports at concentrated loads such as pumps, valves, etc. to maintain alignment and prevent sagging.
 4. Support Rod: Hanger support rods sized as follows:

<u>Pipe and Tube Size</u>		<u>Rod Size</u>	
<u>Inches</u>	<u>mm</u>	<u>Inches</u>	<u>mm</u>

1/2" to 4"	12.7 to 101.6	3/8"	9.5
5" to 8"	127.0 to 203.2	1/2"	12.7
10" to 12"	254.0 to 304.8	5/8"	15.9

- D. Adjust hangers and supports to bring piping to proper levels and elevations.
- E. Provide all necessary structural attachments such as anchors, beam clamps, hanger flanges and brackets in accordance with MSS SP-69. Attachments to beams wherever possible. Supports suspended from other piping, equipment, metal decking, etc., are not acceptable.
- F. Horizontal banks of piping may be supported on common steel channel member spaced not more than the shortest allowable span required on the individual pipe. Maintain piping at its relative lateral position using clamps or clips. Allow lines subject to thermal expansion to roll axially or slide. Size channel struts for piping weights.
- G. Installation of drilled-in concrete anchors shall comply with the manufacturer's instructions for working load, depth of embedment, and spacing between anchors and from the edge of the slab. Use only wedge-style anchors.

3.6 EQUIPMENT CONNECTIONS

- A. Provide complete connections for all items of equipment requiring such connections, including incidental piping, fittings, trim and labor necessary for a finished working installation.
- B. Verify the rough-in and finish requirements for all equipment provided under other Divisions of the work and requiring HVAC piping or duct connections with equipment supplier and installer prior to rough-in.

3.7 PROTECTION

- A. Protect all work and materials against loss or damage. Close all pipe openings with caps or plugs. At final completion, thoroughly clean and deliver all work and equipment in an unblemished new condition. Keep all motors and bearings in watertight and dustproof covers during entire course of installation.
- B. Protect floors, walls, framing and sheathing where pipe cutting and threading operations are conducted with plastic sheeting under plywood sheets. Extend plastic sheeting beyond the plywood. Clean-up metal cuttings, oil, etc., daily or as necessary to prevent debris from being tracked beyond the protected area. Damages, as determined by the Architect, due to the pipe cutting/threading operation shall be repaired by the responsible trade.

3.8 PIPE PENETRATION FIRE STOPPING

- A. Install as recommended by manufacturer and in accordance with the product's UL listing. Below are the minimum installation requirements.
 - 1. Install specified penetrating item(s) with required annular spacing in proper size wall or floor opening. Support penetrating item(s) adequately on both sides of construction.

2. Clean all opening and penetrating item surfaces in penetration area to remove loose debris, dirt, oil, wax, grease, old caulking, etc.
3. If needed or required for gypsum or concrete block walls, install specified galvanized steel wire mesh or sleeve recessed and centered inside wall around penetrating item(s) so that it is snug against perimeter of opening.
4. When required, install specified type and depth of backing material in annular space, recessed to required fill depth of fire stopping caulking.
5. Gun, trowel, and/or pump fire stopping sealant to specified depth in annular space around penetrating item(s). Trowel sealant surfaces flush with wall or floor surfaces to a smooth, defect-free finish. Where required, apply specified size caulking bead around penetrating item(s) at zero annular contact areas and tool smooth.

3.9 HVAC WORK CLOSEOUT

- A. General: Refer to the Division 1 sections for general closeout requirements. Calibrate all equipment requiring same. Complete each system as shown or specified herein and place in operation except where only roughing-in or partial systems are called for. Each system shall be tested and left in proper operation free of leaks, obstructions, or contamination.
- B. Record Drawings: Submit record set of Drawings as previously specified in this Section.
- C. Closeout Equipment/Systems Operations: Sequence operations properly so that work of project will not be damaged or endangered. Coordinate with seasonal requirements. Operate each item of equipment and each system in a test run of appropriate duration with the Architect present, and with the Owner's operating personnel present, to demonstrate sustained, satisfactory performance. Adjust and correct operations as required for proper performance. Clean and lubricate each system and replace dirty filters, excessively worn parts and similar expendable items of the work.
- D. Operating Instructions: Conduct a walk-through instruction seminar for the Owner's personnel who are to be involved in the continued operation and maintenance of the HVAC equipment and systems. Provide written instructions outlining and explaining the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, seasonal provisions, security, safety, efficiency and similar features of the systems.

END OF SECTION

SECTION 23 05 90 - TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: After completion of the work of installation, test and regulate all components of the new heating, air conditioning and ventilating systems to verify air volumes and heating-cooling flow rates indicated on the Drawings.
- B. Related Work: The requirements of Section 23 05 00, Common HVAC Materials and Methods, also apply to this section.
- C. Balancing Organization:
 - 1. Balancing of the Heating and Air Conditioning Systems: Performed by a firm providing this service established in the State of Oregon.
 - 2. Provide all necessary personnel, equipment, and services.
- D. TAB will be responsible to carry out the commissioning requirements specified in Section 23 08 00, 01 91 00 and other Sections referenced in 01 91 00.

1.2 SUBMITTALS

- A. Balancing Data: Include the following minimum information in the Operation and Maintenance Data, as specified in Section 23 05 00.
 - 1. Names or initials of personnel performing the balancing.
 - 2. Dates balancing was performed.
 - 3. List of balancing instruments utilized.
 - 4. Weather conditions at the time of the test.
 - 5. Mechanical system descriptions.
 - 6. All motor rated voltages, amps, starter and overload protective device sizes.
 - 7. All motor operating data.
 - 8. Fan cfm, rpm, operating static pressures, driven and motor sheave data, and all drive changes necessitated to obtain design capacities. List actual minimum outside air volumes measured for each system.
 - 9. All supply, return and exhaust air outlet cfm readings.

1.3 DETAILED REQUIREMENTS

- A. Adjusting and Balancing:
 - 1. Prior to beginning the balancing work, obtain from the Architect the latest version of the mechanical Drawings including addenda, revisions, change orders, etc.
 - 2. Adjust and balance all portions of the mechanical systems to produce indicated results within limits of minus 5 or plus 10 percent.
 - 3. Adjust diffuser throws as shown on the Drawings (shown as directional arrows).

NICK FISH TI MERKATO

APRIL 27, 2026
TENANT IMPROVEMENT

END OF SECTION

SECTION 23 07 00 - HVAC INSULATION

PART 1 – GENERAL

1.1 DESCRIPTION

- A. The requirements of this section apply to the insulation of mechanical equipment specified elsewhere in these specifications.
- B. Related Work: The requirements of Section 23 05 00, Common HVAC Materials and Methods, also apply to this section.

1.2 QUALITY ASSURANCE

- A. Inspection: A certified mechanical insulation shall be performed by inspectors who maintain current certification, by the National Insulation Association or other certified mechanical association, throughout the project to inspect and verify the materials and the total insulation system has been installed correctly in accordance with the specifications and material manufacturer's instructions.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products **listed and labeled in accordance with UL 723 or in accordance with ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction**. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
 - 1. Piping Mockups:
 - a. One **10-foot (3-m)** section of **NPS 2 (DN 50)** straight pipe.
 - b. One each of a 90-degree threaded, welded, and flanged elbow.
 - c. One each of a threaded, welded, and flanged tee fitting.
 - d. One **NPS 2 (DN 50)** or smaller valve, and one **NPS 2-1/2 (DN 65)** or larger valve.
 - e. Four support hangers including hanger shield and insert.
 - f. One threaded strainer and one flanged strainer with removable portion of insulation.
 - g. One threaded reducer and one welded reducer.
 - h. One pressure temperature tap.
 - i. One mechanical coupling.
 - 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.

3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 4. Obtain Architect's approval of mockups before starting insulation application.
 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed.
- D. Insulation Thickness and Thermal Performance: Comply with the provisions of the State of Oregon Energy Efficiency Specialty Code (OSEEC).
[State of California Title 24 Energy Conservation Standards.]
[State of Washington Energy Regulations.]
- E. Composite (Insulation, Jacket or Facing and Adhesives) Fire and Smoke Hazard Ratings: Not to exceed a flame spread of 25 or smoke development of 50 and containing less than 0.1% by weight deca-PDE fire retardant.
- F. Component Ratings of Accessories (Adhesives, Mastics, Cements, Tapes, Finishing Cloth for Fittings): Same as "B" requirements above and permanently treated. No water soluble treatments.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. General: In addition to the requirements specified in Section 23 05 00, the following apply:
1. Deliver insulation, coverings, cements, adhesives and coatings to the site in factory-fabricated containers with the manufacturer's stamp or label affixed showing fire hazard ratings of the products. Store insulation in original wrappings and protect from weather and construction traffic.
 2. Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged insulation. Remove such insulation from project site.

1.4 SUBMITTALS

- A. Submit catalog data and performance characteristics for each product specified.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Insulating Manufacturers: Johns Manville, Knauf, Armacell, Owens-Corning, Pittsburgh Corning, Pabco, Imcoa, Nomaco, or Certain Teed. Johns Manville products are listed unless indicated otherwise.
- B. Adhesive Manufacturers: Foster, 3M, Insul-Coustic, Borden, Kingco or Armacell.

2.2 PIPING INSULATION

- A. Interior and Exterior Piping Systems 50 to 850 Deg. F, ASTM C 547: Glass fiber preformed pipe insulation with a minimum K-value of 0.23 at 75 Deg. F, a minimum density of 3.5 pounds per cubic foot within all-service vapor barrier jacket containing less than 0.1% by weight deca-PDE fire retardant, vinyl or pre-sized finish and pressure sensitive seal.
- B. Exterior Installations: Same as for interior installations except 0.016" aluminum finish jacket **[or, in coastal environments, 0.01" stainless steel]**.
- C. Interior Piping Systems 32 to 50 Deg. F: Glass fiber preformed pipe insulation with a minimum K-value of 0.23 at 75 deg. F, a minimum density of 3.5 pounds per cubic foot. Polymer vapor barrier jacket containing less than 0.1% by weight deca-PDE fire retardant and with pressure sensitive seal and wicking system to remove condensation from pipe surface. Owens Corning "VaporWick."
- D. Pipe Temperatures Minus 30 to 180 Deg. F: Flexible, preformed, pre-slit, self-sealing elastomeric pipe insulation, thermal conductivity of 0.27 BTU/hr. sq. ft./in. at 75 deg. F and vapor transmission rating of 0.2 perms/inch. Armacell AP ArmaFlex or, in concealed locations, Imcoa or Nomaco also approved.
- E. Insulation Materials will be **listed and labeled per UL723, in Plenum Spaces as required by code.**
- F. Flexible Elastomeric: Closed-Cell, or expanded-rubber materials. Comply with ASTM C534, (Type I for tubular materials OR Type II for sheet materials), **and Listed and Labeled per UL 723 at 25/50, in Plenum Spaces as required by code.**

Subject to compliance with requirements, provide **Armacell ArmaFlex, Ultima for Plenum applications** or a comparable product by one of the following:

 - 1. Aeroflex
 - 2. K-Flex
 - 3. *Insert Manufacturer*
- G. Pipe Temperatures up to 1200 Deg. F: High temperature molded calcium silicate insulation with aluminum metal jacket. Furnish with aluminum snap straps. Apply in thickness required for a maximum surface temperature of 120 deg. F at 80 deg. F ambient and for the flow media temperatures. Johns Manville Thermo-12/Gold or Arma Gel HT – with aluminum metal jacket.

2.3 DUCT INSULATION

- A. Insulation Materials will be listed and labeled per UL723, in Plenum Spaces as required by code.

Subject to compliance with requirements, provide **Armacell ArmaFlex**, or a comparable product by one of the following:

 - 1. Aeroflex
 - 2. K-Flex

- B. Interior Above Grade Ductwork: Glass fiber formaldehyde-free blanket with "FSK" facing containing less than 0.1% by weight deca-PDE fire retardant, k value = 0.31 at 75 deg. F, 0.2 perms, and UL 25/50 surface burning rating. Johns Manville "Microlite."
- C. Below Grade Ductwork: Insulate with foamed-in-place urethane insulation.
- D. Exterior Above Grade Ductwork: Glass fiber board with "FSK" facing containing less than 0.1% by weight deca-PDE fire retardant, 3 pound density, k value of 0.23 at 75 deg. F and 0.2 perms. Install with 0.016" aluminum jacket. **[0.01" stainless steel jacket.]** Johns Manville 800 Series Spin-Glas.

2.4 EQUIPMENT INSULATION

- A. Equipment Temperatures Below 70 Deg. F: Flexible, closed cell, elastomeric sheet insulation of 5.5 #/cubic feet density and 0.27 thermal conductivity at 75 deg. F. Armacell "AP Armaflex."
- B. Equipment Temperatures From 70 to 450 Deg. F: Glass fiber 3 pound density insulation with a 0.23 thermal conductivity at 75 deg. F. Johns Manville "814 Spin-Glas" with "FSK" jacket containing less than 0.1% by weight deca-PDE fire retardant or finished as recommended by manufacturer.
- C. Equipment Temperatures From 350 to 1200 Deg. F: Molded high temperature calcium silicate minimum 12.5 pound density and 0.4 thermal conductivity at 200 deg. F mean temperature. Glass cloth finish, Claremont Diplag or finished as recommended by insulation manufacturer.
- D. Exterior Tanks and Equipment Insulation Covering: Same as interior insulation with weatherproof metal or finished as recommended by insulation manufacturer.

2.5 INSULATION ACCESSORIES

- A. Insulation Compounds and Materials: Provide rivets, staples, bands, adhesives, cements, coatings, sealers, welded studs, etc., as recommended by the manufacturers for the insulation and conditions specified except staples not permitted on chilled water lines.
- B. Interior Tanks and Equipment Insulation Covering: Finished metal jacket or as recommended by the manufacturer for insulation material specified.
- C. PVC Protective Jacketing and Valve and Pipe Fitting Covers: Johns Manville Zeston 2000, Proto LoSmoke, Speedline Smoke Safe, or Ceel-Co Ceel-Tite 100 Series with precut fitting fiberglass insulation or approved.
- D. Jacket Lap Sealing Adhesives: Foster Drion 85-75 contact cement or approved substitute.
- E. Saddles and Shields: Install to prevent crushing of insulation at support points.
 - 1. Protection Saddles: MSS Type 39. Armacell Insuguard Multi.
 - 2. Protection Shields: MSS Type 40. Armacell ArmaFix Ecolight.
 - 3. Preinsulated Pipe Supports: Calcium silicate load bearing metal jacketed inserts. Pipe Shields Inc. or accepted substitute.

- a. Pipe supported on rods - Models A1000, A2000, A3000, A4000.
- b. Pipe supported on flat surfaces - Models A1000, A2000, A3000, A4000.
- c. Pipe supported on pipe rolls - Models A3000, A4000, A5000.
- d. Vertical riser clamp – Models E1000, E1100, E1200.

PART 3 – EXECUTION

3.1 PIPING INSULATION

- A. General: Do not insulate underground piping except at joints and fittings on preinsulated piping unless indicated otherwise.
- B. Heating Water Piping: Insulate with glass fiber pipe covering:

<u>Size</u>	<u>Thickness</u>
1/2" to 1-1/2"	1-1/2"
2" to 3"	2"
4" and larger	2-1/2"
- C. Runout piping not exceeding 4 feet in length and 1" diameter between the control valve and the HVAC coil connections shall be insulated with minimum 1/2" thick glass fiber pipe covering.
- D. Refrigerant Piping Insulation: Insulate suction piping with minimum 1" thick flexible, closed-cell elastomeric pipe insulation; Ap Armaflex or of thickness necessary to prevent condensation at 85 deg. F and 70% RH. Where possible, slip insulation over the piping as it is installed. Seal all joint and seams.
- E. Pipe Fittings:
 - 1. Insulate and finish all fittings including valve bodies, bonnets, unions, flanges and expansion joints with precut fiberglass insulation and preformed PVC covers sealed to adjacent insulation jacket for continuous vapor barrier covering over all fittings.
 - [2. Use 1/2" thick Armaflex or Aerotube foamed plastic at flexible pipe connections on chilled **[and/or cold]** water lines. No insulation on other flexible pipe connections.]
 - 3. Provide removable/reusable insulation covers on 4" and larger valves, unions, flanges, pump casings, strainers and similar fittings or equipment requiring periodic service.
- I. Protective Covering: Install continuous protective PVC or metal covering on all piping and fittings in mechanical rooms, accessible tunnels, attic spaces, accessible ceilings, etc., where insulation may be subject to damage. Install with rivets or cement seams and joints.
- J. Insulated Piping Supports: Where insulated piping with continuous vapor barrier or where exposed to view in finished areas is specified, install hard maple wood insulation shields, insulation inserts, or steel pipe covering protection shields at each hanger.

- K. Piping Insulation Lap Seams and Butt Joints: Install insulation jacket in accordance with manufacturer's recommendation. Where jacket joint and lap seams have not adhered, remove affected section of insulation and reinstall or apply lap sealing adhesive in accordance with manufacturer's instructions.

3.2 DUCTWORK INSULATION

- A. Ductwork: Insulate the following:
1. All supply ductwork. **[with cooling.]**
 2. All supply and return ductwork in systems routed in unconditioned spaces or exposed to the outside conditions.
 3. All outside air intake ducts.
 4. All ductwork required to be insulated by code.
- B. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Grade 1, Type II for sheet materials. UL Classified per UL 723 at 25/50. **Listed and labeled in accordance with UL 723 or in accordance with ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction.**
1. Basis-of-Design Product: Subject to compliance with requirements, provide Armacell LLC; **[ArmaFlex Ultima] [or] [ArmaFlex Ultima SA]** or a comparable product by one of the following:
 - a. Aeroflex USA, Inc.
 - b. K-Flex USA.
 - c. **<Insert manufacturer's name>.**
- C. Insulation Thickness: Select board and blanket insulation of thickness required to provide the following installed R-value.
1. All heating or cooling system supply and return ducts located on the exterior of the insulated building envelope, including ventilated attics, and all outside air intake ducts, R-8.
 2. All heating and cooling system supply and return ducts located in unconditioned spaces within the building insulation envelope, R-5.
 3. All heating and cooling system supply ducts located in conditioned spaces and where exposed in unfinished spaces or concealed from view in finished spaces, R-3.
 4. Exposed ductwork in finished spaces shall not be externally insulated.
 5. Ducts located within or below concrete slabs on grade, R-4.
- D. Fittings: Install with wire, straps, and duct adhesive as required. To prevent sagging on all rectangular or square ducts over 24" wide, install Gramweld or equal welding pins on the bottom. Maximum spacing 18" on center in both directions.
- E. Installation: Applied with butt joints, all seams sealed with vapor seal mastic or taped with 2" wide vapor-proof, pressure-sensitive tape. Seal all penetrations with vapor barrier adhesive.

- F. Internally Lined Ductwork: Where internally lined ductwork is indicated on the Drawings and/or specified, no exterior insulation is required. Select duct lining to provide the required R-value. Carefully lap the ends of the exterior insulation a minimum of 6" past the interior insulation unless otherwise shown. Seal the end of vapor barrier jacket to the duct with mastic where the vapor barrier is required. Duct lining is specified in Section 23 30 00.

3.3 EXPANSION JOINTS

- A. Insulation: Insulate expansion joints on heating and/or cooling piping to match thickness of adjacent piping. Build up piping insulation adjacent to the expansion joints sufficiently to allow internal clearance within the insulation for the diameter of the expansion joint. Fasten one end of the expansion joint insulation securely and provide aluminum or sheet metal on the built-up insulation at the other end to permit movement of the insulation without damage.
- B. Finish: Finish as specified for adjacent piping with fireproof covering.

END OF SECTION

SECTION 23 10 00 - FACILITY FUEL GAS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this section apply to the fuel gas distribution systems for the facility.
- B. Related Work: The requirements of Section 23 05 00, Common HVAC Materials and Methods, also apply to this section.

1.2 CODES AND STANDARDS

- A. Comply with the provisions of the following referenced codes, standards and specifications:
 - 1. National Fire Protection Association (NFPA)
 - 2. Underwriters Laboratories, Inc. (UL)
 - 3. Factory Mutual (FM)
 - 4. National Fuel Gas Code (NFPA 54)
 - 5. Liquefied Petroleum Gas Code (NFPA 58)
 - 6. International Mechanical Code (IMC) with State and Local Amendments
 - 7. American Society for Testing and Materials (ASTM)
 - 8. International Fire Code (IFC) with State and Local Amendments
 - 9. American Gas Association (AGA)

1.3 SUBMITTALS

- A. Required for all items.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Black Steel Pipe:
 - 1. Applications: Aboveground or underground.
 - a. Natural Gas.
 - 2. Pipe: Systems 10" or smaller, operating below 400 psi, schedule 40, standard black steel pipe ASTM A-120 or A-53.
 - 3. Underground Piping: Coated with a minimum of ten mils of factory applied 100% thermosetting epoxy resin.
 - 4. Threaded Fittings: For above ground installations only. Banded class 150 malleable iron fittings, ANSI B16.3 to 150 psi.
 - 5. Welding Fittings: Standard weight, seamless steel, beveled end fittings, ANSI B16.9.
 - 6. Flanged Fittings: For above ground installations only.
 - a. Class 150 steel welding neck flanges, ANSI B16.9 to 150 psi.

- b. Facing and Gasketing: Selected for service pressures and temperatures. Raised face for steel flanges.
- B. Flexible Fuel Gas Piping (CSST):
 - 1. Application: 2 psi or less:
 - a. Natural gas
 - 2. Pipe: Corrugated 300 series stainless steel tubing with yellow polyethylene jacketing.
 - 3. Fittings: Fittings shall be yellow brass and provide a self-flaring connection to the tubing. Systems incorporating gaskets or o-rings are not acceptable.
 - 4. Underground Installations: CSST pre-sleeved with heavy wall internally ribbed polyethylene secondary venting conduit with end seals and vent connection fittings.
 - 5. Approvals: System shall be listed by an approved independent laboratory and approved for use by the local code officials. TracPipe, Gastite, or approved.

2.2 PIPING ACCESSORIES

- A. Fuel Gas Valves: UL listed or AGA approved valves.
 - 1. 10 psig or Less:
 - a. Ball: NIBCO bronze body T/S 585-70-UL, brass body FP-600.
- B. Gas Pressure Regulators: Size based on pressures indicated on the Drawings and for 1.5 times connected load. Style and model as approved by Northwest Natural Gas Co. Maxitrol, Rockwell, Fisher, Reliance, or approved substitute.
- C. Gas Appliance Connectors: For low pressure gas connection to indoor or outdoor rigidly mounted stationary appliances, AGA approved corrugated stainless steel tubing with zinc plated steel end fittings. Brasscraft or approved substitute.
- D. Solenoid Gas Shutoff Valve: Normally closed solenoid valve, ASCO or approved.

2.3 EXPANSION JOINTS AND LOOPS

- A. Flexible Expansion/Seismic Loop: Factory fabricated assembly consisting of two elbows and return bend or three elbows, and two lengths of flexible hose to allow free movement in three axis. Return bend or elbow shall include a drain/vent fitting. Hose shall be corrugated metal style with metal overbraid compatible with the piping materials. Connections to match piping system except connection 2" and larger shall be flanged style. Listed for fuel gas use. Metraflex "Metraloop" or Unisource "Uni-loops".

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Locating and Positioning Equipment: Observe all Codes and Regulations and good common practice in locating and installing mechanical equipment and material so that complete installation presents the least possible hazard. Maintain adequate clearances for repair and service to all equipment. Installation of any equipment with less than minimum clearances shall not be accepted.
- B. Anchorage: Anchor and/or brace mechanical equipment and piping to resist displacement due to seismic action.
- C. Gas Pressure Regulators: Install with drip leg at regulator inlet and capped test tees at inlet and outlet piping connections. Vent to exterior in accordance with code requirements except where vent limiting devices are installed.

3.2 PIPE INSTALLATION

- A. General: Install pipe, tube and fittings in accordance with recognized industry practiced for each indicated service without piping failure. Install each run with a minimum of joints and couplings, but with adequate and accessible unions and flanges for disassembly, maintenance and/or replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections.
- B. Ferrous Threaded Piping: Thread pipe in accordance with ANSI 82.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave no more than 3 threads exposed.
- C. Flexible Gas Piping (CSST): Comply with manufacturer's recommendations for system installation. Provide striker plates and supports as required. All penetrations of finished walls, including mechanical room walls, shall be accomplished using surface or recessed termination fittings. Where installed underground below a building, vent the conduit to outdoors per Code.
- D. Changes in Direction: Use fittings for all changes in direction. Run lines parallel with building surfaces.
- E. Unions and Flanges: At all equipment to permit dismantling and elsewhere as consistent with good installation practice.
- F. Expansion: Provide loops, swing joints, anchors, runouts and spring pieces to prevent damage to piping or equipment.
- G. Underground Gas Piping: Standard schedule 40 black steel pipe with welding fittings coated with a minimum of ten mils of 100% thermosetting epoxy resin, Scotchkote No. 203 factory applied per resin manufacturer's recommendations. Wrap all joints with 10 mil polyvinyl chloride pipewrap tape to a total thickness of 40 mils. Provide one 15 pound magnesium anode per each 100' of underground pipe, attached to coupling or other fitting with No. 10 copper wire. No underfloor slab natural gas piping except as provided for by code.

3.3 GAS SERVICE

- A. Contact Northwest Natural Gas Co. service as required and pay all costs involved. Run all gas distribution piping and make final connections to all gas using equipment. Install regulators to deliver proper inlet pressures and vent regulators to outside where required.

3.4 CLEANING

- A. General: Clean all dirt and construction dust and debris from all mechanical piping systems and leave in a new condition. Touch up paint where necessary.
- B. Fuel Piping: Blow clear of debris with nitrogen or oil free air.

3.5 TEST

- A. General: Minimum duration of two hours or longer, as directed for all tests. Furnish report of test observation signed by qualified inspector. Make all tests before applying insulation, backfilling, or otherwise concealing piping or connecting fixtures or equipment. Where part of the system must be tested to avoid concealment before the entire system is complete, test that portion separately, same as for entire system.
- B. Natural Gas Piping: One half hour minimum air at 60 psig for 2 psig gas, and 15 minutes at 10 psig for 7" water gauge natural gas or as approved and certified by serving utility.
- C. Storage Tanks: Test tank according to manufacturer's recommendation.

3.6 MECHANICAL PAINTING

- A. Uninsulated Piping: Paint black steel piping in moist equipment rooms, crawl spaces, inside of secondary containment piping, or exposed to weather two (2) coats black rust-inhibiting paint.

END OF SECTION

SECTION 23 30 00 - AIR DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide Air Distribution Materials as specified herein and as shown on the Drawings.
- B. Material characteristics and size shall be as indicated on the Drawings.
- C. Related Work: The requirements of Section 23 05 00, Common HVAC Materials and Methods, also apply to this section.

1.2 QUALITY ASSURANCE

- A. Air Distribution Equipment Rating: In accordance with AMCA certified rating procedures and bearing the AMCA label.

1.3 SUBMITTALS

- A. Submit catalog data, construction details and performance characteristics for all manufactured materials.
- B. Submit operating and maintenance data.

PART 2 - PRODUCTS

2.1 SHEET METAL

- A. Quality Assurance: Galvanized steel sheet metal except where otherwise indicated. Metal gauges, joints and reinforcement in accordance with Mechanical Code, ASHRAE and SMACNA standards. Ductwork shall be fabricated to the following pressure classifications:
 - 1. Return and local exhaust ducts: 1" negative.
 - 2. Central exhaust system ducts: 2" negative.
 - 3. Supply ducts from fan discharge to diffuser: 1" positive.
- B. Acoustical Duct Lining: Schuller "Linacoustic," Gustin Bacon "Ultra-Liner", Owens Corning "Aeroflex", and Certainteed "Tough Guard" approved, meeting NFPA 90A requirements for maximum flame spread and smoke developed. Mechanically attach lining to sheet metal duct with Schuller Grip Nails or Gramweld welding pins. Apply fire-retardant type adhesive similar to Schuller No. 44 adhesive, Benjamin Foster 81-99, Insul-Coustic 22 or 3M equivalent on all leading edges, joints and seams.
- C. Duct Sealants and Adhesives:
 - 1. For joints and seams exposed to the weather in lieu of soldering, United "Uni-Cast" system or approved.

2. Joint & Seam Sealants (Water Based): Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
 3. Liner Adhesive: Water based, fire and moisture resistant, used to adhere insulation to metal duct. It shall comply with NFPA 90A and UL 723 requirements.
 4. Duct Liner Sealant: Water based sealant, fire and moisture resistant, used to encapsulate fiberglass duct insulation to eliminate airborne fibers. Must comply with UL requirements.
 5. Duct Sealing Tapes: Provide a UL 181B listed duct sealing system.
- D. Optional Duct Joints for Sheet Metal Ducts: "Ductmate System" by Ductmate Industries, Inc., Ward Duct Connectors, Inc., Mez Industries, or acceptable substitute. Spiramir self-sealing round duct connector system meeting Class 3 leakage standards with EPDM o-ring seal.
- E. Concealed Round Duct: Round and flat oval spiral seam duct shall be manufactured of galvanized sheet metal with spiral lock seam. Construction, gauges, and reinforcement in accordance with SMACNA standards. Fittings shall be manufactured of galvanized steel with spot welded or riveted and sealed seams or continuously welded seams. Snap lock longitudinal seam duct shall fully comply with SMACNA standards for duct gauge and seam type for appropriate pressure class. Adjustable elbows shall be minimum 24 gauge.
- F. Flexible Ductwork-Low Pressure: Low pressure flexible duct, factory fabricated assembly consisting of a zinc-coated spring steel helix mechanically attached to reinforced aluminized polyester fabric tube. The composite assembly, shall meet the Class 1 requirements of NFPA Bulletin No. 90-A and be labeled by Underwriters Laboratories, Inc., with a flame spread rating of 25 or less and a smoke developed rating of 50 or under. Flexmaster, Genflex, ATCO, Wiremold, Thermaflex, Glassflex, Clevepak, Schuller, or accepted substitute.

2.2 ACCESSORIES

- A. Manual Volume Dampers: Construct of material two gauges heavier than duct in which installed; single plate up to 12" wide; multiple over 12" wide. Hem both edges 1/2" and flange sides 1/2" on rectangular dampers. Use Young, Duro-Dyne, MAT, or accepted substitute damper accessories. Install with bearings at each end of damper shaft and with locking quadrant. Location of all volume dampers is not necessarily shown on Drawings; minimum required is one in each supply, return or exhaust main, and one in each branch.
- B. Exterior Wall Louvers: Prefabricated galvanized sheet metal fixed stormproof blades with frame to suit building construction, and with 1/2" x 1/2", 16 gauge galvanized wire mesh on back side of all intake louvers and insect screen on exhaust/relief louvers. 4" deep, 45 degree fixed drainable type blade, AMCA 500 tested for 800 fpm without water penetration, and maximum of 0.07" wg intake pressure loss and 0.09" wg exhaust pressure loss. Provide "Kynar" protective coating and stainless steel fasteners (ASTM A167, type 302, cadmium finish, ASTM A165 type NS). Ruskin L375D as basic pattern on blade and frame, Greenheck, Cesco, American Warming, or approved.
- D. Locking Connection Straps: 1/2" wide positive locking steel straps or nylon self-locking straps. Panduit or accepted substitute.

2.3 GRILLES, REGISTERS AND DIFFUSERS

- A. Description: Provide grilles, registers and diffusers as shown on the Drawings.
- B. Finishes:
 - 1. Steel: Flat white enamel prime coat, factory applied on ceiling diffusers. Others are to have a baked enamel finish, color as selected by Architect.
 - 2. Aluminum: Anodized clear finish unless indicated otherwise.
- C. Manufacturers: Carnes, Krueger, Titus, Price, Shoemaker, and Tuttle & Bailey are accepted substitutes where only Titus model numbers are listed. Where other manufacturer's products are listed and/or "accepted substitute" is indicated, only the products or an accepted substitute for that item shall be provided.
- D. Perforated Face Diffusers: Perforated snap-in or concealed hinged face plate with internal deflection blades at diffuser neck in steel or extruded aluminum frame and margin to suit the ceiling construction. Provide with opposed blade volume damper. Panel size shall be 24" x 24" where lift-out tile ceiling system is indicated. Titus PCS.
- E. Ceiling Matched Return and/or Exhaust Register: To match adjacent ceiling outlets. Use in spaces containing ceiling diffusers and/or T-bar ceilings. Provide with damper except where dampered plenums are indicated. Match manufacturer of supply.
- F. Sidewall Supply Register: Double deflection grille with face bars parallel to long dimension on ceiling type and horizontal on wall type; bars to be individually adjustable, spaced on 0.66" to 0.75" centers; key operated opposed blade volume damper. Titus 300RL.
- G. Sidewall or Ceiling Return or Exhaust Register: Face bars parallel to long dimension on ceiling type and horizontal on wall type; bars set at 35 degrees to 45 degrees, spaced on 0.66" to 0.75" centers; key operated opposed blade volume damper. Titus 350RL Series.
- H. Sidewall or Ceiling Return, Exhaust or Relief Grille: Face bars parallel to long dimension on ceiling type and horizontal on wall type; bars set at 35 degrees to 45 degrees, spaced on 0.66" to 0.75" centers. Titus 350 Series.

PART 3 – EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Air Handling Equipment Installation and Arrangement: Install and arrange as shown on Drawings. Comply with the manufacturer's recommendations for installation, connection, and start-up.
- B. Equipment Access Panels: Locate free of all obstructions such as ceiling bars, electrical conduit, lights, ductwork, etc.

- C. Filters: Install specified filters in supply units and systems prior to start-up.

3.2 INSTALLATION OF GRILLES, REGISTERS AND DIFFUSERS

- A. Size and air handling characteristics shall be as shown on the Drawings.
- B. Locate, arrange, and install grilles, registers and diffusers as shown on the Drawings. Locate registers in tee-bar ceilings with diffusers centered on the tile unless indicated otherwise.

3.3 DUCTWORK INSTALLATION

- A. Support: Install ductwork with 1" wide strap cradle hangers not more than 8' on centers or as required by code. Support terminal units independent of adjacent ductwork. Attach to available building construction according to good practices for materials involved. Manufactured hanger system acceptable in lieu of fabricated hangers at contractors option. Ductmate "Clutcher" system or approved.
- B. Elbows and Fittings: Construct elbows with throat radius equal to duct width in plane of turn or make them square and provide double wall, air foil turning vanes.
- C. Fittings: Make transitions and take-offs as shown on Drawings. Provide volume dampers and splitter dampers as indicated on Drawings and as specified. Straight saddle tees are not allowed.
- D. Acoustical Duct Lining: Acoustically line all fan unit intake and discharge plenums, all ductwork indicated as lined on the Drawings, all sheet metal ductwork specified per Section 23 07 00 as insulated, where exposed to view or subject to damage in areas such as mechanical rooms, and, at the Contractor's option, all insulated ductwork specified in Section 23 07 00. The duct size noted on the Drawings is the clear opening of the duct with insulation. Insulation shall not reduce duct size listed.
- E. Manual Volume Dampers: Location of all volume dampers are not necessarily shown on the Drawings. Provide a minimum of one volume damper in each supply, return or exhaust branch.
- F. Duct Insulation: Specified in Section 23 07 00.
- G. Sealing: Seal all ductwork and plenums to make airtight at seams, joints, edges, corners and at penetrations. Install sealant materials in accordance with manufacturer's requirements.
- H. Flexible Duct Connections:
 - 1. Install in full extended condition, free of sags and kinks, using only the minimum length required to make the connection.
 - 2. Make all joints and connections with 1/2" wide positive locking steel straps or nylon self-locking straps. Connecting duct shall have retention bead or flexible duct shall be attached with 2 screws in addition to strap.
 - 3. On vertically suspended ducts, secure with a minimum of three sheet metal screws on a maximum of 8" on center.

3.4 NEW DUCTWORK CLEANING

- A. Store all ductwork materials on pallets or above grade, protected from weather, dirt/mud and other construction dust.
- B. Remove all accumulated dust, dirt, etc. from each duct section as it is being installed.
- C. Prior to installation of diffusers, grilles and registers, install temporary system filters and cover all diffuser, grille and register openings with temporary 25% efficiency filter materials and start the fan systems. Operate fans a minimum of 8 hours. Remove all temporary filters at the end of that period.
- D. Clean all diffusers, grilles and registers just prior to project final completion.

END OF SECTION

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide Fans as specified herein and shown on the Drawings.
- B. Equipment capacity and size as indicated in the equipment lists on the Drawings.
- C. Related Work: The requirements of Section 23 05 00, Common HVAC Materials and Methods, also apply to this section.

1.2 QUALITY ASSURANCE

- A. Air Handling Equipment: Rated in accordance with AMCA certified rating procedures and AMCA labeled.

1.3 SUBMITTALS

- A. Submit catalog data, construction details and performance characteristics for each fan.
- B. Submit operating and maintenance data.

PART 2 - PRODUCTS

2.1 EXHAUST FANS AND UNITS

- A. Ceiling Cabinet Exhaust Fan: Direct drive, forward curved centrifugal wheel, sleeve bearings, motor and wheel isolated from unit on vibration isolators; provide grille on inlet and duct connection with backdraft dampers on discharge. Size and capacity as indicated on Drawings. Carnes VCD, Acme V, Penn Zypher, Jenn-Air J-Series, Greenheck SP, Soler & Palau SV, Jen Fan FF, Cook Gemini, Twin City T, Panasonic, or approved. Provide with spring wound 30 minute timer switch. Bathroom fans to be Energy Star Rated.

2.2 EXHAUST FAN accessories

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and arrange equipment as shown on the Drawings and as recommended by the equipment manufacturer.

3.2 AIR HANDLING INSTALLATION

- A. Installation and Arrangement: Air handling equipment shall be installed and arranged as shown on the Drawings. Comply with the manufacturer's recommendations for installation connection and start-up.
- B. Lubrication: All moving and rotating parts shall be lubricated in accordance with the manufacturer's recommendations prior to start-up.

3.3 CONTROLS

- A. Wiring: All wiring shall be in accordance with the National Electrical Code and local electrical codes.

END OF SECTION

SECTION 23 80 00 - TERMINAL HVAC EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide Heating, Cooling, and Ventilating Equipment as specified herein and shown on the Drawings.
- B. Equipment capacity and size shall be as indicated on the Drawings.
- C. Related Work: The requirements of Section 23 05 00, Common HVAC Materials and Methods, also apply to this section.

1.2 QUALITY ASSURANCE

- A. Air Handling Equipment: Rated in accordance with AMCA certified rating procedures and AMCA labeled.
- B. Air Conditioning and Refrigeration Equipment Rating: Rated in accordance with ARI certified rating procedures and ARI labeled.
- C. Gas-fired Equipment: Design certified by American Gas Association.

1.3 SUBMITTALS

- A. Submit catalog data, construction details and performance characteristics for each HVAC unit.
- B. Submit operating and maintenance data.

PART 2 - PRODUCT

2.1 DUCTLESS SPLIT SYSTEM TERMINAL HVAC EQUIPMENT

- A. Indoor Section: Compact fan coil unit designed for wall, ceiling, recessed ceiling, or low profile concealed ducted mounting. Quantity, style, and capacity as listed on the Drawings. Multispeed direct drive fan with air filter. Provide with wired thermostat and condensate pump as indicated.
- B. Outdoor Section: Capacity matched with indoor section(s), steel cabinet with hermetically sealed inverter driven compressor(s), accumulator, crankcase heater, high and low pressure switches, restart delay relay, condenser coil, and propeller fans. Low ambient operation to 20 degrees. Single or multiple circuit as indicated. Cooling only or heat pump as indicated on the Drawings. Provide preinsulated lineset for each indoor unit.
- C. Acceptable Manufacturers: Mitsubishi, Daikin, LG, or approved

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and arrange equipment as shown on the Drawings and as recommended by the equipment manufacturer.

3.2 AIR HANDLING INSTALLATION

- A. Installation and Arrangement: Air handling equipment shall be installed and arranged as shown on the Drawings. Comply with the manufacturer's recommendations for installation connection and start-up.
- B. Lubrication: All moving and rotating parts shall be lubricated in accordance with the manufacturer's recommendations prior to start-up.

3.3 CONDENSATE DRAINAGE

- A. Provide complete condensate drainage system for cooling and heat pump equipment. Route condensate to approved interior receptor. Discharging condensate to the exterior is not permitted. See Division 22 for piping materials and methods.

3.4 CONTROLS

- A. Wiring: All wiring shall be in accordance with the National Electrical Code and local electrical codes. All thermostat wire shall be minimum 18 gauge, 6 conductor.
- B. Mounting: All controls intended to be operable by the occupant shall be mounted with the operating portion no more than 46" above the floor or as otherwise required by applicable codes.

END OF SECTION

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The provisions of the General Requirements, Supplementary Requirements, and Division 1 apply to the electrical work specified in this Section.
- B. The requirements of this Section apply to the electrical systems specified in these Specifications and in other Division 26 sections.
- C. Provide all items, articles, materials, equipment, operations and/or methods listed, mentioned, shown and/or scheduled on the Drawings and/or in these Specifications, including all labor, supervision, services, permits, fees, and incidentals necessary and required to provide a complete and operable facility with complete systems as shown, specified, and required by applicable codes.
- D. The work shall include, but not be limited to, the following systems:
 - 1. Electrical service complete per serving utility company requirements.
 - 2. Electric service and distribution equipment.
 - 3. Complete lighting and power systems, including panelboards, branch circuits, devices, lighting fixtures, etc.
 - 4. Connection of electrical equipment furnished under other Divisions of this Specification.
 - 5. Wiring to and connection of electrical equipment or appliances furnished outside of these Specifications and Contract but described on the Electrical Drawings.
 - 6. Special systems as specified herein.
 - 7. Grounding.
 - 8. SPEC WRITER NOTE: Coordinate with Low Voltage Sections
 - 9. Telephone service conduit, terminal boards, terminal cabinets, outlets, raceway system, and grounding per utility requirements.
 - 10. Fire alarm central control panel, initiating and annunciating devices, raceway and cabling system, etc.
 - 11. Rough-in provisions for security alarm system.
- E. Advise subcontractor, suppliers, and vendors involved in the work specified in this Section of the applicable requirements.
- F. Temporary electrical service, Division 1.

1.2 QUALITY ASSURANCE

- A. All work and materials shall conform to all applicable local and state codes and all federal, state and other applicable laws and regulations. All clarifications and modifications which have been cleared with appropriate authorities are listed under the applicable sections. All electrical products shall bear the UL label.
- B. Whenever the requirements of the Specifications or Drawings exceed those of the applicable code or standard, the requirements of the Specifications and Drawings shall govern.
- C. Codes and Standards: Comply with the provisions of the following referenced codes, standards and specifications:
 - 1. Institute of Electrical and Electronic Engineers (IEEE)

2. Federal Specifications (FS)
 3. American National Standards Institute (ANSI)
 4. National Electrical Manufacturer's Association (NEMA)
 5. National Fire Protection Association (NFPA)
 6. Underwriters Laboratories, Inc. (UL)
 7. Factory Mutual (FM)
 8. International Building Code (IBC) with State and Local Amendments
 9. National Electrical Code (NEC) with State and Local Amendments
 10. American Society for Testing and Materials (ASTM)
 11. Americans with Disabilities Act (ADA)
 12. International Fire Code (IFC) with State and Local Amendments
 13. National Electrical Contractors Association (NECA)
- D. Each piece of equipment furnished shall meet all detailed requirements of the Drawings and Specifications and shall be suitable for the installation shown. Equipment not meeting all requirements will not be acceptable, even though specified by name. Where two or more units of the same class of equipment are furnished, use product of the same manufacturer; component parts of the entire system need not be products of same manufacturer. Furnish all materials and equipment, new and free from defect and of size, make, type and quality herein specified or approved by the Architect. All materials shall be installed in a neat and professional manner.
- E. All apparatus shall be built and installed to deliver its full rated capacity at the efficiency for which it was designed.
- F. All disconnect switches, panelboards, switchboards, motor control centers, and equipment of like nature shall be of the same manufacturer.
- G. The Drawings and Specifications are complementary. What is called for by one shall be as though called for by both. If Drawings and Specifications contradict each other, the Contractor shall obtain written clarification prior to the bid. If time constraints are such that this is not possible, then the more stringent of the conflicting requirements shall be included in the bid. The Specifications are not automatically more authoritative than the drawings.

1.3 WORK OF OTHER CONTRACTS

- A. Work under this contract shall be conducted in a manner to allow for the future installations of such equipment or items, and include the wiring and/or devices shown on the Drawings or listed in other sections of this Specification. Also see "Equipment Connections."

1.4 WORK OF OTHER DIVISIONS

- A. Work under this Division shall be conducted in a manner to cooperate with the installation of work of other Divisions.
- B. Control devices (i.e. magnetic starters) and control wiring relating to the heating, ventilating and air conditioning systems and plumbing systems are specified under other Sections of these Specifications except for provisions or items specifically noted on the Drawings or specified herein.
- C. Consult all Drawings and Specifications in this project and become familiar with all equipment to be installed. Coordinate all aspects of the construction with the other trades on the job to ensure that all work and materials required to provide a complete and operational facility are included in the bid.

- D. All sections of Division 26 are interrelated and shall be considered in their entirety when interpreting any material, method, or direction listed in any section of Division 26. Individual sections are not written for specific subcontractors or suppliers but for the general contractor.

1.5 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- A. Submit in accordance with Division 1 full technical and descriptive shop drawing data on proposed materials and equipment as detailed in each section.
- B. The Contractor shall verify that all equipment submitted can be delivered and installed within the time constraints of the construction period.
- C. Include the manufacturer, type, style, catalog number, complete specification, certified dimensions, and description of physical appearance for each item and option submitted. Reproduction of catalog data sheets shall be clean and legible to show all details, including gauge of metal used.
- D. Include only information on exact equipment to be installed, not general catalogs of the manufacturer. Where sheets show proposed equipment as well as other equipment, identify proposed equipment with rubber stamp arrow or similar concise method.
- E. Submit with each copy a transmittal letter verifying that all included equipment submittals have been carefully considered for quality, dimensions, function, and have been coordinated with the Drawings and Specifications. Guarantee that proposed materials will meet or exceed the quality and function of those specified.
- F. Include wire run and connection diagrams for all signal and/or low voltage systems, including floor plans.
- G. Submittal Review: The submittal review process is a means to determine quality control. The action noted to be taken (or where conflicts with the contract documents are not noted) shall not be interpreted by the Contractor as automatic "change orders." Approval of the data for substitution and shop drawings shall not eliminate the contractor's responsibility for compliance with Drawings or Specifications, nor shall it eliminate the responsibility for freedom from errors of any sort in the data discovered prior to or after the review process. Deviations, discrepancies, and conflicts between the submittals and the Contract Documents shall be called to the Architect's attention in writing at the time of transmittal of the data.
- H. Unless otherwise directed by Division 1, submittal data shall be in PDF format. All required sections shall be submitted at one time.

1.6 PRODUCT SUBSTITUTION

- A. Material other than those specified may be approved for this project providing a written request is submitted to the Architect prior to bid in accordance with Instructions to Bidders. Requests shall include complete specifications, dimensions, manufacturer and catalog number for each item for which approval is desired. If, in the opinion of the Architect, the material is not complete or if it is not an acceptable substitute, he may reject it. The Architect's evaluation will be based solely on the material submitted.
- B. The Architect reserves the right to require the submission of an actual sample of the specific item before the review and acceptance of any product as an equal to that specified.

1.7 CHANGE ORDERS

- A. All supplemental cost proposals by the Contractor shall be accompanied by a complete itemized breakdown of labor and materials without exception. At the Architect's request, the contractor's estimating sheets for the supplemental cost proposals shall be made available to the Architect. Labor must be separated and allocated for each item of work. Lump sum cost proposals will not be reviewed.

1.8 RECORD DOCUMENTS

- A. Maintain a set of record drawings as directed in Division 1.
- B. Keep Drawings clean, undamaged, and up to date.
- C. Record and accurately indicate the following:
 - 1. Depths, sizes, and locations of all buried and concealed conduits/cables.
 - 2. Changes, additions, and revisions due to change orders, addenda, obstructions, etc. Eradicate extraneous information.
- D. Make Drawings available when requested by Architect for review.
- E. Submit as part of the required Project Closeout documents as indicated in Division 1.
- F. Use standards set in contract documents. Note field modifications, all addenda and change order items on project record drawings. If deficiencies are found in either the quality or the accuracy of the drawings, they will be returned unapproved. Additional review of subsequent submissions shall be at the contractor's expense.

1.9 OPERATING AND MAINTENANCE DATA

- A. Upon completion of Contract and after no further action is noted as being required on catalog data submitted for review, submit a PDF copy of the Operating and Maintenance Manuals for inclusion in Owner's Maintenance Brochure as specified in Division 1. Operation and maintenance manual shall include descriptive and technical data, maintenance and operation procedures, wiring diagrams, spare parts lists, service representatives, supplier for replacement parts, etc. Manual shall have cover sheet, table of contents, and section header sheets.

1.10 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. At the completion of the project, at a time scheduled by the Owner, assemble key mechanics, subcontractors, vendors, factory representatives and similar personnel required to explain all facets of maintenance and operation of the installed system to the Owner's personnel. Instructions shall include actual operation of systems and methods of maintenance.
- B. Systems Manual: Submit separate Systems Manual [30] days prior to scheduling the required Instruction Period. The Systems Manual shall be a hard copy binder with fold out full size drawings, and a CD or Thumb Drive with all data in electronic format. The Document shall contain at minimum the following:
 - 1. Permit/Construction/Design Drawings.
 - 2. Contractor As-Built Drawings.
 - 3. A final version of the Basis of Design Document for LEED or Design Build projects.
 - 4. Single line diagrams for all systems or components that require regular owner adjustment.
 - 5. As-Built Sequence of Operations, Control Drawings, and Original Set Points for all equipment requiring contractor programming or set up, including but not limited to;
 - a. Lighting Control Systems.
 - b. Emergency Power systems.
 - c. All systems specifically required to be Commissioned.
 - d. Minimum set point data to include
 - 1) Original settings for time clocks, schedules, and Lighting Control Panels.
 - 6. Operating instructions for integrated building systems.

7. Programing instructions.
8. Recommended schedule of maintenance requirements and frequency.
9. Recommended schedule for retesting of commissioned systems with blank test forms from the original commissioning plan.
10. Recommended schedule for calibrating sensors and actuators.
11. Emergency measures and procedures for systems failures.

1.11 ALTERNATE BIDS

- A. Refer to Division 1 for possible effect of bid alternates upon Work of this Division.

1.12 WARRANTY

- A. Furnish, prior to application for final payment, three copies of written and signed guarantee effective a period of one year from date of completion and acceptance of entire project; agree to correct, repair and/or replace defective materials and/or equipment or the results of defective workmanship without additional expense to the Owner. Where no response satisfactory to the Owner has occurred within three working days from the written report of a warranty covered defect, the contractor shall agree to pay for the cost of repair of the reported defect by a contractor of the Owner's choice.
- B. Where the manufacturer's guarantee exceeds one year, the longer guarantee shall govern and include the Contractor's labor.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All electrical products installed in this project shall be listed by Underwriters Laboratories, Inc., or be approved in writing by the local inspection authority as required by governing codes and ordinances.
- B. All material shall be new and bear manufacturer's name, model number, electrical characteristics and other identification, and shall be the standard product of manufacturer regularly engaged in production of similar material.
- C. All materials shall be of manufacturer's latest design, and of the best quality. The materials shall be manufactured in accordance with applicable standards listed under Quality Assurance.

2.2 ACCESS PANELS

- A. Provide panels of adequate size for equipment requiring service and installed above plaster or gypsum board ceilings, behind walls or in furring. Furnish complete with correct frame for type of building construction involved. Size, number and location of access panels is not necessarily shown on Drawings. Use no panel smaller than 12" x 12" for simple manual access, nor smaller than 16" x 20" where personnel must pass through. Milcor Style A, K, L, or M panels or equivalent Bilco or Potter-Roemer as required by construction. Access panels shall maintain ceiling fire rating.

2.3 PAINTING

- A. The work of this Division includes painting of the electrical items. All exposed conduits, boxes, surface raceways, etc. shall be painted per the Architect's direction. See Division 9 for additional painting requirements.

2.4 FIRE RATINGS

- A. Electrical items (light fixtures, boxes, etc.) recessed into fire rated walls or ceilings shall be alcoved in gypboard enclosures or be UL listed to maintain the fire rating.

PART 3 - EXECUTION

3.1 LAYOUT AND COORDINATION

- A. The Contractor shall inspect the job site prior to bidding and become familiar with existing conditions which will affect his work. The Drawings are diagrammatic indicating approximate location of outlets, lighting fixtures, electrical equipment, etc. Consult the Architectural, Structural and Mechanical Drawings to avoid conflicts with equipment, structural members, etc. When required, make all deviations from Drawings to make the work conform to the building as constructed, and to related work of others. Minor relocations ordered prior to installation may be made without added cost to the Owner.
- B. Obvious omissions from Drawings or Specifications or differences between Drawings and Specifications shall be called to the Architect's attention at least ten (10) days prior to the bid date for clarification. Failure to do so will be construed as the willingness of this Contractor to supply all necessary materials and labor required for the proper completion of this work in a manner approved by the Architect.
- C. Call to the attention of the Architect any error, conflict or discrepancy in Drawings and/or Specifications. Do not proceed with any questionable items of work until clarification of same has been made.
- D. Supplementary details and plans may be supplied as required and they will become a part of the Contract Documents.
- E. Work under this Division shall be conducted in a manner to cooperate with all other trades for proper installation of all items of equipment.
- F. Coordination of work with other crafts employed on the project is mandatory. Arrange work to reduce interruption of existing services to minimum. When interruptions are unavoidable, consult Architect and utilities involved and agree in writing, with copy to the Architect, upon a mutually satisfactory time and duration.
- G. Verify the physical dimensions of each item of electrical equipment to fit the available space and promptly notify the Architect prior to roughing-in if conflicts appear. Coordination of equipment to fit the available space and the access routes through the construction shall be the Contractor's liability.
- H. Locations of items shown on the Drawings as existing are partially based on record and other drawings which may contain errors. The Contractor shall verify the correctness of the information shown prior to rough-in or demolition and notify the Architect of any discrepancies.
- I. Coordinate all work and trim with carpet installers. Provide carpet plates on all carpet surfaces, complete as required.
- J. Install equipment such that code-required working clearances are maintained, and allow clearances for future maintenance.
- K. Coordinate installation of electrical conduit, boxes, fittings, anchors, and miscellaneous items to be concealed in precast concrete assemblies.

3.2 UTILITY COORDINATION

- A. Utility Coordination: Coordinate all aspects of the incoming electrical utility service with the city engineer, serving utility, and the off-street improvements contractor. Requirements of the utility company which exceed the provisions made on the Drawings or covered by these Specifications shall take precedence. Provisions made on the Drawings or Specifications in

excess of the utility company's requirements shall take precedence. No additional compensation will be allowed to the Contractor for connection fees or additional work or equipment not covered in the Drawings or Specifications which are a result of policies of the serving utilities.

- B. The Contractor shall contact the serving utility representatives and verify if any charges will be rendered against this project. These charges, if any, shall be included within the basic bid figure.

1. The utility representative is []:

3.3 EXCAVATING AND BACKFILL

- A. Provide trenching, backfilling, compaction, repaving or other site restoration as required by the work done in this Division. Minimum trench depth shall be 36" unless otherwise noted. Install 6" wide red vinyl tape with lettering "Caution: Buried Electric Line Below" 18" above all buried electric lines in this contract.
- B. Excavating and backfilling required for installation of electrical work shall be performed in accordance with requirements specified in Division 31. Backfill in excavations outside of building may be excavated material from site containing no rocks over 3/4" in diameter.
- C. Provide all necessary backfill materials, whether from site excavations or from off-site borrows, to completely fill excavations. Coordinate patching of all asphalt or concrete surfaces disturbed by this work with the Owner.
- D. Bored Crossings: Casing shall be smooth steel pipe fabricated in sections for welded joints, of size sufficiently large to provide adequate working space to properly install conduits, continuous butt welded at joints for rigid, watertight encasement, minimum thickness of 0.188" for casing under 14" diameter, and 0.281" for casings 14" and larger diameter.

3.4 PROTECTION OF WORK

- A. Protect electrical work, wire and cable, materials and equipment installed under this Division against damage by other trades, weather conditions or any other causes. Equipment found damaged or in other than new condition will be rejected as defective.
- B. Switchgear, panels, light fixtures and electrical equipment shall be kept covered or closed to exclude moisture, dust, dirt, plaster, cement, or paint and shall be free of all contamination before acceptance. Enclosures and trims shall be in new condition, free of rust, scratches or other finish defects. Properly refinish in a manner acceptable to the Architect if damaged.
- C. Including products of other Sections, clean, repair and touch-up or replace when directed, products which have been soiled, discolored or damaged.
- D. Provide for dehumidification of equipment during construction when directed by Architect.
- E. Remove debris from project site upon completion or sooner if directed.

3.5 GENERAL INSTALLATION METHODS

- A. Provide raceways and conduits for all electrical system wiring as specified herein. Class II or III systems wiring installed per Article 725 of NEC will be required to be installed in raceway unless otherwise indicated. When open wiring is permitted, raceways will be required in insulated walls and in other inaccessible areas. Low voltage wiring installed in return air plenums shall utilize plenum rated cable.
- B. The extent of the branch circuiting and control wiring shown shall not be changed.
- C. Cross or hash marks on power and lighting conduit runs indicate quantity of No. 12 minimum copper branch circuit conductors unless otherwise noted. Where such marks do not appear, provide conductors as required to provide an operable system, sized per local codes.

- D. Repair surfaces damaged during installation to match adjacent undisturbed areas. Surface preparation, including cleaning and priming, shall be in accordance with the paint manufacturer's requirements.
- E. Adjacent panelboards, component cabinets, terminal cabinets, trench duct, and wire gutter exposed in finished areas shall have matching trim and finish.
- F. In general, the mounting heights shall be as noted on the Drawings or as listed below. Where no heights are indicated, request clarification from the Architect. Consult the Architectural, Structural, and Mechanical Drawings to avoid conflicts prior to roughing in. All dimensions are to the center of the device above finished floor unless specified otherwise. Lighting dimensions are to the bottom of suspended fixtures; mount panelboards 72" to top handle; mount devices above counters, 12" above counter or 4-1/2" above backsplash, whichever is greater; and receptacles in unfinished areas 48".
- G. All raceways and wiring shall be concealed where possible. All wiring devices, recessed light fixtures, etc., shall be flush mounted unless otherwise noted.
- H. Relays, panels, cabinets and equipment shall be level and plumb and installed parallel with structural building lines. All equipment and enclosures shall be suitable for the environmental conditions in which they will operate.
- I. The Drawings do not indicate all items necessary. Provide associated equipment, materials, and labor as required for complete and operable systems.

3.6 CUTTING AND PATCHING

- A. Under no conditions are beams, girders, footings or columns to be cut for electrical items unless so shown on Drawings or written approval obtained from the Architect.
- B. Cutting, patching and repairing for the proper installation and completion of the work specified, including plastering, gypsum board, masonry work, concrete work, carpentry work and painting shall be performed by workers skilled in their respective trades.
- C. Follow requirements specified in Division 1.

3.7 SLEEVES AND CHASES

- A. Provide necessary rigid conduit sleeves, openings and chases where conduits or cables are required to pass through floors, ceilings or walls. Seal all openings around conduits against leaks and in a manner to maintain the fire rating of the structure penetrated. Prevent unnecessary cutting in connection with the finished work. Make all repairs and seals in a manner acceptable to the Architect.

3.8 NOISE CONTROL

- A. The entire electrical system apparatus shall operate at full capacity without objectionable noise or vibration.
- B. Outlet boxes at opposite sides of partitions shall not be placed back-to-back, nor shall straight-through boxes be employed, except where specifically permitted on the Drawings by note, to minimize transmission of noise between occupied spaces.
- C. Contactors, transformers, starters, and similar noise-producing devices shall not be placed on walls which are common to occupied spaces unless specifically called for on the Drawings. Where such devices must be mounted on walls common to occupied spaces, they shall be shock mounted or isolated in such a manner as to effectively prevent the transmission of their inherent noise to the occupied space.
- D. Ballasts, contactors, starters, transformers, and like equipment which are found to be noticeably noisier than other similar equipment on the project will be deemed defective and shall be replaced.

3.9 EQUIPMENT CONNECTIONS

- A. Provide complete electrical connections for all items of equipment requiring such connections, including incidental wiring, materials, devices and labor necessary for a finished working installation.
- B. Verify the rough-in and wiring requirements for all equipment provided under other Divisions of the work and requiring electrical connections with equipment supplier and installer prior to rough-in. Check the voltage and phase of each item of equipment before connecting. Motor connections shall be made for the proper direction of rotation. Pump motors shall not be test run until liquid is in the system and proper lubrication to all bearings in unit is checked. Minimum size flex for mechanical equipment shall be 1/2". Exposed motor wiring shall be jacketed metallic flex.
- C. Conduit, wire and circuit breaker sizes for mechanical equipment and equipment furnished under other Divisions are based on the equipment ratings of one manufacturer. The equipment actually furnished may be of a different brand with different electrical characteristics. Conduit, wire and circuit breakers shall not be ordered or installed until exact electrical requirements are obtained. Responsibility for this coordination shall rest with the Contractor.

3.10 TESTS

- A. Complete each system as shown or specified herein and place in operation except where only roughing-in or partial systems are called for. Each system shall be tested and left in proper operation free of faults, shorts, or unintentional grounds.
- B. After the interior wiring system installation is completed, and at such time as the Owner may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of the Specification. The test shall be performed in the presence of the Owner or an authorized representative. The Contractor shall furnish all instruments and personnel required for the tests, and the Owner will furnish the necessary electric power. The Contractor shall submit in writing to the Owner upon completion of the project the measured ground resistance of each ground rod, indicating the location of the rod, the resistance, and the soil conditions at the time the measurements were made.

3.11 DEMOLITION AND REMODELING NOTES

- A. Keep all systems functioning with minimum system interruptions. Power, telephone, and life-safety system interruptions shall be coordinated with the Owner.
- B. The Contractor shall have the option to reuse existing raceways as far as practical, provided it remains code accessible, concealed by new work, and not in conflict with demolition.
- C. The Electrical Drawings are not wiring diagrams but schematic plans prepared to aid the Contractor in bidding the electrical revisions and additions shown. It is intended that the Contractor shall visit the job site prior to bidding to verify all existing conditions which will be affected by or will have affect upon the required revisions and additions, prepare a wiring diagram, secure all permits and accomplish the work, securing approval from the Architect for deviations from the schematic plan.
- D. Remove all unused lighting fixtures from remodel area prior to completion of the work.
- E. All removed lighting fixtures and other electrical devices accumulated during the demolition process shall become the property of the Owner and shall be transported by the Contractor to the Owner's designated storage prior to job completion.
- F. All removed lighting fixtures and other electrical devices accumulated during the demolition process shall become the property of the contractor and shall be transported by the contractor away from the job site prior to job completion.
- G. All removed electrical equipment is the property of the contractor. Disconnect and remove such equipment from the project property. All equipment noted as "salvage" shall remain the Owner's

property as specified in Division 2. Remove all debris resulting from the electrical work and sweep broom clean.

- H. Remove all existing fixtures, clocks, horns, switches, receptacles, and other wiring devices from surfaces scheduled for remodeling. Replace devices as required following application of remodeling finishes, installing box extensions where required.
- I. All lighting fixtures in the project area scheduled to be relocated shall be relamped, repaired as required, and cleaned.
- J. All relocated grid fixtures must be equipped with class "P" ballast protection. Those fixtures without class "P" ballasts shall be retrofitted with new external ballast fusing, complying with NEC 410. The contractor shall have the option to furnish new fixtures, matching the existing as approved by the Engineer or other new fixtures as approved by the Engineer.
- K. Unless shown otherwise, every attempt shall be made to retain existing 120 volt receptacle outlets in use (whether shown on the plan or not). Replace all existing non-grounded receptacles with grounded type. Prove existing conduit ground or provide green ground conductor which proves to the service entrance ground. New and existing 120 volt receptacle (re)wiring shall typically not exceed 6 duplex receptacles per 20 ampere circuit.
- L. If abandoned outlets serve as feed-through boxes for other existing electrical equipment which is being retained, new conduit and wire shall be provided to bypass the abandoned outlets. If existing conduits pass through partitions, floors, or ceilings which are being removed or remodeled, new conduit and wire shall be provided to route around the removed area and maintain service to the existing load.
- M. Where devices are removed from a wall to remain, provide blank cover plate similar to other cover plates in that area.
- N. The contractor shall trace the remaining load on existing branch circuits, remove all unused wiring, make code approved circuit consolidations (where possible) to conserve and update use of existing capacity, and provide new updated panel schedules. Provide copies of resulting panel schedules and transmit with the electrical record drawing set, on which the contractor shall also note "as-built" circuit number assignments.
- O. Where existing electrical items are scheduled for removal, also remove associated raceways, boxes, conduits, etc. as far as practical.
- P. Where replacement boxes are deeper than existing boxes being replaced (i.e. panelboard tubs), provide appropriate trim around box to provide for a neat and workmanlike appearance. Verify exact methods and materials with Architect.
- Q. Where equipment is removed and/or replaced, patch and paint surface newly exposed to match surrounding surface finish. Verify exact methods and materials with Architect.

END OF SECTION

SECTION 26 05 19 - ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide all conductors, cables, connectors, lugs, cable ties, and terminations for all systems.

1.2 QUALITY ASSURANCE

- A. All conductors shall be Underwriters Laboratories, Inc., listed and comply with Fed. Spec. J-C-30B and UL 83. Materials omitted here but necessary to complete the work are to be of comparable quality.

1.3 PRODUCT DELIVERY, STORAGE & HANDLING

- A. Deliver conductors and cables in complete coils with UL label and bearing manufacturer's name, wire size, and type of insulation.
- B. Store and handle materials so as not to subject them to corrosion or mechanical damage and in a manner to prevent damage from environment and construction operation.
- C. Deliver conductors No. 10 and smaller in manufacturer's original unopened and undamaged cartons with labels legible and intact.

1.4 SUBMITTAL AND RECORD DOCUMENTATION

- A. None required.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Conductors No. 10 AWG and smaller may be soft-drawn, stranded, or solid copper. Conductors larger than No. 10 AWG shall be stranded, soft-drawn copper.
- B. Insulation for new conductors installed in raceways shall be "THWN" for conductors No. 8 AWG or smaller, and "THWN" or "THHN" for conductors No. 6 AWG or larger, or as noted.
- C. Where adverse conductor exposure exists, code-approved insulation suitable for the conditions encountered shall be used unless shown otherwise on the Drawings.
- D. All wire and cable for feeder circuits shall conform to the latest requirements of the current edition of the NEC and shall meet all ASTM Specifications. Wire and cable shall be new and have wire size, grade of insulation, voltage, and manufacturer's name permanently marked on outer covering at regular intervals.
- E. Sizes shall not be less than indicated. Branch circuit conductors shall not be smaller than No. 12 AWG. Class 1 remote control and signal circuit conductors shall not be less than No. 14 AWG. Class 2 low energy remote control and signal circuit conductors shall not be less than No. 18 AWG.
- F. All insulation shall be rated 600 volts unless noted otherwise.
- G. Acceptable Manufacturers: General Electric, Hatfield, Anaconda, Rome Cable, Essex, Belden, West Penn, or approved.

2.2 SPLICES AND TERMINATIONS

- A. All connectors shall be solderless pressure type per Fed. Spec. W-S-610, properly taped. All taped joints shall be with plastic tape, "Scotch 33," applied in half-lap layers without stretching to deform.
- B. Splices shall utilize Scotch "Hyflex" or "Ideal" wing nut connector installed properly. Splices for No. 8 and larger wires shall be made with tin or silver plated copper compression sleeves.
- C. Splices made in handholes and manholes, or underground splices, shall be made water tight with epoxy resin-type splicing kits.

PART 3 - EXECUTION

3.1 CONDUCTORS

- A. Insulation shall be removed with a stripping tool designated specifically for that purpose. All conductors shall be left nick-free.
- B. UL listed pulling compounds may be used with the residue cleaned from the conductors and raceway entrances after the pull is made.
- C. Raceway shall be complete, clean and free of burrs before pulling conductors.
- D. Wire shall not be left extending out of exposed conduit stubs or incomplete raceways where subject to mechanical injury.
- E. Pulleys or blocks shall be used for alignment of the conductors when pulling. Pulling shall be in accordance with manufacturer's specifications regarding tensions, bending radii of the cable and compounds.
- F. Conductors shall be terminated as required.
- G. Conductor sizes for special systems shall be as recommended by the equipment manufacturer except as noted.
- H. Stranded conductors shall not be terminated with post and screw unless compression spade/ring lug is utilized.
- I. 120-volt homeruns over 80 feet in length shall be minimum #10 conductor.

3.2 LABELING

- A. Provide color coding of building wiring consistent throughout the work as listed herein, unless required otherwise by local code authority. Band feeder conductors not available in colors where clearly visible at each termination, tape or splice using two full wraps of 3/4" adhesive vinyl tape or equally visible color marking corresponding to the following table.
- B. Less than 250V between phases 251 to 600V btwn phases
- C. Phase A - Black Phase A - Brown
- D. Phase B - Red Phase B - Orange
- E. Phase C - Blue Phase C - Yellow
- F. Neutral - White Neutral - Gray
- G. Ground - Green Ground - Green
- H. Switch legs, travelers, etc., to be consistent with the above phases to which they are connected or may be any other color distinctive from those listed above. Complex control circuits may utilize any combination of colors but the identification shall be by labels throughout. Labeling shall be accomplished by using computer-generated heat shrink labels suitable for the wire size used. In no case will hand lettering or wraparound labels be accepted.

- I. Phase color code to be consistent at all feeder terminations, A-B-C left to right or A-B-C top to bottom.
- J. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made.
- K. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved shop drawings. Hand lettering or marking is not acceptable.

3.3 SPLICES AND TERMINATIONS

- A. Splices are to be made up completely promptly after wire installation. Single wire pigtails shall be provided for fixture and device connections. Wire nuts may be used for fixture wire connections to single wire circuit conductor pigtails.

3.4 CONNECTORS

- A. Control and special systems wires shall be terminated with a tool- applied, spade-flared lug when terminating at a screw connection.
- B. All screw and bolt-type connectors shall be made up tight and be retightened after an eight-hour period.
- C. All tool-applied compression connectors shall be applied per manufacturer's recommendations and physically checked for tightness.
- D. Check terminations in all panelboards, switchgear, motor control centers, etc., six months after completion of installation. Supply a confirming letter to the Owner at completion of test.

3.5 TESTS

- A. Perform insulation resistance tests on all feeders and circuits over 100 A, 480 volt and below, with a 1,000 volt megger. The written test report listing the results of the test to be included in the Operating and Maintenance Manuals. Equipment which may be damaged by this test shall be disconnected prior to the test.

END OF SECTION

SECTION 26 05 20 - NONMETALLIC-SHEATHED CABLE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide all nonmetallic-sheathed cables, supports, and terminations as indicated on the drawings and described herein, to provide a complete and operable system. It may only be used in Type R occupancies where allowed by the NEC and local codes. Refer to Architectural drawings for identification of occupancy types.

1.2 SUBMITTAL AND RECORD DOCUMENTATION

- A. Submit product data for cables and supports.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cable shall be by type NMC (overall covering shall be flame retardant, moisture resistant, fungus resistant, and corrosion resistant) cable, and shall meet or exceed UL Standards 83 and 719. Conductors shall be annealed solid or stranded copper conductors No. 12 through No. 6 AWG, 600 volt, with color-coded insulation, rated at 90 deg C.
- B. Acceptable Manufacturers: Rome Cable or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Support horizontal and vertical cable 4-1/2 feet on center (maximum) and within 12" of boxes with approved cable staples, per the NEC.
- B. Support cable above accessible ceilings; do not rest cables on ceiling tiles.
- C. Cable shall be cut with manufacturer-approved devices.
- D. Splice conductors only in accessible junction boxes.
- E. Cable shall not be supported from or come into contact with mechanical ducts, water, sprinkler or gas piping; maintain 6-inch separation minimum.
- F. Provide junction box at all cable penetrations of wall, ceiling, or floor surfaces for equipment connections; cable shall not be run directly through finished surfaces.
- G. Voltage Drop: Conductors over 75 feet for 120-volt, for branch or individual circuit home runs from equipment connection, receptacle or lighting fixture shall be No. 10 AWG minimum.
- H. Provide junction box at transition from concealed to exposed wiring. Exposed wiring shall conform with Section 260533 – Raceway and Boxes for Electrical Systems.
- I. Where cable penetrates fire-rated walls or floors, provide fire stop material with UL-listed fire rating equal to wall or floor rating.
- J. Provide junction box at transition from interior to exterior wiring. Exterior wiring shall conform to Section 260533 – Raceway and Boxes for Electrical Systems.
- K. Protect shallow-installed cables with steel plates per the NEC.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide ground system as specified herein, as shown on the Drawings, and as required by NEC and other rules and regulations pertaining to grounding.

1.2 SUBMITTAL AND RECORD DOCUMENTATION

- A. None required.

PART 2 - PRODUCTS

2.1 GROUND CONDUCTORS

- A. Equipment or grounding conductors shall be soft drawn copper, stranded per ASTM B8 and, if insulated, shall have green insulation.

2.2 GROUNDING BUSHINGS/WEDGES

- A. Sufficient ampacity with grounding conductor set screw connection.

2.3 CONNECTOR

- A. Cast, set screw or bolted type.

2.4 GROUND RODS

- A. Copper-clad steel, not less than 3/4" in diameter, 8' long, driven full length into the earth.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All grounding conductors shall be sized in accordance with Article 250, Tables 250.66 and 250.122 of the NEC.
- B. Except where specifically indicated otherwise, all exposed non-current-carrying metallic parts of electrical equipment, metallic raceway systems, and neutral conductor of the wiring system shall be grounded.
- C. The ground connection shall be made at the main service equipment and shall be extended to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flange connection.
- D. Where the metallic water service is used, it shall be grounded as described by Article 250.52 of the NEC.
- E. Generally, all supplemental grounding electrodes shall be ground rods.
- F. All ground wire connections below finished grade, cast in concrete, or bonding solid wire shall be exothermically welded.
- G. Where there is no metallic water service to the building, ground connections shall be made to driven ground rods on the exterior of the building.
- H. The maximum resistance measured in accordance with IEEE Standard 142 of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with

a single rod, additional rods shall be installed not less than 6' on centers, or if sectional-type rods are used, additional sections may be coupled and driven with the first rod. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Engineer shall be notified immediately.

- I. Grounding conductor connectors shall be made up tight and located for future servicing and to ensure low impedance.
- J. The Contractor shall submit in writing to the Owner upon completion of the project the measured ground resistance of each ground rod, indicating the location of the rod and the resistance and the soil conditions at the time the measurements were made.
- K. Where new circuits are to be served by existing panels with no ground bus, provide supplemental copper ground bus in panel.

END OF SECTION

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide all electrical equipment and wiring with adequate supports of specified type required for a complete installation.

1.2 SUBMITTAL AND RECORD DOCUMENTATION

- A. Submit shop drawings indicating details of fabricated products and materials.

PART 2 - PRODUCTS

2.1 FASTENERS

- A. Fastenings shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring steel tension clamps on steel work; for new concrete installation use cast-in-concrete inserts. Kindorf D-255 or approved.
- B. Hammer-driven and trigger-fired anchors may be used only after obtaining specific written authorization from the Architect.

2.2 OUTLET BOX SUPPORTS

- A. Wood Stud Walls: Adjustable bar hangers with "C" channel cross section Steel City 6010 series, or approved, or mounted on solid blocking. 4-inch square boxes adjacent to wood studs may be side nailed and back braced with Steel City No. 50 box brace.
- B. Light steel construction, bar hangers with 1-inch long studs between metal studs or metal stud "C" brackets snapped on and tab-locked to metal studs.
- C. Concrete or masonry walls where boxes are not cast in place. Flush anchors or concrete inserts.
- D. Flush Ceiling Outlets: Steel City 6010 series or equal bar hangers.

2.3 CONDUIT SUPPORTS

- A. One Hole Malleable Straps: Steel City, Appleton, T&B, Diamond, Raco, or approved.
- B. Conduit Clips: Caddy, Raco, or approved.
- C. Nail-Up Straps: 1/2" through 1", Raco 2252, 2253, 2254, or approved.
- D. Adjustable Hangers for Conduits 1-1/2" and Larger: Steel City C-149 with threaded steel rod of proper size.
- E. Adjustable trapeze hangers to support groups of parallel conduits; Steel City B-905 steel channel, H-119 square washer, C-105 strap, threaded rod. Components of Unistrut, Globe Strut, Harvey Alstrut, Kindorf, Thomas & Betts, or approved.

2.4 HANGER ROD ATTACHMENTS

- A. Side Beam Connector, Kindorf E-244; 90 degree fitting, Kindorf B-916; clamp type anchor clips Kindorf Type "C," Unistrut P2675 or approved, spot type concrete insert Kindorf B-255 with "Galv-Krom" finish.

2.5 SUPPORT CHANNELS

- A. Conduit: Kindorf B-905 with Galv-Krom finish, and C-105 single bolt channel pipe straps.

- B. Lighting: Kindorf B-900 with G-969 closure strip and G-977 swing connector.
- C. Recessed in Concrete: Kindorf D-980 with D-982 anchored end caps and D-983 joiner clips.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Every fastening device and support for electrical equipment (includes fixtures, panels, outlets, conduits, and cabinets) shall be capable of sustaining not less than four times the ultimate weight of the object or objects. Fasten support to the building or a building structural member.
- B. Provide independent supports to the building or building structural member for electrical fixtures, materials, or equipment installed in or on ceiling, walls, or in void spaces and/or over the furred or suspended ceilings. Chain or additional ceiling wires may be used for light fixture supports.
- C. Other crafts' fastening devices shall not be used for the supporting means of electrical, equipment, materials, or fixtures.
- D. Supports and/or fastening devices shall not be used to support more than one particular item.
- E. Vertical support members for equipment and fixtures shall be straight and parallel to building walls.
- F. Examine all equipment locations to determine type of supports required.
- G. Raceways or pipe straps shall not be welded to steel structures.
- H. Holes cut to a depth of more than 1-1/2" in reinforced concrete beams or to a depth of more than 3/4" in concrete joists shall avoid cutting the main reinforcing bars. Holes not used shall be filled.

3.2 BOXES

- A. Boxes and pendants for surface-mounted fixtures on suspended ceilings shall be supported independently of the ceiling supports.
- B. In open overhead spaces, cast metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers.
- C. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved fastener not more than 24" from the box.

3.3 RACEWAYS

- A. Support conduits within 18" of outlets, boxes, panels, cabinets, couplings, elbows, and deflections. Maximum distance between supports shall not exceed ten (10) foot spacing.
- B. Conduit up to and including 1" EMT may be supported from ceiling fixture wires by conduit clips or other approved devices only with written approval of the installer of the ceiling support system. All other conduit runs shall be secured to the structure by two-hole straps or supported on Kindorf or Unistrut hangers. Wire will not be permitted for supporting conduit. All visible conduit runs will be parallel to the building structural lines.
- C. Anchor conduit installed in poured concrete to the steel reinforcing with No. 14 black iron wire.
- D. In partitions of light steel construction, sheet metal screws may be used, and bar hangers may be attached with saddle-suspended ceiling construction only. Lighting system branch circuit raceways shall be fastened to the ceiling supports.
- E. Support suspended feeder conduits by metal ring or trapeze hangers with threaded steel rods. Wire ties to prevent displacement, using not less than No. 14 iron wire, may be used only for concealed runs in concrete for conduit up to 1-1/4".

- F. At main distribution and surface mounted branch panels and cabinets where conduit exits from the top, provide support channels on wall 24" above panel and at 6'-0" intervals from there on for support of conduits.

END OF SECTION

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide all raceways, fittings, and boxes of specified type required for complete project. Install all systems in raceways unless specifically noted otherwise. Provide all outlet boxes, junction boxes, pull boxes and special boxes required for pulling of wires, making connections, and mounting of devices or fixtures.

1.2 QUALITY ASSURANCE

- A. Underwriters Laboratories, Inc., listed and NEC approved
- B. All boxes shall be Underwriters Laboratories, Inc., listed. Where special fabrication is required, the work shall be performed by a listed facility in accordance with UL 50, and all products of manufacture shall bear a label. Outlet and junction boxes shall be sized in accordance with NEC requirements for "THHN" wire or as noted on Drawings.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver raceways with Underwriters Laboratories, Inc., label and bearing manufacturer's name on each length.
- B. Deliver fittings in manufacturer's original unopened and undamaged packages with labels legible and intact.

1.4 APPLICATION

- A. Areas of use:
- B. Underground conduit shall be minimum 3/4" trade size. PVC shall not be used inside building. Unless otherwise approved, all conduits shall be installed under reinforcing steel.
- C. Where the contractor elects to utilize PVC in lieu of GRC, the contractor shall provide supplemental ground bus in terminating switch and panelboards, and green ground wire in conduit according to code rules.
- D. For the purposes of this section, poured concrete slabs on grade and under-the-building slabs are not classified as dry locations.
- E. Flexible metal conduit will be permitted only where flexibility is necessary. Exceptions are connections to recessed light fixtures. Flexible metal conduit shall be used for connection to all equipment subject to movement or vibration such as motors, transformers, etc. Liquid-tight flexible metal conduit shall be used when moisture may be present and for exposed motor and equipment connections.
- F. Surface raceway may be used only where specifically called for on the Drawings or in the Specifications.
- G. Aluminum conduit is not permitted.

1.5 SUBMITTAL AND RECORD DOCUMENTATION

- A. Submit product data for surface raceway and wireway.
- B. Submit product data for floor boxes. Submit shop drawings for nonstandard boxes, enclosures, and cabinets. Include layout drawings showing components and wiring.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Allied Tube & Conduit, Western Tube & Conduit, Triangle, Bridgeport, AFC, Carlon, Western Plastics, Alfalex, O'Kote, or approved substitute. Wiremold, Walker, or approved substitute. Raco, Thomas & Betts, or approved substitute.

2.2 CONDUITS

- A. Galvanized Rigid Conduit (GRC) shall be hot-dip zinc, galvanized inside and out, mild steel pipe manufactured in accordance with UL-6 and ANSI C80.1. All threads shall be galvanized after cutting.
- B. Electrical Metallic Tubing (EMT) shall be steel only and shall comply with UL-797 and ANSI C80.3. Exterior shall be hot-dip zinc galvanized and interior protected by a corrosion-resistant lubricating coating.
- C. Intermediate Metallic Conduit (IMC) shall comply with UL-1242 and ANSI C80.6. Exterior shall be hot-dip zinc galvanized and interior protected by a corrosion-resistant lubricating coating.
- D. Rigid non-metallic conduit (PVC) polyvinyl chloride shall be schedule 40 unless otherwise noted, and shall comply with UL-651 and NEMA TC 2.
- E. Surface raceway shall utilize snap-in cover and fittings as recommended by the manufacturer and shall comply with UL 5 standard. Material and size shall be as indicated on the Drawings.
- F. Flexible metal conduit shall be steel and comply with UL 1 and ANSI standards. Liquid-tight flexible metal conduit shall comply with UL 360 and ANSI standards.
- G. PVC coated conduit shall be hot dipped galvanized inside and out with galvanized threads, and shall comply with NEMA Standard No. RN-1.

2.3 WIREWAYS

- A. Gutters: Steel, painted, square in cross section, preformed knockouts on standard spacing, screw cover, suitable for environment.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.
- C. Exterior wireways and fittings/accessories shall be stainless steel.

2.4 FITTINGS

- A. GRC and IMC shall be coupled and terminated with threaded fittings. Ends shall be bushed with insulating bushings equal to T&B 1220 or 1230 Series.
- B. Connectors and couplings for EMT shall be steel concrete tight compression type or set screw type with insulated throats on connectors. Indent type connectors shall not be used.
- C. Conduits piercing a building waterproof membrane shall be provided with O-Z type FSR fittings.
- D. Flexible metal conduit shall utilize screw-in type connectors. Couplings and set-screw type connectors are not permitted.
- E. Seal-offs with filler fiber, compound, large removable cover. All components shall be of the same manufacturer.
- F. Expansion Couplings:
 - 1. Exposed Conduit Runs: Expansion couplings shall be weatherproof with external bonding jumper, providing at least 4" longitudinal movement with bushed conduit ends.

2. Concealed Conduit Runs: Expansion couplings shall be water tight with an internal bonding jumper and neoprene construction. The fitting shall allow 3/4" movement in any direction or deflection of 30 degrees from normal.
3. Locknuts shall be galvanized steel.

2.5 BOXES

- A. Boxes for use with raceway systems shall not be less than 4" square and 1-1/2" deep except where shallower boxes required by structural conditions are approved.
- B. Flush and Concealed Outlet Boxes: Galvanized stamped steel with screw ears, knock-out plugs, mounting holes, fixture studs if required.
- C. Surface Outlet Boxes: Galvanized stamped steel same as above for use on ceilings and walls above 14 feet.
- D. Boxes shall be of the cast-metal hub type when located in normally wet locations and when surface mounted on outside of exterior surfaces.
- E. Boxes installed for concealed wiring shall be provided with suitable extension rings or plastic covers as required.
- F. Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed.
- G. Provide boxes suitable for the intended environment and sized as required to accommodate the equipment within. Exterior boxes shall be stainless steel.
- H. Pull boxes of not less than the minimum size required by the National Electrical Code shall be constructed of code-gauge aluminum or galvanized sheet steel except where cast-metal boxes are required in locations specified above. Boxes shall be furnished with screw-fastener covers. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Ends of metal conduits shall be reamed and left free of burrs.
- B. Provide pull boxes or vaults where shown or required to limit the number of bends in any conduit to not more than three 90 degree bends, or to ease pulling tension. Use boxes of code-required size with removable covers, installed so that covers will be accessible after work is completed.
- C. Conceal all wiring in finished spaces so far as practicable. Exposed conduit shall be used only in unfinished spaces.
- D. Exposed raceways shall be parallel or at right angles to structural lines, and shall be neatly offset into boxes. Exposed raceways shall follow existing exposed piping/ductwork/conduit paths as far as practicable.
- E. Conduit stubbed from a concrete slab or wall to serve an outlet mounted on a table or to supply a machine shall have a rigid conduit coupling flush with the surface of the slab. Provide plug where conduit is to be used in future.
- F. Keep conduit and raceway closed with suitable plugs or caps during construction to prevent entrance of dirt, moisture, concrete or foreign objects. Raceways shall be clean and dry before installation of wire and at the time of acceptance.
- G. Remove all foreign matter from raceways and pull mandrel through conduits larger than 1-1/2" prior to installing conductors.

- H. Where no conduit size is noted on the Drawings, conduit may be the minimum code permitted size for the quantity of type THHN conductors installed, but in no case smaller than 1/2" trade diameter. Conductor quantities indicated in conduits do not include ground wire unless otherwise noted. Adjust conduit sizes accordingly.
- I. Where the contractor elects to combine branch circuit runs shown as separate runs on the Drawings, provide a minimum 3/4" conduit or increase raceway size to provide a minimum of 25 percent spare capacity for future conductors. Feeder runs shall not be combined.
- J. All conduits installed in concrete construction, underground, or under the building slab shall be minimum 3/4", unless otherwise noted.
- K. Assemble, glue and seal PVC conduit in straight lengths prior to installation in trench.
- L. Seal-offs shall be installed in all conduits which route from warm areas into refrigerated areas.
- M. Install PVC conduit in accordance with manufacturer's instructions. Cut the conduit ends square and apply an approved solvent to clean the joint. Apply an approved cement and allow to set 24 hours before installing conductors.
- N. Conduits shall be fastened to all sheet metal boxes and cabinets with two locknuts where required by the National Electrical Code, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used.
- O. A pull wire shall be inserted into each empty raceway in which wiring is to be installed by others. The pull wire shall be of No. 15 AWG zinc-coated steel, or of plastic having not less than 200-pound tensile strength. Not less than 10" of slack shall be left at each end of the pull wire.
- P. Raceway shall not be installed under the fire pits of boilers and furnaces and shall be kept 6" away from parallel runs of flues, steam pipes and hot water pipes.
- Q. Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed.
- R. Expansion fittings complete with grounding jumpers shall be installed where raceways cross expansion joints, construction joints, sawed joints, and where shown.
- S. Where conduit is shown stubbed into a telephone, computer or communication terminal area, conduit shall be stubbed up 6" above floor or 12" below ceiling and terminated with insulating bushings.
- T. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate head room, working clearance, and access to both boxes and other equipment.
- U. The end of a conduit stub shall have an insulated bushing.
- V. Pack spaces around conduits with polyethylene backing rods and seal with polyurethane caulking to prevent entrance of moisture where conduits are installed in sleeves or block-outs penetrating partitions.
- W. Install intumescent material around ducts, conduits, etc., to prevent spread of smoke or fire where installed in sleeves or block-outs penetrating fire-rated barriers. An alternate method utilizing intumescent materials in caulk and/or putty form may be used.
- X. Outlet boxes shall be designed for the intended use. Flush outlet boxes shall be installed flush with finished surface lines.
- Y. Outlet boxes on flex connected fixtures shall be installed within five feet of conduit knock-out in fixture.
- Z. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate head room, working clearance, and access to both boxes and other equipment.

3.2 INSTALLING CONDUIT BELOW SLAB-ON-GRADE OR IN THE GROUND

- A. All electrical wiring below slab-on-grade shall be protected by a conduit system.
- B. No conduit system shall be installed horizontally within concrete slab-on-grade. For slab-on-grade construction, horizontal runs of rigid plastic shall be installed below the floor slab.
- C. Conduit passing vertically through slab-on-grades shall be coated rigid steel.
- D. Slope conduits away from terminal equipment; drain away from the building interior.
- E. Rigid steel or IMC conduits, metal boxes, and couplings installed below slab-on-grade or in the earth shall be field-wrapped with 0.010" pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory applied plastic resin, epoxy, or coal-tar coating system. Zinc coating may be omitted from rigid steel conduit, or IMC which has a factory-applied epoxy system. All joints shall be threaded, sealed and wrapped with tape to prevent entry of water. Use 20 mil pipe wrapping tape to cover wrench marks, field cuts, or abrasions to the outer factory installed anti-corrosion covering.
- F. Provide duct seal at ends of all underground and under-slab conduits.

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Clearly and properly label the complete electrical system to indicate the loads served or the function of each item of equipment connected under this work.

1.2 SUBMITTAL AND RECORD DOCUMENTATION

- A. None required.

PART 2 - PRODUCTS

2.1 IDENTIFICATION MARKERS

- A. Unless otherwise specified, all identification nameplates shall be made of laminated three-ply plastic in accordance with Fed. Spec. L-P-387 equal to "Lamicoid." Nameplates shall be minimum 1/16" thick, with black outer layers and a white core, red outer ply for all emergency applications. Edges shall be chamfered.
- B. Provide identification nameplates for starters, switchboards, safety switches, panelboards, motor control centers, transformers, equipment (air handling units, exhaust fans, pumps, etc.), with a minimum of 1/4" high letters.
- C. Provide identification nameplates for control power transformers, control devices (relays, contactors, etc.), with a minimum of 1/8" high letters.
- D. Where switches control remote lighting, exhaust fans, or power outlets, or where switches in the same gang (two or more) serve different purposes, such as light, power, intercom, etc., or different areas, such as corridor and outlet, furnish engraved cover plates with 1/8" black letters indicating function of each switch or outlet.

PART 3 - EXECUTION

3.1 LABELING

- A. Major items of electrical equipment and major components shall be permanently marked with an identification nameplate to identify the equipment by type or function and specific unit number as shown on the Drawings.
- B. 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 designation on the construction drawings. Minimum panel schedule width shall be 4" with 1/4" height allowed for each circuit line. Panel schedules shall be the type which install in a metal frame or pocket. Panel schedules shall be of the odd/even sequence (1-3-5-7-9... and 2-4-6-8-10...).
- C. Identify service entrance and distribution switchboards with engraved nameplate corresponding with the plans, mounted on the face of the switchboard. Identify each feeder, breaker, and switch with engraved nameplate corresponding with the plans.
- D. Identify branch panels with engraved nameplate corresponding with the main or subdistribution panel labeling, mounted on the face of the door. No brand labels or other markings shall be on the outside of the panels.
- E. Label all disconnect switches, relays, contactors, starters and time switches indicating voltage, amperage, power panel source, circuit number and equipment served with laminated plastic label.

- F. Nameplates shall be secured with screws or pop rivets. Adhesive-only fasteners shall not be permitted.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide at locations shown on the Drawings, panelboards of a type indicated and specified herein.

1.2 COORDINATION

- A. Coordinate with other Trades affecting or affected by Work of this Section.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protect against damage and moisture. Store materials off ground. Remove damaged materials from site immediately after detection.
- B. Deliver with UL label and bearing manufacturers name. Panelboard exterior trim separately packaged to prevent damage during delivery and storage on site.
- C. Store and handle panelboards so as not to subject them to corrosion or mechanical damage and in a manner to prevent damage from environment and construction operation.

1.4 QUALITY ASSURANCE

- A. Underwriters Laboratories, Inc. listing/approval.
- B. Underwriters Laboratories, Inc. Standards.
 - 1. Panelboards - UL67.
 - 2. Cabinet and Boxes - UL50.
- C. National Electrical Code.
- D. NEMA Standard - PB1.

1.5 SUBMITTAL AND RECORD DOCUMENTATION

- A. Approval documents shall include drawings. Drawings shall contain overall panel dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one-line diagrams with applicable voltage systems. Include copy of panel schedules in record documents.

PART 2 - PRODUCTS

2.1 PANELBOARDS

- A. Panels shall be factory pre-assembled using tin-plated aluminum bussing and bolt-on circuit breakers. Separate feeder lugs shall be provided for each feeder conductor. They shall be so designed that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors, so that circuits may be changed without machine drilling or tapping.
- B. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. A nameplate shall be provided listing panel type and ratings.
- C. Unless otherwise noted, full size insulated neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection. A separate ground bus shall be included in all panels. There shall be a neutral and ground bus space for each breaker location listed as space.

- D. Panelboard boxes shall be at least 20" wide, made from galvanized steel. Provide minimum gutter space in accordance with National Electrical Code. Maximum panel depth shall be 5-3/4", unless otherwise shown or specifically approved by the Owner. Surface panel boxes shall be painted to match trim.
- E. Switching device handles shall be accessible. Doors and panelboard trims shall not uncover any live parts.
- F. All panel doors shall be provided with a flush type combination catch and lock with two milled keys. On doors more than 48" high, a three point combination catch and lock shall be provided with a vault type handle. All locks shall be keyed alike. All panel trims shall be "hinged front" construction, meaning trim has a piano hinge down one side, door opens by a single latch, and entire trim hinges open by removing two screws.
- G. Single pole breakers shall be full module size; two poles shall not be installed in a single module. Each breaker shall be securely fastened to prevent movement and trims shall fit neatly and tightly to the breaker assembly. Interrupting capacity shall be minimum 14,000 amperes fully rated for 480Y/277V, and 10,000 ampere fully rated for 208Y/120V, or as indicated on the Drawings and shall conform to Fed. Spec. W-C-375. All 15 or 20 ampere single pole breakers shall have "switching-duty" capability.
- H. Permanent numbers, engraved, stamped or painted shall be affixed to each pole next to breakers. Stick-on numbers are not acceptable.
- I. Panelboards shall be coated with a rust inhibiting phosphate primer and two coats of light gray enamel. Trims to be separately packed and protected from scratching and marring.
- J. Panelboards shall be tested, listed, and marked for use with a UL witnessed and recognized fuse/breaker combination.

2.2 ACCEPTABLE MANUFACTURERS

- A. Siemens, Square D, Eaton, and GE.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Breaker handle guards shall be provided on each circuit supplying obviously constant loads to prevent accidental shutting off. Such loads are contactor controlled circuits, freeze protection, etc.
- B. Provide typed schedules as in Section 260553.
- C. Provide engraved laminated name plates under the provisions of Section 260553.
- D. Provide one 3/4" spare conduit stubbed into an available accessible space above for every three single pole spare or space in new flush branch panels.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide all wiring devices and finish plates as required unless specifically indicated otherwise.

1.2 QUALITY ASSURANCE

- A. Underwriters Laboratories, Inc., listed and NEC approved.
- B. Wiring devices shall be specification grade, with special devices as noted on the Drawings. Should the Drawings indicate a device other than those listed herein, such device shall be of same grade and manufacture as specified below.
- C. All lighting switches and duplex receptacles installed shall be from the same manufacturer and have identical appearance characteristics.

1.3 SUBMITTAL AND RECORD DOCUMENTATION

- A. Submit product data for wiring devices and cover plates.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Wall Switches: 20 ampere, 120/277 volt AC, quiet type, Hubbell HBL1221 Series, color as selected by Architect. Single pole, double pole, 3-way, locking, or other type as indicated. Switches connected to emergency circuits shall be red.
- B. Receptacles: Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounded type, Hubbell HBL5362 Series. Receptacles shall have nylon faces, one-piece brass mounting strap with integral ground contacts and bypass power contacts; color as selected by Architect. Receptacles connected to emergency circuits shall be red.
- C. Receptacles with ground fault interrupters shall be in accordance with UL 943.
- D. Special-purpose or heavy duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle-type plug shall be furnished with each receptacle. Locking facilities, where indicated, shall be accomplished by the rotation of the plug.
- E. Device plates of the one-piece type shall be provided for all outlets and fittings to suit the devices installed. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be impact-resistant plastic or stainless steel, color/material as selected by the Architect. Plates on emergency receptacles and switches shall be red.
- F. Receptacles in wet locations shall be in a weatherproof enclosure, the integrity of which is not affected when the receptacle is in use. The enclosure shall be of high-impact polycarbonate construction, with a keyhole hinge without a spring and other metal parts, with a gasketless translucent lid that is lockable and tinted and has large cord openings. The enclosure shall be one or two-gang, and shall be securely secured to the receptacle box with tamper-proof fasteners through factory-drilled or field-drilled through factory-prepared drill points.
- G. Bell "Rayntite II", Intermatic WP1000 Series, or equal.
- H. Tamper-resistant (child-proof) receptacles shall be a type which contains internal contacts which require the presence of both blades to energize the receptacle, and shall be UL 498 listed. Hubbell #HBLSG62H or equal.

2.2 ACCEPTABLE MANUFACTURERS

- A. Hubbell, Bryant, P&S, Leviton, and Cooper.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Devices and finish plates to be installed plumb with building lines.
- B. Finish plates and devices not to be installed until final painting is complete. Scratched or splattered finish plates and devices will not be accepted.
- C. Wall mounted receptacles shall be installed vertically at centerline height shown on the Drawings unless otherwise specified.
- D. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch.
- E. All outlets shall have a cover plate. Provide blank cover plate to match surrounding area if none other is specified.
- F. In general, lighting switches shall be installed on latch side of doorway.
- G. Tamper-resistant, GFCI, etc. type receptacles shall be installed where codes require such special-purpose devices.

3.2 TESTS

- A. Test all receptacles for line to line, line to neutral, line to ground, and neutral to ground, opens or shorts, and correct defective wiring.

3.3 LABELING

- A. See Section 260553, Identification for Electrical Systems.

END OF SECTION

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide all lighting outlets indicated on the Drawings with a fixture of the type designated and appropriate for the location. Outlet symbols on the Drawings without a type designation shall have a fixture the same as those used in similar or like locations.
- B. Provide lamps or LED modules for all fixtures.
- C. Coordinate installation of fixtures with the ceiling installation and all other trades to provide a total system that is neat and of orderly appearance.

1.2 QUALITY ASSURANCE

- A. Fixtures shall conform to the following specifications.
- B. Manufacturers specified are indicative of the general type and performance desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved by the Architect prior to the bid. Digital IES files shall be provided as part of Submittal and Substitution Request processes upon request in order to properly evaluate proposed fixtures.
- C. Equality shall be determined by comparisons of performance, construction, installation ease, maintenance, and appearance.
- D. All light fixtures shall be UL listed and labeled.

1.3 SUBMITTAL AND RECORD DOCUMENTATION

- A. Submit product data describing fixtures, lamps, LED modules, ballasts, drivers, and emergency lighting units. Arrange product data for fixtures in order of fixture designation.
- B. Include data on features and accessories and the following information.
 - 1. Outline drawings of fixtures indicating dimensions and principle features.
 - 2. Electrical ratings and photometric data with specified lamps/LED modules and certified results of laboratory tests, including digital IES files.
 - 3. Data on batteries and chargers of emergency lighting units.
- C. Submit shop drawings from manufacturers detailing nonstandard fixtures and indicating dimensions, weights, methods of field assembly, components, features, and accessories.

PART 2 - PRODUCTS

2.1 LED FIXTURES

- A. General:
 - 1. LED lighting fixtures shall be in accordance with IES, NFPA, UL, as shown on the Drawings and as in these Specifications.
 - 2. LED drivers shall include the following features unless otherwise indicated:
 - a. Power factor: > 0.9 nominal
 - b. Input Voltage: 120V – 277V, 60 Hz
 - c. Total Harmonic Distortion: < 20%

- d. Temperature Rating: 0 deg C – 40 deg C
 - e. Integral short circuit, open circuit, and overload protection.
- 3. LED modules shall include the following features unless otherwise indicated.
 - a. Comply with IES LM-79 and LM-80 requirements.
 - b. Minimum 80 CRI and color temperature 3500 deg K (interior) and 4000 deg K (exterior) unless otherwise specified in Lighting Fixture Schedule/List.
 - c. Minimum Rated Life: 70,000 hours per IES L70, unless otherwise specified in Lighting Fixture Schedule/List.
 - d. Light output initial lumens as specified in Lighting Fixture Schedule/List.
 - e. LED modules shall be field replaceable and contain quick-disconnects.
- 4. LED lighting fixtures shall have available digital IES files from a NVLAP accredited testing laboratory in accordance with IESNA LM-79, which specifies the entire luminaire as the source, resulting in an efficiency of 100%. Lighting fixtures that do not have these test results available will not be accepted.
- B. Miscellaneous:
 - 1. All surface-mounted lighting fixtures shall have low density label.
 - 2. All recessed lighting installed in fire-rated ceilings shall be provided with fire-rated protective covers per UL standards.
 - 3. All fixtures mounted outdoors or in unheated spaces shall have 0 deg F ballasts/drivers.

2.2 RECESSED FIXTURES

- A. In insulated ceilings, recessed fixtures to be equipped with "IC" rated housing or with a field fabricated fireproof box (metal, sheet rock, etc.), complying fully with all clearance requirements.
- B. Recessed troffers shall be as follows, unless specified otherwise:
 - 1. Diffusers shall be pattern 12 extruded clear acrylic plastic, 0.125" overall thickness, unless otherwise specified in the fixture schedule by catalog number or remarks. Door shall be securely closed by use of enclosed cams.
 - 2. Finish shall be white baked enamel, unless otherwise specified with a minimum average reflectance of 85% on all exposed and light reflecting surfaces.
 - 3. Housing shall be 22-gauge minimum.

2.3 EMERGENCY LIGHTING

- A. Wall Packs:
 - 1. Emergency wall packs shall comply with UL 924 and be self-contained units, complete with two adjustable lensed fixtures and LED modules, battery, and battery charger, suitable for 120V or 277V AC power supply as indicated on the Drawings.
 - 2. Battery shall be sealed, maintenance-free, lead-calcium recombination type, 10-year life expectancy. Battery shall have 1-1/2 hour minimum capacity at rated wattage to 87-1/2% of rated DC voltage from a fully charged state. Shall carry a five-year pro-rata warranty.
 - 3. Battery charger shall be solid-state, voltage regulated. Charge circuit shall react to the condition of the battery and alter the rate of charge in order to maintain peak battery capacity and maximum battery life.

4. A solid-state overload monitoring device in the DC circuit shall disconnect the lamp load from the battery should excessive wattage demands be made, and automatically reset when the overload or short circuit is removed.
 5. A brownout circuit shall monitor the flow of AC current to the unit and activate the emergency lighting system when a predetermined reduction of AC power occurs.
 6. The unit shall incorporate a solid-state switching system, not relays. The switching circuit shall detect a loss of AC voltage and automatically energize the DC lamps. Upon restoration of the AC power, the emergency lamps shall switch off and the charger shall automatically recharge the battery.
 7. When the battery's terminal voltage falls below 80% of the rated voltage, the low voltage circuitry shall disconnect the lighting load. The disconnect shall remain in effect until normal utility power is restored, preventing deep battery discharge.
- B. LED Emergency Battery Backup: Emergency battery backup for LED fixtures shall be internal to the fixtures, and shall provide at least 20% of full fixtures lumen output in the emergency mode for a minimum of 90 minutes.
- C. Emergency Bypass Relay:
1. 20 amp relay, 120-277 volt operation, UL924 listed, no minimum load requirement, five-year warranty.
 2. Shall connect to the line side of the lighting control device to sense the presence of "normal" power. It shall also connect to the load side of the lighting control device to provide an ON/OFF signal for control of the emergency lights along with the general lighting.
 3. When the normal power is lost, control is suspended and the normally closed relay provides emergency power to the emergency fixtures.
 4. Provide one relay per lighting control switch leg which has emergency fixtures.
 5. Relay shall be located in accessible ceiling space (or flush mount box in hard ceiling) above the lighting controls associated with the relay.

2.4 OUTDOOR FIXTURES

- A. Outdoor fixtures shall be weatherproof, heavy duty types designed for efficient light utilization, adequate dissipation of lamp and ballast/driver heat and safe cleaning and relamping. Ballasts/drivers shall be incorporated within the luminaire housings unless otherwise noted. Luminaires shall be sealed unless charcoal filters are provided. Lenses shall be heat and impact resistant, tempered glass. Lens gasket shall be heat and weather resistant. Materials shall be rustproof. Latches and fittings shall be nonferrous metal or stainless steel.

2.5 POLES AND STANDARDS

- A. Lighting standards, assemblies, and pole bases shall be designed and constructed to withstand a steady wind velocity of 100 miles per hour without permanent distortion or displacement. Where unusual soil or base installation conditions occur, the Contractor shall provide adequate reinforcement under the guidance of the Architect to assure the specified strength for 100-mile-per-hour wind. Generally poles/bases shall be suitable for installation in earth having an allowable bearing of 1800 pounds per square foot.

2.6 FIXTURES

- A. See Drawings for Lighting Fixture List/Schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lamps of the proper type, wattage, and voltage rating shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project. Provide lamp type as recommended by the fixture manufacturer.
- B. Fixtures shall be left clean at the time of acceptance of the work with every lamp or LED module in operation. If fixtures are deemed dirty by the Architect at completion of the project, the Contractor shall clean them.
- C. Fixtures shall be carefully aligned, leveled in straight lines, and located as shown on the Architectural reflected ceiling plan. The final decision as to adequacy of support and alignment shall be made by the Architect. The fixtures shall be supported and fastened to the ceiling system. The lighting plans are to be used for fixture types and connection information only, not exact locations.
- D. Verify all ceiling conditions and provide all lighting fixtures complete with factory furnished stems, balls, aligners, and canopies as required for a complete installation.
- E. Recessed troffers installed in suspended T-bar ceiling shall be independently supported on two opposite corners by #12 gauge steel wire attached to structure, per UBC Standard #47-18.
- F. Surface mounted light fixtures shall be securely fastened to the building surface via factory-created holes in the fixtures. Attachment of fixture merely to recessed outlet box is not sufficient.
- G. Where two switches are shown dedicated to an office, room, or area, provide two-level lighting.
- H. Lighting fixtures in any single enclosed room shall be connected using a common (one) circuit, except in cases where the loading requires a second circuit.
- I. Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.
- J. Standards shall be plumb with arms aligned and square. Arms shall be perpendicular to the parking axis unless specifically shown otherwise.
- K. Standards shall be in line such that sighting along straight lines of standards will show no standard out of line with the others. The Contractor is cautioned that some curbs or roadway edges may not be straight and, therefore, should not be used for alignment.
- L. The Contractor shall erect the luminaires and pole assemblies complete on locations called out on the Drawings.
- M. The poles shall be installed with leveling nuts (galvanized). The space between the bottom of the pole base flange and the top of the footing shall be grouted to present a finished appearance with a 1/2" drain hole.

END OF SECTION